the Upper Carboniferous to Lower Permian intrusions of the Great Whin Sill on the crest of which part of the wall was constructed. This is an ideal circumstance, for it is clear that all the dolerites were originally magnetized in the same direction because they came from the same body. Now, however, they are oriented randomly with respect to that direction and have presumably maintained their present positions since Roman times. Whatever viscous components the rocks may have had before removal by the Romans, the present viscous magnetizations must date from the construction of the wall. The Heller-Markert techniques thus effectively give an independent method of dating the building of Hadrian's Wall. An added bonus is that similar techniques may also be applied to the Great Whin Sill itself, the source of the dolerite in the wall.

According to Birley (*Hadrian's Wall*, Ministry of Public Building and Works, London, 1963), Hadrian's Wall was constructed during the first four centuries AD. According to Heller and Markert, the ages of the viscous magnetizations in three of the wall dolerites are 1,600, 1,800 and 2,400 years, respectively (average 1,933 years). The agreement is thus quite good, although the spread of measured ages indicates that the experimental techniques are subject to errors. It is perhaps unfortunate that the age of the viscous magnetization is apparently an exponential function of the parameters which are measured experimentally, so that any experimental error is magnified in the final result. For example, an experimental error of only 5 per cent will lead to error limits of 600 years and 3,600 years for the dolerite "dated" at 1,800 years. For this reason, and because of uncertainties in the basic theory, the agreement between palaeomagnetism and archaeology is really quite remarkable. But by the same token, if the Heller-Markert method is ever to be used widely, extremely high experimental accuracy will be required and statistical methods will have to be applied to large numbers of samples.

Finally, what of the Great Whin Sill itself? Because of the times involved in viscous remagnetization, it is evident that any viscous magnetization acquired in previous geomagnetic polarity epochs will have been completely erased by now. Thus as the Sill is older than the last major field reversal, its present viscous magnetization should date only from that reversal 700,000 years ago. The viscous magnetization age of the Sill obtained by Heller and Markert is 818,000 years. This is in fair agreement with the onset of the Brunhes epoch, although there must inevitably be some uncertainty in the effects of possible geomagnetic events occurring during the past 0.7 million years.

QSOs AND GALAXIES

Nature of Ton 256

by our Cosmology Correspondent

THE hypothesis that QSOs are, in general, associated with the nuclei of galaxies (see *Nature*, 242, 18; 1973) receives a further boost in a recent issue of *Astrophysical Journal Letters* (181, L25; 1973). Silk and his colleagues report a detailed study of the nuclear and extranuclear regions of the peculiar object Ton 256. They conclude that the data are consistent with a two component model, where a central QSO-like object is embedded in a giant elliptical galaxy.

Ton 256 is relatively easy to study because of its small (by QSO standards) redshift of 0.131. Spectroscopically, it cannot be distinguished from a QSO but it has a fuzzy photographic image which covers as much as 9 arc s on 200-inch plates. Silk *et al.*, suspecting that "Ton 256 may be a prime example of an object intermediate between a quasar and (compact) galaxy", set out to determine the nature of the fuzz. They chose positions 2 arc s north and 4 arc s southwest of the object's nucleus, and compared the observed properties of the fuzz at those positions with those of the nucleus.

It seems that the fuzz is markedly different from the central object, showing no line emission even though the nucleus has hydrogen Balmer lines and OIII emission. The colours measured for the fuzz also differ from that of the

nucleus and are similar to those of the outer portions of a giant elliptical galaxy.

Silk and his colleagues are able to unravel the probable properties of the two components of the system, assuming that the nucleus of Ton 256 contains a "normal" QSO, and these in no way suggest that the hypothesis is incorrect. The lack of emission lines in the light from the fuzz sets a limit on the amount of gas in the underlying galaxy, again well within the values plausible for a giant elliptical. There seems little doubt that the Ton 256 system is an almost classic example of the QSO embedded in a giant elliptical galaxy and as such will probably be widely referred to as an archetype if that model maintains the remarkable progress towards complete acceptance which it has made this year.

HIGH SPEED PHOTOGRAPHY

Versatile Technique

from a Correspondent

THE host for this year's spring conference of the Association for High Speed Photography, held on April 26 and 27, was the Physics and Chemistry of Solids (PCS) Section of the Cavendish Laboratory, University of Cambridge. The meeting was opened by Dr David Tabor, the present head of the PCS Laboratory, who briefly outlined how interest in high speed photography has developed in Cambridge.

Origin of Cosmic X-ray Background

THE enigma of the cosmic X-ray background seems close to being resolved, after ten years of observation. The sudden increase in the amount of data available, thanks to the success of satellite-borne X-ray instruments, has provided sufficiently stringent limits to make realistic theoretical work possible; previously, so few parameters could be tied down by observation that a wide variety of more or less complex models could be adjusted to fit the data. The flexibility of the situation is highlighted by the fate of the supposed break in the spectrum of this background at 40 keV. A short time ago it was one of the few features which all models had to explain; today, however, there is considerable doubt about whether the break exists at all and it seems that it may well be some kind of instrumental effect.

So where do theories of the X-ray background stand in the light of the latest observations? In next Monday's *Nature Physical Science* (April 30) Fabian relates the Uhuru data on extragalactic sources to the problem of the X-ray background. Radio sources, at least one quasar (3C 273) and clusters

of galaxies are all now known sources of X-rays, and according to Fabian a summation of the contribution of these and as yet unidentified components can explain the background.

With a cutoff brightness for individual sources of 5×10^{-4} counts s^{-1} , a total of 3.4×10^7 sources is required; if the faintest sources are at 3,000 Mpc, corresponding to the Hubble radius, then the mean luminosity of the objects is 9×10^{42} erg s^{-1} . "The important factor," says Fabian, "is that the satellite data give a log N -log S plot agreeing both with the intensity and fluctuations as observed by rockets."

Locating the individual contributors to the background is, however, another problem. Many known sources of extragalactic X-rays have the wrong spectra to fit the bill and Fabian points out that the sought-for objects are probably relatively faint at other than X-ray frequencies. The answer seems to be to concentrate the search on those X-ray source error boxes which are relatively free from bright optical objects, for example those of 2U1443 + 43 and 2U0043 + 32.