difficult to answer because Robbins *et al.* do not offer a solution, but they do offer a solution to the next most obvious question. What is the distribution of the last time that $Z_n - \mu \geq \epsilon$? If this time is τ , then the distribution of τ will depend on ϵ in such a way that $\tau \rightarrow \infty$ as $\epsilon \rightarrow 0$. Moreover, Chebychev's inequality, which states that $Pr\{|Z_n - \mu| \geq \epsilon\} \leq n^{-1} \epsilon^{-2} \sigma^2$, suggests that τ is of the same order of magnitude as ϵ^{-2} , for very small ϵ . Robbins *et al.* show that in the limit as $\epsilon \rightarrow 0$, $\epsilon^2 \tau$ has a chi-squared distribution with one degree of freedom.

Their proof goes as follows. They assume first, without loss of generality, that $\mu = 0$ and $\sigma^2 = 1$. By definition

$$\begin{aligned} Pr\{\epsilon^2 \tau < x^2\} &= Pr\{Z_n < \epsilon, \text{ for all } n \geq \epsilon^{-2} x^2\} \\ &= Pr\{\sqrt{m} Z_n < x \text{ for all } n \geq m\}, \end{aligned}$$

where $m = \epsilon^{-2} x^2$. However, as $m \rightarrow \infty$, and with n equal to the integer part of mt , $\sqrt{m} Z_n \rightarrow t^{-1} X(t)$, where $\{X(t), t \geq 0\}$ is the standard Wiener process. Thus, if $F(x)$ is the limiting distribution of $\epsilon^2 \tau$ as $\epsilon \rightarrow 0$

$$\begin{aligned} F(x^2) &= \lim_{\epsilon \rightarrow 0} Pr\{\epsilon^2 \tau < x^2\} \\ &= \lim_{m \rightarrow \infty} Pr\{\sqrt{m} Z_n < x \text{ for all } n \geq m\} \\ &= Pr\{t^{-1} X(t) < x \text{ for all } t \geq 1\}, \end{aligned}$$

and since $tX(t^{-1})$ is also the standard Wiener process

$$\begin{aligned} F(x^2) &= Pr\{X(t^{-1}) < x \text{ for all } t \geq 1\} \\ &= Pr\{X(t) < x \text{ for all } t, 0 \leq t \leq 1\}. \end{aligned}$$

At this stage, unfortunately, it is necessary to step in and state that it is well known that for $x > 0$

$$\begin{aligned} Pr\{X(t) < x \text{ for all } t, 0 \leq t \leq 1\} \\ = 2\Phi(x) - 1, \end{aligned}$$

where $\Phi(x)$ is the standard normal distribution function. Thus $F(x) = 2\Phi(\sqrt{x}) - 1$, the distribution function of chi-squared, with one degree of freedom.

If $\epsilon^2 \tau^*$ has the same limiting distribution as $\epsilon^2 \tau$, then $Pr\{\epsilon^2 \tau^* < 6.635\} \approx 0.99$. Thus in order to approximate the mean μ by Z_n to within 0.01, with 99 per cent certainty one needs to make 66,350 observations of X . With 5,000 observations (a very large number of observations) there can only be 50 per cent certainty of approximating to within 0.01.

TEKTITES

Lunar or Terrestrial?

from a Correspondent

THE third International Tektite Symposium sponsored jointly by the Corning Museum of Glass and the Smithsonian Institution was held in New York from April 16 to 18. Physicists, chemists, engineers, astronomers and museum curators were among the contributors, and so the enigma of these characteristic glassy objects, found in certain restricted "strewn fields" on the Earth, was examined from almost every angle and with great subtlety and sophistication.

The overriding question, of course, is whether the tektites come from the Moon or whether they are of terrestrial origin (the possibility that they are ordinary meteorites which have spent a long time in outer space is now generally discounted). It was impressive that both sides in the controversy, especially the lunar hypothesis faction spearheaded by Dr Dean Chapman of

Ames Research Centre (NASA), were prepared to stick out their necks so close to D day. Chapman went so far as to pinpoint the lunar crater (Tycho) from which he believes the tektites found in the Far Eastern and West African strewn fields are likely—as a result of detailed computation of their projected flight path based on their known distribution—to have originated. The remaining projectile material from the Moon crater "ray elements" could indeed, according to him, have simultaneously produced the Earth craters which are sometimes found to be associated with the tektite strewn fields and which, according to the "terrestrialists", are the origin of the tektite showers (as a result of meteoritic or cometary impact).

The other major question of the symposium was the age(s) of tektites from the various known strewn fields—the Far Eastern (containing indochinites, philippinites, javaites and australites), the West African (Ivory Coast tektites), the Central European (moldavites from Czechoslovakia) and the North American (tektites from Texas and Georgia). The Australian tektites are an example of the lack of agreement on this question. While the geologists, led by Drs Brian Mason and E. P. Henderson of the Smithsonian Institution, were convinced that the australites were no more than 15,000 years old (because of their geological associations), the physicists and chemists were equally emphatic that the ages were of the order of several hundreds of thousands of years. The latter estimates emerged from the fission track analysis of Dr R. L. Fleischer *et al.* (G.E. Research Centre, Schenectady), the thermoluminescent method of dating of Dr F. A. Durrani *et al.* (University of Birmingham) and the K/A ratio studies of Drs I. McDougall and J. F. Lovering (Australian National University).

These questions and many more are certain to continue to engage the attention and ingenuity of all those present. The squad of investigators is sure to swell by the time the fourth international symposium on tektites takes place in Australia in about three years from now. That symposium, with lunar samples amply studied in the meantime, ought to resolve some of the controversies now raging; but no doubt some intriguing new ones will be raised.

CIVIL ENGINEERING

South Wales Valleys

from a Correspondent

CIVIL engineering problems of the South Wales valleys were the theme of a conference held by the Institution of Civil Engineers at Cardiff from April 15 to 17. Many speakers emphasized the sociological aspects of engineering problems—one even suggested that all sociologists should have an engineering training.

Geological history made the South Wales valleys what they are by forming a basin with abundant beds of coal and ironstone; in 1803 Merthyr, with 12,000 inhabitants (against Cardiff's 1,000), dominated world iron markets. Geological events have also left conditions which raise geotechnical problems in valley redevelopment, notably cavitation in limestone, land-slipping on steep glaciated slopes and the presence of some thick drift deposits and buried valleys. These difficulties were dealt with by Professor J. G. C. Anderson and C. F. Trigg (University College, Cardiff), who