equal to the difference between the energy of the incident photons and the binding energies of the electrons. This is just the photoelectric effect. The essential difference between this method and conventional absorption spectroscopy is that here the electron binding energy is measured directly, whereas in absorption spectroscopy it is the difference between two energy levels that is recorded. It is perhaps surprising that although the photoelectric effect has been common knowledge for more than sixty years, until recently nobody had thought of applying it to analyse molecular levels.

There are two chief sources of monochromatic photons in regular use. The first resonance line of helium produces a strong output at 584 ångstroms in the far ultraviolet, and soft X-rays from magnesium and aluminium are also used. Higher energy photons tend to produce better resolution in the photoelectron spectra, but usually a lower intensity as well.

Two review papers set the scene for the conference. Dr D. W. Turner of Oxford University and Professor K. Seigbahn of the University of Uppsala, the originators of the two principal branches of the technique, discussed how photoelectron measurements have been used to determine molecular electronic structure and for chemical analysis. The halogens are elements which give sharp lines in the helium-584 spectra, and Professor W. C. Price of King's College, London, gave a paper on the spectra of the halides of group 3 elements.

An incisive theoretical paper on the general theory of diatomic molecules was given by Dr J. M. Sichel of Bristol University, in which he analysed the angular distribution of the photoelectrons from such molecules. An interesting paper on photoionization cross-sections by Dr J. A. R. Samson of GCA Technology Division, Bedford, Massachusetts, contained an account of how the angular distribution of photoelectrons can be estimated from measurements at two particular angles.

Several papers referred to the phenomenon of autoionization, which is the major contributor to the difficulties in absorption spectroscopy. This process occurs when an electron is not emitted directly from the atom, but jumps to a resonant state and is then emitted later. The line shape for such processes in photoelectron spectra is under investigation at present. As Dr Turner pointed out in his paper, it is now also possible to analyse the fine structure of the spectra to give the vibration frequencies of the molecular ion, and from these the electron orbits of complicated molecules can be inferred.

X-RAY STARS

Radio Observations of Sco *X*-1

THE X-ray star Scorpius *X*-1, known to be variable at visible and X-ray wavelengths, has now been found to fluctuate in the radio range. This is reported by J. G. Ables of Adelaide, who has been observing Scorpius *X*-1 at a wavelength of 6 cm with the 210 foot radio telescope at Parkes, the Australian National Radio Observatory (*Astrophys. J. Lett.*, **155**, 27; 1969). It is too early, however, to say how periodic the fluctuations are, but their time scale of the order of hours seems very like the slower of the optical variations which have been observed. Shorter time scales are present in the optical variations, but would have escaped detection in the 45 minute integration time of the radio measurements. Changes which have been detected so far in the X-ray emission from Scorpius *X*-1, the strongest X-ray star, also seem to have a short time scale and be of the flare type.

There is little room for doubt in the veracity of the radio observations. A total of 164 scans across the X-ray star were broken up to give fifteen data points for the flux density, showing a peak-to-peak variation of a factor of twenty which has a negligibly small chance of arising statistically. Neither can the variation be attributed to ionospheric scintillation, or to inconstancies in the gain of the receiver which was carefully monitored. The observations were spread over three mornings last year.

Ables's measurements seem to be the first which have been published since Scorpius *X*-1 was reported as a very weak radio source by Andrew and Purton of the National Research Council, Ottawa (*Nature*, **218**, 856; 1968). Unfortunately, however, Ables's measurements were at almost the same wavelength as those of Andrew and Purton so there is still no information about the radio spectrum.

It is clear that the radio fluctuations are a different kettle of fish from those which have been observed in the optical range. Ables points out that the factor of twenty intensity variation corresponds to more than three stellar magnitudes, while the largest optical variation seems to have been about 1·1 magnitudes, with an average value of about 0·5 magnitudes. The X-ray flare which has been observed by Lewin and his colleagues, however, was of 1·5 magnitudes (*Astrophys. J. Lett.*, **152**, 55; 1968). These need not be serious discrepancies, however, if factors such as differential absorption and the presence of emission lines are taken into account. Nevertheless, there is a broad range of time scales to be explained, going from optical flare-like activity with magnitudes up to 0·2 and a time scale of minutes through the X-ray flare with its duration of about 30 minutes to the slower optical variation with a time scale of the order of an hour.

STABLE LAYERS

Turbulence and Mixing

from our Astronomy Correspondent

IN spite of the esoteric sound of last week's geophysical discussion meeting at the Royal Astronomical Society—"Turbulence and Mixing in Stably Stratified Environments"—the topic is more than a mere curiosity. This much was clear after a meeting which attracted oceanographers, astrophysicists and meteorologists. Astrophysicists especially, and in particular those concerned with the Sun, stand to gain from a study of stably stratified layers which oddly enough is relevant to the experimental test of general relativity. The connexion was spelt out by Professor R. J. Tayler of Sussex University. If the experiments by Dicke which seem to show that the Sun is flattened at the poles are correct, the flattening could be due to the solar interior spinning much more rapidly than the exterior. This would mean that the Sun's gravitational forces are different from what has been assumed hitherto. The new notion of the configuration of the Sun's field then has to be