

## Guest editorial

### Perceptual pilgrimages

Visions are often associated with sites. The locations of revelations are revered and folk flock to them to receive some reflected revitalisation. Pilgrimages are associated with journeys to the shrines of such religious revelations. Why do we not accord the sights of our past the same reverence? Why is vision treated so differently from visions? One reason is that the origins of particular phenomena are rarely associated with particular locations. They are linked with the person who described them rather than the location at which they were seen. Another is that they rarely have a distinct origin; phenomena have often been described with increasing refinement over centuries (see Wade 1998).

This is not the case for the waterfall illusion. It was described in 1834 by Robert Addams after viewing the lower Fall of Foyers (figure 1) on the south-eastern side of Loch Ness in Scotland. Addams was a peripatetic lecturer on natural philosophy, who was visiting the celebrated falls during a tour through the Highlands. He was based in London, and was a scientific acquaintance of Michael Faraday and Charles Wheatstone. He supplied Faraday with carbonic acid for experiments at the Royal Institution, and he used Wheatstone's electromagnetic chronoscope in his lectures at the United Services Museum.



**Figure 1.** Left, a nineteenth century lithograph of the lower Fall of Foyers (from *Tourist's Guide to the West Highlands*). Addams would have observed the falls from the observation point on the left, from which the photograph on the right was taken. This figure and figure 4 can be seen in colour on the *Perception* website at <http://www.perceptionweb.com/misc/p3110ed/>.

Addams wrote:

Having steadfastly looked for a few seconds at a particular part of the cascade, admiring the confluence and decussation of the currents forming the liquid drapery of waters, and then suddenly directed my eyes to the left, to observe the face of the sombre age-worn rocks immediately contiguous to the water-fall, I saw the rocky surface as if in motion upwards, and with an apparent velocity equal to that of the descending water, which the moment before had prepared my eyes to behold this singular deception. (page 373)

A pilgrimage of perceptionists was made to this site in 1993, when the Waterfall Illusion Conference was held at the Foyers Hotel, a short walk from the picturesque falls (see 1994 *Perception* **23** 1107–1264).

There is nothing at the site to indicate the reverence in which it is held by some visual scientists. A plaque was erected in 1996 to mark the centenary of hydroelectric power generation by diverting the waters of the River Ness, but no sign of its perceptual significance is available other than the waterfall illusion itself. Its beauty, on the other hand, has long been remembered, and it is because of this that Addams visited it. Such was its fame that it has been celebrated in verse by Scotland's poets, best and worst! Robert Burns composed the following "Lines written with a pencil, standing by the Falls of Foyers, near Loch Ness", in 1787 (Wilson and Chambers, 1840, page 40):

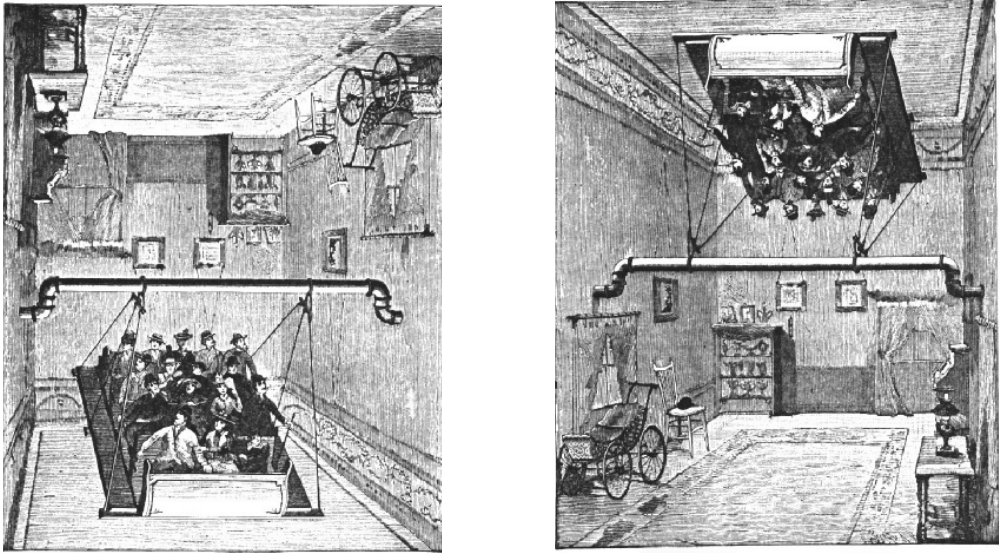
Among the heathy hills and ragged woods  
The roaring Foyers pours his mossy floods;  
Till full he dashes on the rocky mounds,  
Where, through a shapeless breach, his stream resounds,  
As high in air the bursting torrents flow,  
As deep-recoiling surges foam below,  
Prone down the rock the whitening sheet descends,  
And viewless Echo's ear, astonish'd rends.  
Dim seen, through rising mists and ceaseless showers,  
The hoary cavern, wide-surrounding, lowers.  
Still, through the gap the struggling river toils,  
And still, below, the horrid cauldron boils.

