

# Super refraction at visible and radio wavelengths

A strange optical effect that coincides with enhanced radio propagation



PHOTO 1: The chimney on a normal day (at the foot of the right hand wind turbine).



PHOTO 2: Super refraction makes the chimney appear much taller.

**SETTING THE SCENE.** In October 2010 there was an article in *RadCom* about the D-Star repeater antenna based at Lynemouth Power station in Northumberland, GB7NE. I played a very small part in its maintenance by photographing the antenna from the power station car park using my Meade 125mm telescope. I was inveigled into this by David, G0EUV who constructed the antenna and wrote the article. My photograph saved him climbing the 375 feet to the top of the chimney to check on its condition a year after its installation. Just for fun I had earlier photographed the top of the chimney from my home QTH, some 38km away. This is why David asked me to take a rather clearer picture from ground level. I often view the chimney to assess the atmospheric seeing conditions. The top of it is visible behind a tree-covered ridge to the north of my QTH.

**IT HAS GROWN!** One cold morning, I viewed the chimney from home and it seemed to be somewhat taller than usual. This is not behavior usually displayed by chimneys; were my eyes playing tricks on me?

I resolved to take a reference photo of the chimney in its 'normal' position. It's at the foot of the right hand wind turbine in **Photo 1**. I then laid in wait for another cold, frosty morning, which turned out to be only a few days later. I looked at the chimney and, sure enough, there it was again – standing proud against the trees. I got out the telescope and camera again; the result was **Photo 2**. My eyes were not playing tricks after all! The outer sleeve of the chimney is visible to

a greater extent than before, by an amount greater than the width of the chimney. This is a clear result, which is more than you can say for the photo: the atmosphere was very turbulent that morning.

**WHY?** After a few moments trying to come up with some sort of scientific reason for this, I turned on my FT847 and tuned to the Angus 2m beacon. I often monitor this beacon, which usually comes in at anywhere between S5 and S7 on my 5-ele Tonna. The result was S +40dB. Even the 70cm Angus beacon signal was S3 – it's usually audible, but not seen on the S-meter.

So there we have it: the effect that bends radio signals better round the Earth's curvature, called refraction, does the same with light. The effect is more pronounced during a cold snap, hence the term superrefraction.

**OTHER EXPERIENCES.** I emailed around the local group of amateurs I communicate with, about this and got this reply from Nick, G4KUX:

*"Hi Stuart,  
Strange coincidence that you should have recently experienced this phenomenon, as just yesterday (Monday, same day as me) we had a quite cold morning associated with an area of high pressure and good visibility. I noticed that I could see the distant water vapor rising from both Drax and Ferrybridge power stations, which are both about 110km south from me. A closer look with my 100mm telescope revealed that I could optically see the top section of the Drax power station chimney. I have seen this several*

*times before and know exactly at what point on the horizon it appears so am able to point the telescope very precisely. I have on occasions before also seen the tops of the cooling towers which, according to my LOS planning software, I am not in optical range of. However on Monday I could only see the chimney, which is 260m high!*

*"I then turned my attention to Ferrybridge. According to my software I am not optically LOS with the 200m high chimney. After some careful looking I could definitely see some of it and some of the cooling towers, something I had not seen before.*

*"The time I saw Drax and Ferrybridge was around 0930 local. I guess that had I begun looking earlier they may have been clearer, as by then the atmospheric turbulence was becoming a problem."*

That's it then, optical super refraction as well as radio. The moral of this story could be that if you want to work some DX, get up early one frosty morning! (But make sure the other station does the same!).

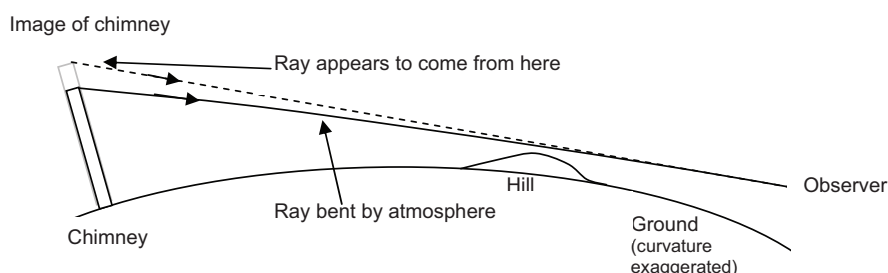


FIGURE 1: How the bent rays of light make the chimney appear taller (the extra height of the chimney is exaggerated).