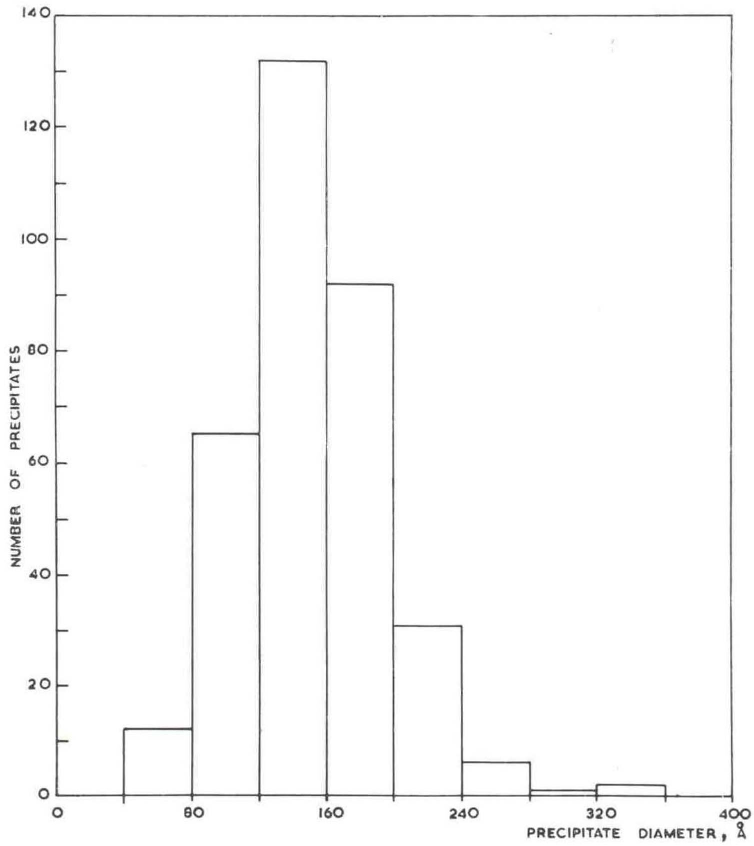
aged at room temperature for 24 hr at atmospheric pressure. Then followed an ageing treatment of 4 hr at 170°C at atmospheric pressure to produce the standard amount of θ'' precipitation with no other type of precipitation present (fig. 2). The θ'' precipitation appeared to occur evenly in the specimens and the diameters of the θ'' precipitates were measured and a histogram constructed for the standard result (fig. 3). The mean θ'' diameter as determined from the measurements was 165 Å. Several specimens were given the standard ageing treatments of 4 hr at 170°C and the range of diameters produced were shown by the Student's *t* test, which will be briefly mentioned later, to come from the same population of diameters.

Fig. 3



Histogram of the distribution of θ'' diameters in a specimen which had been aged under the standard conditions.

3.2. *Formation of θ'' Precipitates under Hydrostatic Pressure at 170°C*

Specimens which had been homogenized, quenched and aged at room temperature and atmospheric pressure for 24 hr were further aged at 170°C at various hydrostatic pressures for times such that the standard θ'' result was obtained. To compare the sizes of the θ'' precipitates formed under pressure with the standard θ'' result for a particular experiment, the diameters were measured and the mean precipitate diameter and the standard deviation from the mean of the precipitate diameter distribution were obtained. These values were then compared with the corresponding values obtained from the standard result using the 'Student's t test'. If the agreement was not within the required limits of error the ageing time was adjusted accordingly. The Student's t test is a statistical method for comparing two sets of data in order to determine the probability that they come from the same population. t is defined as:

$$t=\frac{(\bar{x}_1-\bar{x}_2)(n_2n_1)^{\frac{1}{2}}}{(n_1\sigma_1{}^2+n_2\sigma_2{}^2)^{\frac{1}{2}}},$$

where, in the present work:

$\bar{x}_1$ = mean of the standard set of data,
$\bar{x}_2$ = mean of the trial set of data,
n_1 = number of readings in the standard set of data,
n_2 = number of readings in the trial set of data,
σ_1 = standard deviation from the mean for the standard set of data,
σ_2 = standard deviation from the mean for the trial set of data.

The details of the t test are given by Weatherburn (1961). If $t \leqslant 2$, then the probability that the trial set of data comes from the same population as the standard set of data is at least 95%. This was the criterion used for the comparison of the results obtained under different ageing conditions. It was also used to check that the micrographs which were taken were representative of each result.

The results are summarized in fig. 4. The error bars were obtained by taking the shortest and longest times of ageing within which the standard θ'' result was still obtained. Pressure did not appear to affect the actual density of precipitates for the standard result, nor was there any apparent change in the observed contrast at the precipitates.

It is very probable that the imposition of pressure is slowing down the diffusion of copper atoms to the precipitates and the following is applicable:

$$D=D_0\exp\left(-\frac{\Delta H}{RT}\right),$$

where D is the diffusion coefficient of copper in aluminium, D_0 is the frequency factor and ΔH is the enthalpy change. This may be written:

$$\ln D=D_0\exp\left[-\left(\frac{\Delta U+P\Delta V}{RT}\right)\right],$$

where ΔU = activation energy for the diffusion process at atmospheric pressure, P is the pressure and ΔV is the activation volume. From diffusion theory (see, for example, Wert and Thompson 1964):

$$\bar{x}^2=2Dt.$$