About a century later, William Topaz McGonagall, *Poet and Knight of the White Elephant, Burmah*, wrote a lengthier poem, called "Loch Ness", in part of which he also delighted in the spectacle of the Falls (Smith 1974, page 95):

And the beautiful Falls of Foyers with its crystal spray,  
As clear as the day,  
Enchanting and gay,  
To the traveller as he gazes thereon,  
That he feels amazed with delight,  
To see the water falling from such a height,  
That his head feels giddy with the scene,  
As he views the Falls of Foyers and the woodlands so green.

These may well be considered to be the worst of Burns' and the best of McGonagall's poetry! It is the potential for giddiness that links the waterfall illusion with another pilgrimage that we have recently made.

There are yet other perceptual effects that have a venerable but veiled past because they have been associated with financial gain. This applies to fairground phenomena, many of which embody an understanding of illusions that was far in advance of the contemporary visual science. The exhibits were rarely restricted to one site, but wandered around the country satisfying the vast audience of eager naïve. One such device is the subject of this editorial. We made a pilgrimage to a most unlikely



**Figure 2.** An illustration of a haunted swing from Hopkins (1898). The caption for the left picture is “True position of the swing”. That for the right is “Illusion produced by a ride in the swing”. The two illustrations are the same apart from their orientation.

location—Blackpool Pleasure Beach—to experience the haunted swing. The swing was constructed in 1954, and it is not dissimilar to the older one shown in figure 2, but the participants were not so attired.

Many fairground attractions involve abnormal patterns of motion, both vestibular and visual. The haunted swing consists of a platform on which an individual sits or stands and then experiences considerable self-motion although little physical movement occurs. The visible room surrounding the person is not anchored to the ground, but rotates around them. This induces the impression of self-motion in the opposite direction to that of the room; such impressions are intensified when allied with an unstable platform on which the hapless individual sits or stands (see Hughes 1984). In the late nineteenth century it was engagingly described thus:

Those who are to participate in the apparent gyrations of the swing—and there may be quite a number who enjoy it simultaneously—are ushered into a small room. From a bar crossing the room, near the ceiling, hangs a large swing, which is provided with seats for a number of people. After the people have taken their places, the attendant pushes the car and it starts into oscillation like any other swing. The room door is closed. Gradually those in it feel after three or four movements that their swing is going rather high, but this is not all. The apparent amplitude of the oscillations increases more and more, until presently the whole swing seems to whirl completely over, describing a full circle about the bar on which it hangs. To make the thing more utterly mysterious, the bar is bent crank fashion, so that it seems demonstrably impossible for the swing to pass between bar and ceiling. It continues apparently to go round and round this way, imparting a most weird sensation to the occupants, until its movements begin gradually to cease and the complete rotation is succeeded by the usual back and forth swinging, and in a few seconds, as the children say, “the old cat dies”. The door of the room is opened and the swinging party leave. Those who have tried it say the sensation is most peculiar and the deception perfect. The illusion is based on the movements of the room proper. During the entire exhibition the swing is practically stationary, while the room rotates about the suspending bar. (Hopkins 1898, pages 91–94)

The history of the haunted swing, like those of other fairground illusions, is itself mysterious. Since there was advantage in keeping the trick secret, very few records of their construction were made. Thus, in contrast to science in which information is

shared, the fairground illusions were guarded secrets. A report of the haunted swing did appear in the second volume of *Psychological Review*: Wood (1895) experienced its joys at the Midwinter Fair in San Francisco, where the swing could hold “forty or more persons”. His report was more analytic than that by Hopkins (1898):

The swing proper was practically at rest, merely being joggled a trifle, while the room itself was put in motion, the furniture being fastened down to the floor, so that it could be turned completely over. The illusion was good, though the absence of centrifugal force, and the fact that the swing did not move with uniform acceleration as it descended, would indicate to a careful observer that he was not swinging freely. The curious and interesting feature however, was, that even though the action was fully understood, as it was in my case, it was impossible to quench the sensations of ‘goneness within’ with each apparent rush of the swing. The minute the eyes were shut the sensation vanished instantly. Many persons were actually made sick by the illusion. I have met a number of gentlemen who said they could scarcely walk out of the building from dizziness and nausea. (Wood 1895, pages 277–278)

