DIFFRACTION: PUSHING SHARPNESS TO THE LIMIT

A SIMPLE TEST FOR DETERMINING YOUR OWN LIMITS.

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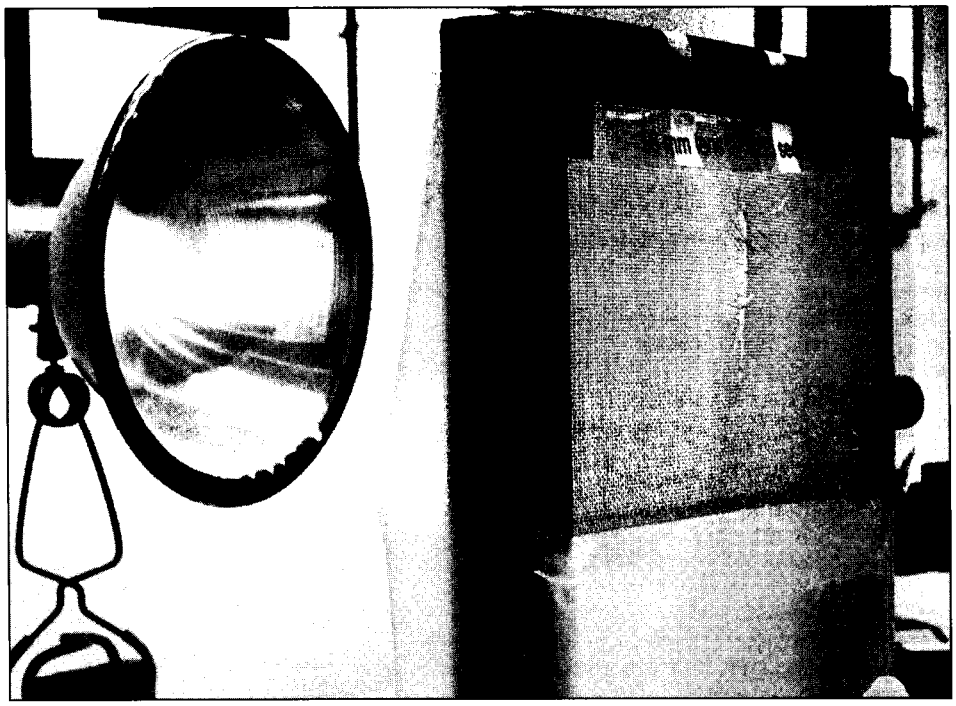

Figure 1. The photographic "subject" consisted of a piece of window screen mounted on a frame, with a slit cut in it to make it easier to perceive differences in sharpness. A 15-watt bulb and a piece of wax paper as a diffuser illuminated this from behind.

SEVERAL MONTHS AGO I WAS OUT MAKING PHOTOGRAPHS WITH my friend Mark Fernald, a fellow view camera user and part-time photography instructor at the New Hampshire Institute of Art. As we were going about our photographic "business" in an old barn, I asked Mark about his advice concerning diffraction—the loss of sharpness at small apertures. As expected, he said to "avoid small apertures." When I asked how small is too small, he explained that it depends on your film and the film developer. When the blurring effect of diffraction becomes comparable to the resolution of your film/developer combination, then you have reached the limit of sharpness. I should have thought of that!

However, Mark's response didn't really answer my question, because although I've been making photographs for 40 years, I still had no idea what the diffraction limit was for *my* equipment, *my* film (TMAX-400) and *my* developer (XTOL).

Another question remained as well: is the loss of sharpness the same for all my lenses, or are there differences between them? I guessed that the effect would be more pronounced for my shorter lenses. A given aperture for a short lens is proportionally smaller than for longer lenses. For example, f/32 on a 58mm lens has an aperture diameter of about 2mm, while f/32 for a 400mm lens has a diameter of about 12mm. Since the bending of light through small openings causes diffraction, one would think that it would be much more of a problem for shorter lenses because of their smaller apertures. In addition to diffraction, are there any other differences between my lenses that affect sharpness?

TESTING FOR SHARPNESS

I've seen articles that measure diffraction and sharpness in terms of lines per millimeter, but when we exhibit our work, we exhibit photographs, not physics experiments. So, in order to figure this out for myself, I set out to make a series of *photographs*.

But photographs of what? Fred Picker used to recommend photographing bare tree branches against a bright sky. If the branches were clear, then the lens was sharp. I tried this approach several years ago with no real conclusions. How far away should the tree be? How bright the sky? What about movement of the branches in the