



## LXXVII. On an apparent inversion of perspective in viewing objects with a telescope

James D. Forbes Esq. F.R.S.

**To cite this article:** James D. Forbes Esq. F.R.S. (1840) LXXVII. On an apparent inversion of perspective in viewing objects with a telescope , Philosophical Magazine Series 3, 16:105, 506-509, DOI: [10.1080/14786444008650079](https://doi.org/10.1080/14786444008650079)

**To link to this article:** <http://dx.doi.org/10.1080/14786444008650079>



Published online: 01 Jun 2009.



Submit your article to this journal [↗](#)



Article views: 2



View related articles [↗](#)

LXXVII. *On an apparent Inversion of Perspective in viewing Objects with a Telescope.* By JAMES D. FORBES, Esq., F.R.S., Professor of Natural Philosophy in the University of Edinburgh.\*

IN October last, Sir John Robison directed my attention to a curious anomaly in the apparent perspective of objects seen through a telescope which had been first mentioned to him by Mr. Whitwell.

It consists in a complete seeming inversion of the true inclination of two horizontal lines towards a vanishing point when seen through an ordinary telescope. The top and bottom lines of a row of windows, for instance, viewed obliquely, seem, within the limit of the field of view of the telescope to converge to a point on the opposite hand of the spectator from that indicated by the common rules of perspective, and by the experience of the naked eye. There is no better exemplification of the fact than by viewing the figure of a common sign-board, not far from the eye and considerably foreshortened, with a common pocket telescope. The letters appear gradually to increase from the nearer towards the more remote part of the inscription.

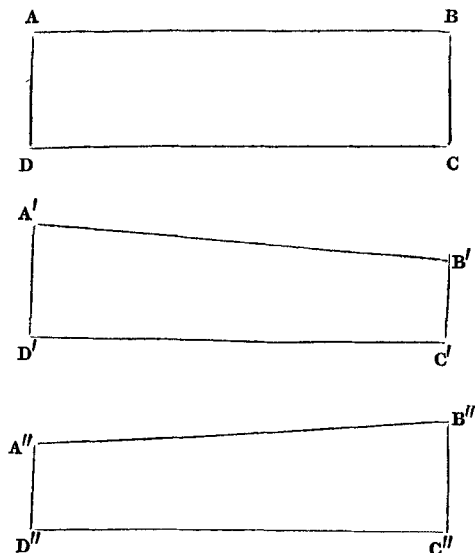
That the appearance is such as we describe no one will readily admit who does not make the experiment for himself; but once made, the fact appears so certain as to create surprise, that it does not always strike us, and that it has not (so far as I am aware) been mentioned in books on such subjects.

The first time I saw the anomalous appearance in company with Sir John Robison and Mr. W. A. Cadell, the explanation which I am about to state occurred to me as the true one. Not being particularly conversant with the subject of perspective, I contented myself with stating my opinion in writing at the time, and should probably have never recurred to the subject, had I not been lately requested to examine an ingenious paper, in which the *reality* of this distortion was admitted, and an attempt made to account for it by tracing the path of the rays through the telescopic lenses. Conceiving these investigations to be unsatisfactory, I made one or two simple experiments, which satisfied me completely of the accuracy of the view which I had previously taken of the matter, and which I now proceed to state.

The fact to be accounted for is, that a parallelogram, A B C D, or a word composed of letters of equal height, which by common perspective assumes to the naked eye the

\* Communicated by the Author.

figure  $A' B' C' D'$ , when viewed through an erecting telescope has the inclination of the lines thrown the other way, or the surface then resembles the figures  $A'' B'' C'' D''$ ; at all events no one will hesitate to affirm that the letters really the most distant seem to be larger than the nearer ones\*.



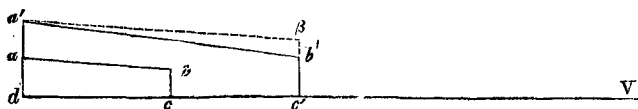
That this singular effect is a mere *optical illusion* I never doubted: and I recently ascertained the fact by measuring roughly with a micrometer the apparent angles under which  $A'' D''$  and  $B'' C''$  are respectively seen; the former was always found to exceed the latter, in other words the telescopic image is *really* convergent in the same direction with the unmagnified one, though the imagination in this case gives so completely the lie to the senses, that even when persuaded of the deception, and with the invariable standard of the micrometer divisions before our eyes, it is impossible to relinquish the preconceived idea.

