# The Discovery Of Quasi-Stellar Objects

Perhaps the event which contributed most towards enlivening extragalactic astronomy this century was the discovery in 1963 of the quasi-stellar objects.

As the adjective 'quasi-stellar' suggests, these objects have a star-like appearance (in contrast to the fuzzy appearance of galaxies), and they had earlier been mistaken for stars. The appreciation of their rather extraordinary nature came about, thanks to a cooperation between optical and radio astronomers.

Radio astronomers C. Hazard, M.B. Mackay and A.J. Shimmins took the first step in this venture in 1962, when they used the then new method of lunar occultation. The radio source 3C 273 was going to be occulted by the Moon and the drop in its radio flux during the period of occultation could be used to pin point the position of the source very accurately. These observations were carried out by the trio at Parkes Radio Astronomy Observatory.

The accurate position coordinates of the source were conveyed to the optical astronomers using the then largest telescope of 5 metres on the Palomar Mountain. With the help of optical plates, the source was identified with a 13th magnitude star. However, it was only when Maarten Schmidt at the Palomar Observatory took the spectrum of the object that its extraordinary nature became clear. The spectrum had emission lines, which are somewhat unusual for a star, but even more importantly, they showed a redshift of 0.158, *which was unheard of for a star*. Thus the source was not a star. What was it?

Shortly thereafter, another radio source 3C 48 was identified with another starlike object and this one had a redshift even higher, of 0.367. Astronomers realized that they were finding a new population of sources. What was the cause of their high redshifts?

Assumptions that the redshift was Doppler or gravitational in origin were tried, but they placed almost impossible constraints on the early models. The third option, that of cosmological redshift (due to expansion of the universe), was known for galaxies and could be applied to these sources. This placed them well beyond the Galaxy and, therefore also demanded that they were as powerful emitters of light as the typical galaxy.

This requirement coupled with the compact size of the source meant that it had its energy reservoir within a very tiny volume compared to a galaxy. In the early part of 1963, Fred Hoyle and William Fowler proposed that the energy source lay in the gravitational field of a compact supermassive object, later to be identified with the name 'black hole'.

Today, around 10,000 quasars have been found and they have provided a wealth of menu to astronomers and astrophysicists. The former have to contend with multi-wavelength observations ranging from radio to X-rays, while the latter have to provide models of high energy astrophysics using at times, inputs from general relativity.