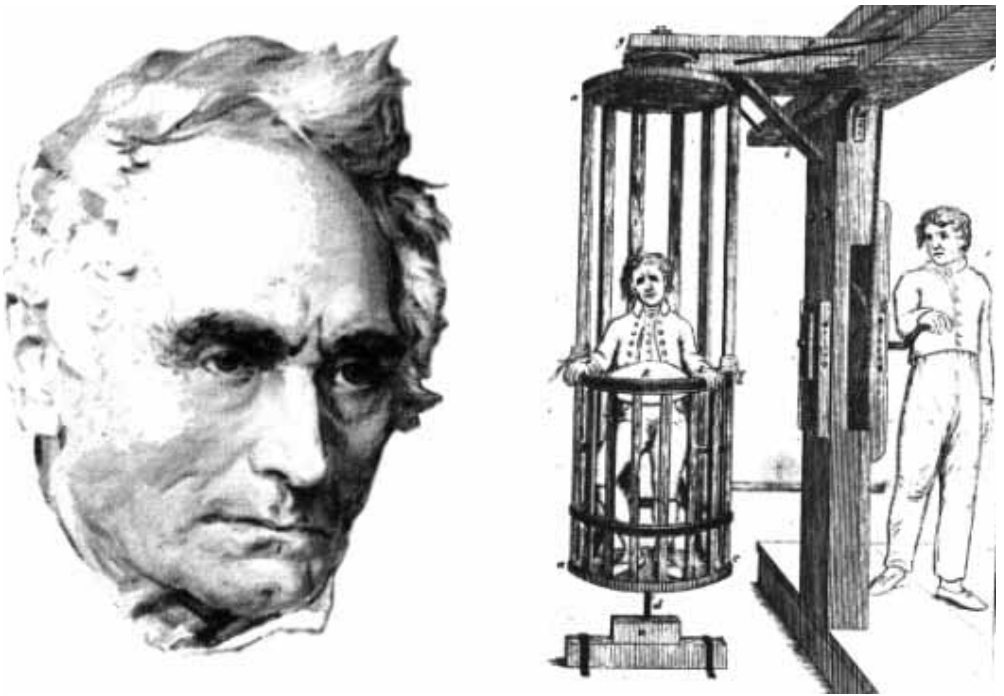
Unfortunately, unlike the descriptions given above, the Blackpool swing did not “go round and round” and so the effect was not quite so compelling; on the other hand, no one was made “actually sick by the illusion” and everyone was able to walk away without assistance! As Wood clearly states, knowledge of the mechanism of the haunted swing has no effect on the impression of body rotation, and the only recourse to stability is to close the eyes.

In the context of stage tricks, books (like that by Hopkins 1898) did appear from the early nineteenth century which described how they worked. Brewster’s (1832) *Letters on Natural Magic* fell into this category. Many of the tricks he described involved principles of optics because “of all the sciences, *Optics* is the most fertile in marvellous expedient” (page 5). He did not, however, mention the haunted swing or its equivalent. Perhaps it was introduced in the late nineteenth century. Nonetheless, Brewster did appreciate the difficulties of divining the past of many magic tricks:

The secret use which was thus made of scientific discoveries and of remarkable inventions, has no doubt prevented many of them from reaching the present times; but though we are ill informed respecting the progress of the ancients in various departments of the physical sciences, yet we have sufficient evidence that almost every branch of knowledge had contributed its wonders to the magician’s budget, and we may even obtain some insight into the scientific acquirements of former ages, by a diligent study of their fables and their miracles. (Brewster 1832, page 3)

A timeless feature of fairground attractions is the large number of moving contraptions that generate atypical vestibular stimulation. The humble roundabout has been transformed into roller-coasters, corkscrews, twistlers, spin doctors, and the like; Blackpool has a more than adequate supply of these. They all involve accelerations and decelerations that are rarely encountered in natural movements. When artificial rotations were introduced in the scientific domain by Erasmus Darwin (1801), the human centrifuge was given a therapeutic role, rather than one for entertainment (see figure 3). Purkinje (1820) and Mach (1875) did study the effects of such rotation on sensations of visual and body movement, but it is clear that there was little in the way of amusement that accompanied the experiences. This was a journey we decided not to embark on at Blackpool.

