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XXVII. *On the apparent Elevation of Objects above the Horizon.* By Professor DE LUC*.

IT is well known, that on the borders of lakes, the banks of broad rivers, and the shore of bays, a certain optical illusion often takes place when the spectator is stationed in a high point of view. The opposite bank, under certain circumstances, is seen as it were floating in the air; and this phænomenon is ascribed to refraction: but in my opinion it proceeds from a different cause.

About two years ago I observed the phænomenon in question in one of those extensive turf moors that occur so often among the heights in Bremerlande, through which I was then travelling. The trees which bordered this moor, towards the horizon, appeared to me to be floating in the air. I at first conjectured, according to analogy, that there must be a lake or river at the end of the turf moor; but the postillion who drove the carriage assured me that this was not the case.

In the month of July this year, being in the same district, I saw a similar phænomenon, and under circumstances which induced me to examine it with more attention. I was on the road between Bremervörde and Brederkesa, proceeding in a north-east direction. It was about nine in the morning; the heavens were covered with light clouds, yet the sun appeared through them a little behind me on the right, and over a turf moor which extended to the horizon, and was bordered with a row of trees. When the phænomenon first appeared, I was travelling down an eminence on a road adjacent to the edge of the moor, which entered it a little way, and then proceeded up an opposite hill. The variations which I observed in the phænomenon as I advanced slowly down the hill, induced me to dismount, that I might be able every now and then to turn back. What I observed on this occasion was as follows:

At the moment when I was about to descend, I could see and observe from the highest point of the hill a very large surface of the turf moor, which extended itself with increasing breadth towards the horizon; the distance of which I estimated at a German mile. From this pretty high point of sight, I could perceive that the trees at the extremity of the moor did not stand exactly in a line, but that they formed a sort of wood, which extended backwards on the other side,

* From *Der Gesellschaft Naturforschender Freunde zu Berlin Neue Schriften*, vol. iii. 1801.

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and, on the side next to me, had some projecting curves, but in such a manner that the row seemed uninterrupted and continued.

The first thing that struck me as I descended, was, that at the bottom of this row of trees, and near the extremity which was opposite to me, there appeared an aperture where there seemed to be no trees, and where I thought I could perceive the heavens under a line of trees which I considered as further distant, because their colour was not so dark, and because they appeared smaller than the trees of the first row between which I saw them. This separated part of the row seemed to be completely floating in the air; the horizon in the interval of the trees of the first row was bounded by the surface of the turf moor, and I imagined that I saw the heavens between this extreme surface of the moor and the row of the most distant trees.

It was at this moment I alighted: I then turned back, ascended the hill a little, and saw the trees which attracted my attention gradually assume their former appearance. The whole separated part again sunk down to the earth, recovered their former dark colour, and also their former height; so that I was scarcely able to distinguish this part from the remainder of the row. Some traces, however, of the former transformation remained. I was therefore induced to examine the whole row throughout with the greatest attention; and, on doing so, I imagined that I observed some parts which lay a little more in the back ground, and which, as I conjectured from certain signs, would appear transformed in the like manner when viewed from a somewhat low point of sight. In regard to the lowest ground line of the row of trees, it appeared, on account of the distance and thickness of the atmosphere, too undefined to perceive bendings in it: I was not able to observe the trunks of the trees, which I distinguished from the surface of the moor merely by its brown colour being rendered less pale by the intervening stratum of air, by the trees having a higher position, and by their being seen through a purer stratum of the atmosphere. On again descending, I saw those parts of the row which I considered as the most remote, gradually raise themselves above the horizontal plain; so that they separated themselves from the row in which they stood, and seemed to float in the air behind the row which now had the appearance of being broken. When I reached the valley, where I was however somewhat elevated above the level of the moor, these phenomena began to appear in the foremost row, where the first breaking appeared. I again thought I saw the heavens below the trees at the ex-

trene edge of the moor. These trees also appeared to be floating in the air, but they did not elevate themselves above the ground so much as those I first observed. As I advanced farther in the valley, my horizon did not any more change in a perceptible manner; though my position in regard to certain parts of the row of trees was considerably altered, which produced several modifications of the phænomenon. The elevation of the trees above the horizontal surface increased the further I proceeded, but gradually decreased in those parts from which I receded, and where it had first begun, and at length the whole disappeared when I ascended the opposite hill.

This circumstance of the phænomenon led me to an observation, from which I concluded that refraction had no share in it. The masses of the distant trees which raised themselves from the ground, were situated between parts of the foremost row, which for a considerable time did not change their position; and these unchanged parts gave me fixed points, by which I was enabled to estimate the elevation of the objects; and it was this estimation which conducted me to a knowledge of the nature of the phænomenon.

The intervals where, in consequence of my progressive motion forwards, the heavens appeared under the most distant trees, raised themselves more the lower my station became on the hill, and the further I advanced in the valley: but the summits of the floating trees were not elevated; on the contrary, they seemed somewhat depressed in comparison of the foremost trees. The masses became shortened below, but at the top they remained on the same level. I had sufficient opportunity to confirm this circumstance, as, by changing my position in a vertical and horizontal direction, I saw three different masses so totally disappear, that, in the interval which they before occupied in the row of trees, nothing more was to be seen but the pure heavens. On one of these masses disappearing in this manner, when I retired back from my position, there first appeared towards the heavens some brown spots, which were the highest summits of the trees; and the more I receded, the more it seemed as if a curtain dropped down which concealed the part of the heavens before seen. But with whatever attention I looked towards the spot where this curtain fell down, and where the summits of the trees at length disappeared, I could observe nothing but the pure heavens. Had a person, without suspecting any thing of this optic transformation, seen from the valley the row of trees in the horizon evidently broken, and had again seen from the hill without observing the gradual change during

during the time of advancing, the same row once more in the horizon entirely whole, without any interval or break, he would certainly not have believed his own eyes.

