NEWS AND VIEWS

Redshifts of Quasistellar Objects

THE physical nature of quasistellar objects is as puzzling now as it was 10 years ago when their large redshifts were discovered. Within 3 years of those first redshift determinations the difficulties encountered theoretically in explaining the observed radio and optical properties of the QSOs, if they were indeed at the enormous distances derived cosmologically, had been clearly laid out. Attempts were made to find alternative explanations for the redshifts, in terms of local objects exploding outward from our Galaxy at relativistic velocities, or collapsed objects whose radii had shrunk to near the Schwarzschild limit so that huge gravitational redshifts were present. But these theories were unsatisfactory either on energetic grounds or because of lack of a physically viable model of such an object near the limiting Schwarzschild radius.

A small minority of workers have maintained a sceptical attitude toward the hypothesis that the QSO redshifts are cosmological in origin, produced by the expansion of the Universe. These workers have mostly accepted that no viable alternative theory for the redshifts exists at present, and they have either pressed for additional observations along any lines that appeared promising for settling the controversy, or they have attempted to devise and carry out such observational programmes themselves, or they have made attempts toward devising alternative theories. But above all they have tried to persuade workers to keep an open mind on the question and, especially, not to ignore any data which pointed toward non-cosmological redshifts.

The large majority of astronomers, however, has adhered to the cosmological hypothesis, because this works well for normal galaxies, and because any alternative hypothesis would involve some radical new thinking.

Unfortunately, it has been very difficult to devise observational tests to give a conclusive answer, because most have had to be based mainly on statistical arguments, or on a painstaking and time-consuming search for luminous connections between objects of different redshifts. To collect enough data when time on large telescopes is in great demand is a real problem. The lack of precision in radio source positions has also led to a considerable amount of wasted telescope time.

It is therefore very interesting that astronomers seem at last to be within shooting distance of making some crucial tests. This has come about mainly because of the recent dramatic improvement in the accuracy of radio positions, so that errors are down to 2 arc s or better in some cases, through work at Molonglo, Cambridge, Malvern and Jodrell Bank, and other radio telescopes now starting precision work.

Two exciting pieces of optical work, made possible by these improved positions, are reported in this issue of *Nature*. The first concerns the discovery of a second double QSO with very discrepant redshifts (Wampler *et al.*, on page 203), a joint result by optical workers at Lick Observatory and Hazard on the radio side. The first pair of QSOs with discrepant redshifts, discovered some time ago by Stockton, were 35 arc s apart, but the new pair are at only 5 arc s separation. There is in addition a faint extended object very near, and the radio source is double with one component coinciding with the brighter of the QSOs. Such a configuration is highly suggestive of physical connection. The authors conclude that "our observation of a close pair of QSOs with discordant redshifts is unlikely under the cosmological hypothesis" and "we believe that these observations add support to non-cosmological theories of redshifts". They also point out some interesting near-coincidences in wavelength: if the brighter and fainter QSOs are *a* and *b*, $(1+z)_b \approx 2(1+z)_a$; an absorption feature appears in *b* very near the wavelength at which strong MgII2800 emission occurs in *a* but it is probably the CIV1549 doublet at a lesser redshift than the emission-line redshift in *b*. Finally, there is an emission in *a* at the same wavelength as strong CIV emission in *b*. The authors conclude that these all represent "either an unfortunate coincidence or a profound mystery".

The second paper (Hazard *et al.*, on page 205) is joint work by radio and optical astronomers at Hale and Lick Observatories. With the improved radio positions, a search was made for close groupings of blue stellar objects coincident with a radio source and with three or more galaxies near the BSO. The important point is that it was not known during the search whether the BSOs were QSOs or, of course, what their redshifts were. Previous work in which QSOs had been found in close proximity to galaxies had been of two sorts. Burbidge *et al.* had found four (and later a fifth) 3C QSOs lying close to fairly bright galaxies of very different redshifts, a result which yielded high statistical significance, but this result concerned strong radio sources and bright galaxies.

Several other workers have looked for faint groups or clusters of galaxies near QSOs of small redshift. Since the QSO redshifts are known and selected in advance, and since galaxy groupings selected are in the right magnitude range to have redshifts of approximately the QSO value, the investigations, which yielded galaxy redshifts agreeing with the QSO redshifts, were of course clearly biased toward finding support for the cosmological redshift hypothesis, as Hazard *et al.* pointed out. Their investigation is unbiased, and the results are very interesting.

Of four sources selected for study, one was in fact the double QSO described earlier. But in all the other three cases, the fact that the BSO proved to be a QSO of large redshift, obviously much larger than those of the nearby galaxy groups as indicated by their magnitudes, is most intriguing.

The authors point out that no statistical conclusions can be drawn with so few samples, and conclude by leaving open the question of the nature of the redshifts. But one may at last hope for a resolution of the problem; because of the new accurate radio positions, optical observers can spend telescope time examining all BSOs near a radio source and even objects of neutral or reddish colour. In this reviewer's opinion, the case for non-cosmological redshifts is already strong. E. M. B.