a magnetic field; or from the scattering of a beam of photons by electrons or larger particles of dust. There are difficulties with both the synchrotron and electron-scattering processes, although they cannot be excluded without further observations. But the scattering of a beam of photons which hits a cloud containing gas mixed with dust is a possibility. We do not see the energetic photons directly because the angle between us and the beam is too great. These putative high-energy photons ionize the gas which exhibits the emission lines. Also, some photons are scattered into our direction of view, after they first collide with dust grains within the cloud.

This mechanism would explain both the high polarization of the continuum light and the fact that the polarization rises with increasing frequency. A crucial test of this model can be made once the much-delayed Hubble Space Telescope is launched. It will then be possible to measure the polarization curve into the ultraviolet regions, which is not observable from the Earth. The shape of the curve, in particular the frequency at which the polarization reaches a maximum, will identify the process producing the polarization. If scattering is responsible, it will also show whether the scatterers are electrons of dust particles.

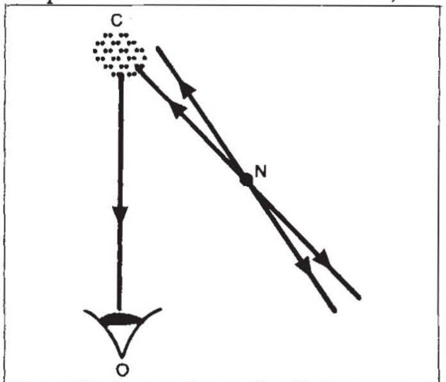

Fig. 1 The intense beam of radiation emitted from the nucleus (N) of an active galaxy can illuminate distant clouds (C) in the galaxy, as observed by Alighieri *et al.* (O, observer).

The authors suggest that their explanation can provide a link between different classes of active nucleus. The so-called blazars which have powerful continuum radiation but relatively weak emission lines are believed to have the axis of their collimated emission pointed nearly directly towards us. Objects like PKS2152−69 could be of the same type, but with a beam orientation that does not permit us to see down the collimated cone of photons and electrons. In the latter case the presence of an unseen blazar nucleus can be inferred indirectly, by observing the emission lines and scattered continuum that would be produced by collisions of the beam with material along its trajectory.

Studying the occurrence statistics of blazars that are not pointed towards us will be a non-trivial exercise. There could be many examples in which the beam escapes from the host galaxy without interacting with any material. Neither do we know what fraction of the total luminosity is scattered towards us, so any comparison of the properties of galaxies like PKS2152−69 with known blazars must be uncertain. Nevertheless, any such unification of the complex classification scheme for active nuclei is welcome.

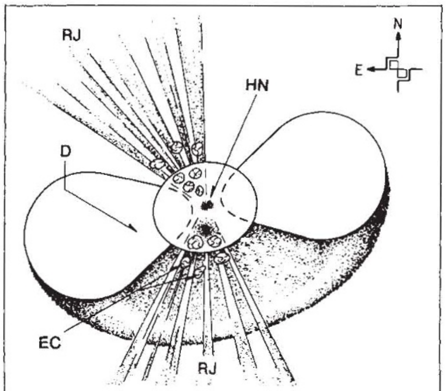

Fig. 2 Beams less collimated than those from blazars can be produced by funnelling along the poles of a dense disk (D) a few parsecs deep. The structure of NGC106B (from Chelli *et al. Astr. Astrophys.* **177**, 51–61; 1987) shows a quasar-type nucleus hidden by the disk, and seen only via radiation reflected from clouds of electrons (EC) above and below the disk. RJ, radio jets; HN, hidden nucleus.

A recent dramatic spectropolarmetric observation of the nearby galaxy NGC1068 (Antonucci, R.R.J. & Miller, J.S. *Astrophys. J.* **297**, 621–632; 1985), which was long known to have relatively low-velocity-broadened optical emission lines, revealed a 'ghost' high-velocity component visible in polarized light. High-velocity gas is a property typical of quasar activity. In NGC1068, the quasar-type nucleus is completely hidden by a thick torus of molecular gas, and we can observe the nucleus only by the nuclear light which is scattered towards us by a cloud of electrons above the torus (Fig. 2). This observation opened up the whole question of how many powerful active nuclei might be hidden in this way.

The nuclear emission from PKS2152−69, in common with blazars and powerful radio galaxies, is probably highly collimated. Less collimated emission may result when an isotropically emitting source is funnelled out along the polar directions by either a thick accretion disk or on much larger scales, by a molecular disk. The scattering phenomenon can be thought of as a mirror, albeit a distorting mirror which reflects only a small fraction of the incident light. But it is a useful tool because it provides a different angle from which to view an active nucleus. □

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Daedalus

A lesson from nature

Masonry and concrete have excellent compressive strength but cannot reliably take tension. Any tensile load threatens catastrophic failure; the whole classical architectural tradition has evolved to keep every component of a building safely and permanently in compression. The reason, of course, is that masonry is full of cracks. Even a trivial tensile stress, amplified by the stress-concentration around a crack, may initiate brittle fracture.

So Daedalus hopes to emulate nature's way with concrete-like materials. Bones, teeth, tusks and the shells of molluscs are all made of highly brittle crystals of calcium salts. But they are bound together by a tough proteinaceous 'glue' whose slight yielding relaxes the stress-concentration around an incipient crack and makes it harmless.

Daedalus plans to exploit the way those tough and resilient siloxane polymers, the silicones, are made by the hydrolytic coupling of organosilane halides. He points out that these halides can bind chemically to a silica surface by a very similar reaction. So DREADCO's chemists are synthesizing various organosilane halides to spray onto, or to diffuse as vapour into, brick and concrete. They will bind on the silicaceous surfaces of the cracks and fill them up with tenacious silicone resin. The masonry will be converted from a brittle porous solid to a tough and coherent one, as strong in tension as in compression. The treatment will probably only penetrate a few centimetres into the concrete. But since tensile failure begins at the surface of a component where the stress is greatest, silicone 'case-toughening' will still be effective.

Case-toughened concrete will revolutionize architecture. Steel and wood, so vulnerable to rust, fire and rot will no longer be needed: the tough new concrete will do it all. Its coherent silicone surface will even save it from the other curse of masonry — water-penetration and frost damage. Freed from the discipline of compression design, architects will doubtless rush to erect extravaganzas and monstrosities even more nightmarish or depressing than their current achievements. But on the positive side, many unique and graceful masterpieces of the past now crumbling into ruin or creeping into tensile instability could be rescued by *in situ* case-toughening (the leaning tower of Pisa comes to mind). And the new concrete may even invade other fields. Concrete chairs, tables and even grand pianos may become commonplace; waterproof and rustproof concrete ships may dominate the seas; and on a small but valuable human scale, repaying the debt to nature's methods, concrete false teeth.

David Jones