The haunted swing continues to amuse and entertain, and modern versions of it have been constructed in theme parks. Peripatetic fairgrounds are becoming rare, and those that are fixed are becoming more elaborate and electronic. Simulating the haunted swing is difficult without a device that is equally elaborate. The whole visual field moves, and this is difficult to arrange with any goggle device. Returning to the earlier pilgrimage, the waterfall illusion has the reverse requirements. It works much



**Figure 3.** Jan Evangelista Purkinje and the device he used for rotating observers in order to study the effects of vertigo. [Portrait after an illustration in Psotníčková (1955); rotating device after an illustration in Kruta (1969).]

more effectively at Foyers than at Niagara! The waterfall illusion requires a test field that will be stimulated by adapted as well as unadapted regions of the retina; in the case of the Niagara Falls, the enormous extent of the descending water renders it difficult to find a suitable static test upon which to project it.

Motion has proved particularly attractive as a source of deception, and Helen Ross (1974) directed attention to a number of naturally occurring motion illusions in her book *Behaviour and Perception in Strange Environments*. She visited and illustrated the Electric Brae in Ayrshire, Scotland, where the apparent slope of the hill is opposite to its actual incline. Photographs of the brae were taken from both directions, indicating the difference between the physical and perceptual slopes of the road: the physically downhill road meets the skyline whereas the physically uphill section has a wooded and mountain background. Ross also mentioned the haunted swing and related it to other instances in which the stationary body appears to be in motion, as is experienced when sitting in a stationary train and the neighbouring train slowly pulls away.

The science of art has provided plentiful sources and sites of wonder (see Kemp 1990). Brunelleschi's perspectives of the Baptistry in Florence, Pozzo's ceiling paintings in the church of St Ignatius, Rome, and Borromini's accelerated/decelerated perspective passages in Rome provide well-known examples. We do not need to travel to Italy in order to make pilgrimages in perspective. Not far south of the Falls of Foyers a modern embodiment of distorted perspective is available for all to see, as it shown in figure 4! There must be many more sites to be seen by those wishing to embark on the journeys, and we look forward to making further perceptual pilgrimages!



**Figure 4.** Photographs taken from the north (left) and south (right) sides of the Tay Road Bridge. The photographs were taken with the same settings from equivalent lateral distances from the piers, at about the same time of day, and at approximately the same height above water level. The bridge has an inclination of less than  $1^\circ$ . If the bridge is considered to be parallel to the river then it has accelerated perspective from the south and decelerated perspective from the north. See caption to figure 1 regarding colour version of that figure.

Nicholas J Wade

University of Dundee, Dundee DD1 4HN; e-mail: [n.j.wade@dundee.ac.uk](mailto:n.j.wade@dundee.ac.uk)

Patrick Hughes

72 Great Eastern Street, London EC2A 3JL

#### References

- Addams R, 1834 “An account of a peculiar optical phenomenon seen after having looked at a moving body” *London and Edinburgh Philosophical Magazine and Journal of Science* **5** 373–374
- Brewster D, 1832 *Letters on Natural Magic Addressed to Sir Walter Scott, Bart* (London: Murray)
- Darwin E, 1801 *Zoonomia; or, the Laws of Organic Life* volume 4, third edition (London: Johnson)
- Hopkins A A, 1898 *Magic: Stage Illusions and Scientific Diversions, Including Trick Photography* (New York: Munn)
- Hughes P, 1984 *More on Oxymoron* (London: Cape)
- Kemp M, 1990 *The Science of Art. Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, CT: Yale University Press)
- Kruta V, 1969 *J E Purkyně [1787–1869] Physiologist. A Short Account of his Contributions to the Progress of Physiology with a Bibliography of His Works* (Prague: Czechoslovak Academy of Sciences)
- Mach E, 1875 *Grundlinien der Lehre von den Bewegungsempfindungen* (Leipzig: Engelmann)
- Psotníčková J, 1955 *Jan Evangelista Purkyně* (Prague: Orbis)
- Purkinje J, 1820 “Beyträge zur näheren Kenntniss des Schwindels aus heautognostischen Daten” *Medicinische Jahrbücher des kaiserlich-königlichen öesterreichischen Staates* **6** 79–125
- Ross H E, 1974 *Behaviour and Perception in Strange Environments* (London: George Allen and Unwin)
- Smith D W (Ed.), 1974 *More Poetic Gems Selected from the Works of William McGonagall* (Dundee: Winter)
- Tourist's Guide to the West Highlands* (Edinburgh: Nelson)
- Wade N J, 1998 *A Natural History of Vision* (Cambridge, MA: MIT Press)
- Wilson Prof, Chambers R, 1840 *The Land of Burns* volume 2 (Glasgow: Blackie)
- Wood R W, 1895 “The ‘haunted swing’ illusion” *Psychological Review* **2** 277–278