Gravitational lens effect may make quasars an optical illusion

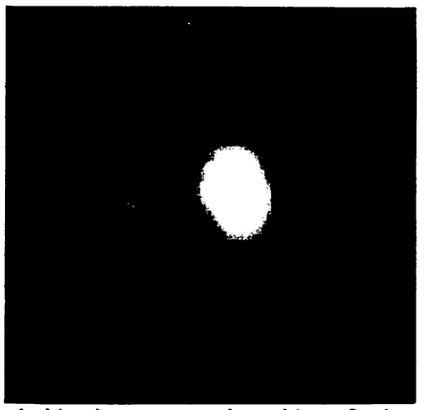
A guru from the Himalayas might shrug and say that everything is the illusion of our senses, but astronomers are people who believe in the objective reality of certain things. Yet astronomers are now seriously discussing whether a whole class of astrophysical objects may be a kind of optical illusion. The situation does not seem to have a precedent in scientific history.

The astronomical objects in question are quasars. The suggestion is that they may not be a separate kind of astrophysical body but images of the nuclei of a certain class of galaxies, the Seyfert galaxies, or perhaps other bodies, made by the action of gravitational lenses. In a recent issue of ASTROPHYSICAL JOURNAL LETTERS (Vol. 248, No. 3) theoretical aspects of the question are discussed in papers by J. Anthony Tyson of Bell Labs in Murray Hill, N.J., and by Y. Avni of the Harvard-Smithsonian Center for Astrophysics. Another proposed observational case of gravitational lens effect (there are really only two or three observed cases so far) is presented in a third paper in that issue by B. Paczyński of Princeton University and the N. Copernicus Astronomical Center in Warsaw and K. Gorski of Warsaw University and the Copernicus Center. It is a triple quasar discovered last year by E. M. Burbidge et al.

The gravitational lens effect is one of the consequences of the theory of general relativity. The theory predicts that light rays from some distant object will be bent as they pass through the gravitational field of a dense heavy object. Under proper geometric conditions this configuration can do what a lens does: produce several images of a distant object and even amplify some of the images.

The idea that quasars might be the result of gravitational lenses was put forward by Jeno and Madeleine Barnothy in 1968. It gained little support at that time for lack of observational evidence of any gravitational lens effects. "They were virtually laughed out of the hall," says Tyson. "I'm glad to see them getting some recognition for it now." Today there is at least some evidence for the gravitational lens effect. There are two or three known instances of what appear to be multiple images of one and the same quasar, and these can be attributed to lenses.

If all or a large proportion of observed quasars are lens images, the object that is imaged could be another quasar very far away (quasars still being a separate kind



of object) or some other object. Seyfert galaxies have been suggested as the sources because of spectral similarities to quasars and because they have bright compact nuclei that are likely to give the bright star-like image of a quasar under amplification by a lens. Tyson did a survey of the distribution in the sky of quasars, Seyfert galaxies and other galaxies to see if enough instances of the proper geometry (distant Seyfert galaxy, nearer quasar image and darkish galaxy or cluster of galaxies in the middle to do the lensing) are likely. He finds that the proportion of galaxies per square degree of sky to quasars per square degree changes in the right way with increasing magnitude. But to get the observed numbers a lot of mass has to be in the galaxies and clusters that do the lensing, almost enough to close the universe, he says. Many astronomers have other reasons for not wanting that much mass to be there.

Avni is trying to see whether a theoretical model can be made that would account for the apparent evolution of quasars as a lens effect. Quasars that appear to be at different distances also appear to be at different stages of development — a circumstance that suggests that quasars evolve over time. Last year astronomer E. L. Turner suggested that quasars don't really evolve. The rearrangement of their apparent locations by lensing effects gives the illusion of evolution. Avni finds the suggestion incompatible with the theory of how lens effects work "unless quasars themselves are largely due to lensing."

Avni is somewhat dubious that this will in fact turn out to be the case. The next step, he told SCIENCE NEWS, is to look for a lot of split images to see if there really are a lot of lens effects. Systematic surveys are being made for that purpose, but rumor has it, he says, that they are not finding very many. Tyson is more positive about the prospects that lensing will explain quasars, but he too feels that so far it doesn't explain evolutionary effects. He says, "This is not the end of the road. Even if [quasars] are gravitationally lensed objects, maybe we have not hit the final explanation." —*D. E. Thomsen*

Arch supports: Cushioning back pain

Low back pain is likely to strike eight out of 10 adults more than 40 years old at some time in their lives. Usually the only symptom is pain. Now two researchers suspect that the main factor in low back pain is not bending but the ability of intervertebral discs to act as shock absorbers.

Arkady Voloshin of the engineering science and mechanics department at Iowa State University and Josef Wosk of the orthopedics department of the Hillel Jaffe Hospital in Hadera, Israel, report that a "mechanical" solution to the "mechanical" troubles of the spine is an effective approach to treating low back pain. They presented their results at the Winter Annual Meeting of the American Society of Mechanical Engineers, held in Washington, D. C., last week.

Every time the heel strikes the ground, a shock wave travels through the body's skeletal system. Voloshin and Wosk measured the bone vibrations at different points in the skeleton by connecting accelerometers with elastic strips to various parts of the body. Each subject walked barefoot for eight meters along a rigid walkway. The researchers compared the ratio of the signal amplitudes just above the knee and at the forehead.

For patients who complained of low back pain, this ratio was about 20 percent less than for healthy subjects. The musculoskeletal systems of the patients seemed less able to reduce and dissipate the vibrations set off by each heel strike.

Voloshin and Wosk write, "The logical focus for treatment of such patients is the reduction of the incoming shock waves resulting from heel strike. This can be done by adding an artificial, external viscoelastic shock absorber to the human musculoskeletal system." Wosk prescribed commercially available feet arch supports. Measurements showed that this simple device — not usually used in conventional treatments — reduced incoming shock waves by 42 percent.

The treatment resulted in dramatic and quick improvement in most of 81 patients in the study. Sixty percent were completely pain-free after the first three or four weeks of using the supports. The percentage grew to 90 percent after one year.

"The results of the first experiments surprised even us," says Voloshin. "We didn't expect such an improvement. It gives us hope that we're moving in a promising direction in prophylactic treatment of low back pains."

The researchers plan a comparative study of different viscoelastic supports to determine the best one for the purpose. They believe a scientific approach to shoe design, with the emphasis on shock absorbing characteristics and incorporating the results of accelerometer measurements, will be a valuable approach to prevention and treatment of low back pain. —*I. Peterson*