Agriculture is typical; he was fined £10. The committee rightly suggests that the penalties should be increased to a fine of up to £250 or three months in gaol on summary conviction and the same fine and up to 12 months in gaol on conviction on indictment. Mr Mellish and his colleagues should give the report serious and prompt attention. There is a strong case for consolidating the Ancient Monuments Acts in a single new act to ensure that legal niceties cannot be used to thwart the spirit of the law, giving the inspectorate the resources to do its job properly and even making examples of a few culprits to encourage all landowners to respect any field monuments they happen to own.

ASTRONOMY

Microwave Background Isotropic?

from our Astronomy Correspondent

SINCE the discovery four years ago that space is apparently filled with microwave radiation corresponding to a black-body temperature of 3° K, much effort has been spent searching for any hint that the radiation is anisotropic. There are several reasons why this is important. One is that anisotropy, if it is there, could have come about from anisotropy in the expansion of the universe. Another reason is that really large density inhomogeneities in the universe, which would have to be several thousand million light years across, could produce anisotropy in the radiation, amounting to a half per cent for a density variation of ten per cent. So far, however, no anisotropy has been detected, possibly because there is none there, or, equally likely, because of the difficulties of measuring the small variations which might be expected. The interest of this question has prompted a group at Stanford University to obtain general equations of the distribution of black-body radiation that would be seen by an observer in arbitrary uniform motion with respect to the radiation (Henry, G. R., Feduniak, R. B., Silver, J. E., and Peterson, M. A., *Phys. Rev.*, **176**, 1451; 1968).

Henry *et al.* have taken the equation for the photon distribution in the frame at rest with respect to the radiation, and transformed it to the frame moving with the observer. Their result, which also seems to have been found by other workers, is that the effect of uniform motion through the radiation is to alter its effective temperature to

$$T_e = T'(1-v^2/c^2)^{\frac{1}{2}}/[1+(v/c)\cos\theta]$$

where T' is the temperature in the rest frame and θ is the angle of observation relative to the direction of motion, implying a twenty-four hour variation in the radiation for an observer on the Earth. The form of the black-body distribution is identical to that in the frame at rest relative to the radiation, so that the radiation ought to appear as perfect black-body whatever the direction of observation. This is very much the conclusion reached by Bracewell and Conklin (*Nature*, **219**, 1343; 1968), who wrote that the motion of the Earth about the galactic centre, as well as the motion of the Galaxy itself, may be detectable.

Henry and his associates also look at their results from the point of view of an observer on the Earth, moving slowly with respect to light. They are particularly interested in evidence, admittedly slender, which Patridge and Wilkinson of Princeton have found for a twelve hour variation in the black-body radiation (*Phys. Rev. Lett.*, **18**, 557; 1967). There seems to be no explanation for this. Any twelve hour term ought to be three orders of magnitude smaller than a twenty-four hour term, for which Partridge and Wilkinson found no evidence at all. Possibly the twelve hour component, only two and a half standard deviations greater than zero, is not genuine. Partridge and Wilkinson also looked at their measurements for evidence of density inhomogeneities and concluded that there are no irregularities in the radiation greater than a half per cent, at least in the directions they scanned, which means the inhomogeneities must be less than ten per cent.

The problems of measuring the 3° K radiation are, of course, formidable. Partridge and Wilkinson used an instrument which they call an isotropometer, which is a modified version of the Dicke radiometer, the standard equipment for 3° K microwave observation. They seem fairly certain that the mysterious twelve hour component is not a solar effect. None the less, a body of evidence is now building up that a twenty-four hour component is what ought to be seen.

ATMOSPHERIC COMPOSITION

Excess Deuterium on Venus

from our Astronomy Correspondent

THE flight of the Mariner 5 spacecraft, which made a close approach to Venus during October 1967, is still yielding dividends. In this month's *Journal of Geophysical Research* (**74**, 1128; 1969) Professor T. M. Donahue of the University of Pittsburgh writes of the inferences that can be drawn from measurements by the probe of an excess of deuterium over hydrogen in the outer atmosphere of Venus. Although this conclusion, based on photometer measurements of airglow at high altitudes in the atmosphere of Venus, is not entirely cut and dried, it is definite enough for Donahue to look for an explanation. The excess—deuterium atoms outnumber hydrogen atoms by ten to one at an altitude of 6,500 km—is disturbing because on the Earth, on the average, there is only one part of deuterium to 7,000 parts of normal hydrogen. Donahue would like to believe that a ratio something like this—he mentions one part of deuterium to 1,000 parts of hydrogen—may be the average planetary abundance for Venus. His aim is then to see how an excess of deuterium might develop in the upper atmosphere. The important conclusion is that the Mariner observations are compatible with a low overall deuterium abundance only if the upper atmosphere of Venus is far less turbulent than the Earth's upper atmosphere.

The chain of reasoning starts with the assumption that the deuterium comes from lower levels of the atmosphere, from compounds of deuterium, hydrogen and oxygen broken up by sunlight or by chemical reactions. Donahue goes on to say that the high relative concentration of deuterium in the upper atmosphere coupled with a low average deuterium abundance is possible if almost all the deuterium diffuses upwards from the level of the sources. The excess then comes about because hydrogen is expected to escape