be coherent at any point along its path of propagation. What matters is whether the beam is organized, in its propagation, to *arrive* coherent at the target. The work at Hughes Laboratories shows that, practically speaking, we can make the coherence length as long as we wish, as large as the size of the "collecting optics" of the phase conjugator; in other words, potentially infinite![14] Lind and Dunning carried out their experiments with turbulence at the highest end of the spectrum of intensities of turbulence in the atmosphere.

Secondly, Luc R. Bissonnette of the Canadian Defense Research Establishment has shown that the Fried construct underestimates even the *apparent* atmospheric coherence length by a factor of at least 55.

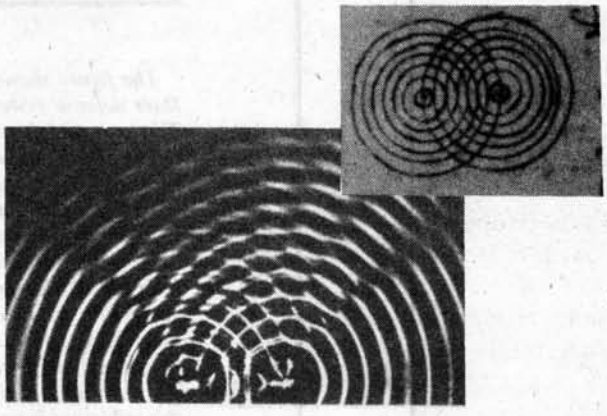
The notion of coherence length is not the only regressive concept dominating optics in the United States and Europe. In addition, the statisticians hold that "an adaptive optics system can only compensate for phase errors that occur at some fraction of the focal plane distance,"[5] i.e., relatively close to the laser transmitter. In other words, turbulence that is farther away from the controlling optics is harder to correct for. The Hughes experiments also refute this claim: in defiance of theory, Optical Phase Conjugation compensated for intense turbulence that occurred along the entire path of the beam.

Leonardo's concept of self-induced transparency

In a now-famous experiment, described by Prof. Enzo Macagno, Leonardo da Vinci placed a flame in front of the mouth of a singer producing a *bel canto* musical tone. The flame remained stable, regardless of the intensity of the voice. Yet the same *bel canto* voice, is capable of inducing resonance in a crystal glass some meters away, so that it shatters. The singer projects waves through the air that "act at a distance," without the transport of matter that would have disturbed the flame. The voice neither disturbs the air, nor is dissipated by it. The *bel canto* song induces "transparency" in the medium of the air, for its own propagation. The complete brilliance of the tone can be heard in the farthest reaches of the opera house, even softly.

In another example of wave action that acts at a distance, Leonardo cited simple sinusoidal water waves:

> If you cast two little stones . . . in water, you will see two separate quantities of circles . . . which growing, come to encounter, one circle intersecting the other, always maintaining for centers the places struck by the stones [see figure]. The reason is that although there is some evidence of movement, the water does not leave its location, because *the opening made in it by the stones closes up again at once* and this motion made by the sudden opening and closing produces a certain shaking, which can be called trembling rather than motion. And to make what I say plainer, take heed of those straws which by their lightness stand on the water; notwithstanding the wave made under them by the coming of the circles, they do not leave their first locations. . . . (Institut de France Ms. A 61r)



Leonardo's pioneering work on optics is well known. He was the first to understand that the scintillation, or "twinkling" of the stars, was not a property of the stars themselves, but the result of turbulence in the atmosphere. Furthermore, he understood that blue light was the best visible wavelength for self-induced transparency in the atmosphere. This fact, which is obvious to anyone who looks at the blue sky on a clear day, seems to have escaped optical theorists of recent days, who pay little heed to nature. Leonardo hypothesized that the sky is blue because of the absorption of other visible wavelengths by the atmosphere, and reemission and scattering of blue light, by which model the radiation of the sun pumps energy into the atmosphere to produce blue:

> I say that the blueness we see in the atmosphere is not intrinsic color, but is caused by warm vapor evaporated in minute and insensible atoms on which the solar rays fall, rendering them luminous against the infinite darkness of the fiery sphere which lies beyond. . . . (Leicester, Ms. 4a)