Between this phenomenon and that where the coasts appear elevated in the like manner, I could observe no difference in regard to the causes which produce them; and the same identity is applicable to those phenomena which I observed in another moor in the same neighbourhood about two years before; only that the trees which formed the horizontal boundary stood actually in a line, so that the whole row seemed floating in the heavens at once, and not in portions at a time. All these phenomena then are identically the same, and it follows from the circumstances here described, that they do not depend on refraction. The cause alone lies in the rays of light reflected from the vapours, which in consequence of this reflection appear so dazzling to the eye, that they conceal the objects situated below, and present the same appearance as the heavens. The sun, as already said, was towards that side where I saw the phenomenon, and his altitude was considerable, as I observed the above transformation on the 18th of July, between the hours of 9 and 10. While I observed from the valley several of these broken parts of the first row of trees, the sun was in a perpendicular direction over them. The elevation of the masses above the ground increased in general more and more as my situation became gradually lower, and according as each mass of the objects to be changed approached nearer to a perpendicular position under the sun, in consequence of my advancing in a horizontal direction. As I descended, I had between me and the objects a stratum of the atmosphere, which was always denser, and consequently more proper for reflecting the rays. When I advanced in the horizontal plain, this reflection took place more in a straight line; and when I came into such a position that the vapours threw back the rays of light to the level of the summits of the most distant trees, I saw nothing but this luminous vapour, which lost itself in the heavens, and formed with them one continued field. When I had reached the lowest point of the plain, where I found a favourable point of view, some of the foremost trees could then raise themselves from the ground, because they were nearer to me; and to compensate for this greater proximity, the rays of light must have penetrated a much thicker stratum of the atmosphere, and must have proceeded from a point so much nearer the perpendicular position under the sun.

The presence of the sun is the principal condition of this phenomenon :

phænomenon: without the action of the sun's beams, the vapours would not be dense enough to conceal the objects: it is by means of the solar rays that they are made to disappear from the eye. These rays, however, can be transmitted to the eye only under a given angle, in the same manner as a certain angle is required in order to produce the rainbow by refraction. The stratum of air which is sufficiently dense to effect this reflection of the sun, rises to a certain height, but it can be perceptible to the eye only when the vapours actually throw back a great number of rays. As soon as the point of sight corresponding to this effect is obtained, the eye sees only the shining vapour, which it cannot distinguish from the heavens. This disappearance, however, takes place in regard to distant as well as to near objects, and rather at the lower than the upper part of the object, because, in the first case, the direction of the line of sight passes through a larger mass of vapour, and in the second through a denser stratum. The less dense part of the vapour, which did not reflect rays of the sun, but which always grew denser the lower my station became, acting like a veil, which interposed itself between my eye and the trees which had not yet disappeared, made me observe their distance, and contributed to cause the elevated trees to appear as if floating behind the row.

In regard to the circumstance that the tops of the distant trees did not raise themselves above those of the foremost, though their lower parts seemed to rise above the ground as I descended, and that these tops on the contrary seemed somewhat depressed; it arose from the decrease in the elevation of my point of station having a greater ratio to the less distant than to the most distant trees; by which means, the former were raised more in the same proportion above the horizon.

When this phænomenon is observed on the banks of large pieces of water, and when the objects are at different distances from the observer, the truth of the principles here advanced may be confirmed by remarking, that the phænomenon is modified by a change of position; but if the observer can move about in a horizontal direction, it will be of great use to observe the changes of the object in a vertical direction, supposing he has opportunity, on any gradual declivity, of ascending and descending. If the vertical measurement of the objects then changes, so that their total height decreases the more the objects seem to rise from the ground when the observer descends the declivity, this is a sufficient proof that the whole image is not elevated, but that
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its lowest part disappears from the eye, behind a mass of vapour so condensed that it cannot be distinguished from the sky above or the water below.

I entertain no doubt, that this is the real cause of all the phenomena of this kind, as I have never been able to comprehend how such phenomena could be produced by refraction.

When the objects which are seen under water appear elevated in different degrees, it may be readily conceived that the rays of light proceed from the water, which is very dense, into air, which is much rarer. When we see the celestial bodies above the horizon, while they are actually below it, we may easily conceive that the rays of light, proceeding in an oblique direction, sometimes pass through rarer and sometimes through denser strata of the atmosphere. But, in the present case, there is no difference in the specific denseness or rarity, and the corresponding power of refraction of the medium through which the ray of light is transmitted to the eye; and if an actual elevation takes place by refraction, the action must be equally great from water or from a lake, and on the objects opposite to them: consequently the whole mass of these objects must appear equally elevated, without any interruption being observed in them.

I shall here add, that I have been very often deceived in these moors, so that I thought I saw at a great distance lakes and rivers, where my drivers assured me there was nothing of the kind. This was always the case in the morning, and when the sun by standing over the object gave rise to the illusion. Had not the horizon on these occasions been bordered with a row of small hills, I should certainly have believed that I saw not only a piece of water, but even the heavens. The hill prevented me from seeing at one view the heavens and the luminous vapour, and the vapour seen alone appeared to me as an extended piece of water illuminated by the reflection of the heavens.

XXVIII. *Description and Natural History of the Wild Goat of the Alps.* By M. BERTHOUT VAN BERCHEM jun.*

THE wild goat of the Alps† is still little known to naturalists, though mentioned by several authors. As it lives on the

* From *Mémoires de la Société des Sciences physiques de Lausanne*, vol. ii.

† *Capra ibex*, Erxleben Syst. Reg. p. 261. Linn. Hist. Nat. p. 95. *Le Bouquetin*, Buffon, vol. xii. p. 136.