The cause to which I assign this effect will appear a natural one to persons who are aware of the unperceived and momentary train of reasoning by which we arrive at conclusions apparently almost intuitive.

In every case in which the illusion now described is ob-

\* It is scarcely necessary to observe that this anomalous appearance is wholly independent of the position of the image in the field of view, and is therefore independent of the common errors of aberration.

served, the spectator has previously determined by his eye the real position of the plane of the object towards which he directs his telescope: and when he views that object with a magnifying power of two, he believes himself to be looking at an object twice as large in the same plane as before; or else (what comes to the same thing) the same object as before brought twice as near to him, but moved parallel to itself. In either of these cases, the vanishing point ought to remain exactly the same for the enlarged as for the original object. If  $a b c d$  be a board 4 feet long and 1 foot high, the eye expects to see through the telescope magnifying twice, a figure similar to that which a board 8 feet long and 2 high would present in the same situation, that is, a figure  $a' b' c' d'$  of which the upper and lower lines converge to the same point  $V$  as before; but the eye *really* sees through the instrument a merely magnified image of  $a b c d$ , namely  $a' \beta c' d$ , in which  $a' \beta$  is



parallel to  $a b$ , and consequently the vanishing point  $V$  is thrown twice as far off. What must the mind, reasoning through the information lent by the eye, infer respecting this enlarged object? One of two things. *Either* that the sign-board so seen is really not a parallelogram, but has its further extremity  $b' c'$  higher than the nearer one; *or else*, that the board is a true parallelogram, but that the plane in which it lies is more nearly perpendicular to the line joining the eye and the object, a plane in short which will give to horizontal lines a vanishing point as far beyond  $V$  as that is from  $d$ .

The former is the case when we look at an object to which we direct a telescope after having mentally formed an estimate of its position; the latter, or an erroneous estimate of a plane of the object, occurs when a person looks suddenly through a telescope previously pointed in an unknown direction.

I am not sufficiently conversant with works on perspective to be aware whether such a circumstance has before been noticed, but it was new to those whom I have had occasion to consult.

At all events it is very singular that it should have remained so long generally unknown that all objects (generally speaking) are seen through a telescope in *false perspective*.

The general principle may be thus stated in a single sentence. By common perspective, all parallel lines in a single

plane, or in any plane parallel to that, have a single vanishing point; but the act of magnifying increases the distance of the vanishing point in the same proportion as it does the apparent dimensions of the object; consequently the magnified object is not seen in true perspective for its own plane.

Edinburgh, March 13, 1840.

JAMES D. FORBES.

*Postscript.*—A casual circumstance brought to my recollection a few days ago an optical illusion mentioned (if indeed it was not shown) to me some years since by Sir David Brewster, the nature of which I could not perfectly recollect. Having applied to Sir David Brewster, he obligingly referred me to the Edinburgh Journal of Science\* for a notice of it, when it proved, as I expected, to be referable to the principle I have just been applying.

“A field,” says Sir David, “may be so situated, that” (from the perspective of the furrows or drills upon its surface) “when seen through the telescope it appears like a perpendicular or *vertical wall of earth*. This phenomenon we have often seen in directing a telescope to a field above Melrose Abbey on the northern acclivity of the north-west Eildon Hill. This field is capable of being ploughed in the direction of its greatest declivity; but when it is viewed through a telescope, the slope is such that *the furrows do not appear to converge*, and the eye cannot readily perceive any difference between the breadth of the furrows at the remote end of the field and their breadth at the near end. The observer therefore immediately concludes that the field must be nearly in a vertical plane rising in front of him. This deception is a very remarkable one, and produces a singular effect on the mind when the field is covered with a crop, and when crows, &c. light upon it.”

A more perfect illustration of the *second form* of the optical illusion which I have described could not be desired. Every one knows how imperfectly the eye estimates the acclivity of a plane in full view. The parallelism of the ridges is tacitly assumed, and as their apparent convergence diminishes exactly in proportion as the magnifying power of the telescope increases, the mind is forced to the conclusion that the plane is more nearly perpendicular to the line joining the eye and any point of it, than it really is.

Hence it appears that Sir David Brewster noticed and published fourteen years ago one case of the curious observation of Mr. Whitwell.

March 17, 1840.

\* First Series, iii, p. 88.