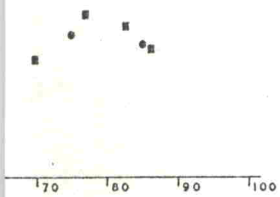
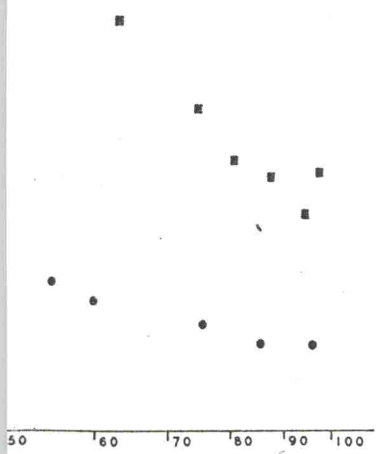


meter b_2 (vertical axis) against the
:is). Circles indicate Pennant sand-

equations can be uniquely solved for
since the root $n = 2$ can always be
on physical grounds. Solution gave
, $m = 1.22$; these values are in the
iggested by the theory.
ing that n, which measures the increase
ion rate caused by stretching the min-
ce, is a constant of the mineral and is
s dependent, values of m can be calcu-
higher loads. They are listed below.



(vertical axis), in microstrains per
s (horizonal axis) logarithmic scale.
ra marble.

$\%P_s$	m	$2n(m-1)/(n-2)$
45	0.97	−0.079
50	1.24	0.63
65	1.44	1.16
75	1.06	0.16
85	1.22	0.58

Since m is not a constant above 35% of the short-term failure load, the value of $2n(m - 1)/(n - 2)$ does not represent the exponent of the power-law dependence of strain rate on stress. A rough value of this exponent is about 1.2 [*Cruden*, 1969]. Therefore, at about a third of the failure strength, the exponent approximately doubles. *Evans* [1958, p. 182] reported a similar phenomenon in creep experiments on concrete.

The data on the creep of Carrara marble are complicated by the stress dependence of the strain-hardening parameter b_2.

Another problem is the value of b_2 from the Carrara marble experiment at 53% of the failure load. From this,

$$(n - 2m)/(n - 2) = 2.11$$

Inspection shows that if $m = 0$ and $n = 10$ the value of the right-hand side is 1.25. The lowest reasonable estimate of b_2 for this experiment is about −1.8. Thus, either n must be about four with m zero, or m must be negative.

Consider the possibility that m is negative. This implies that the number of cracks increases with the length of the crack. At loads above 64% of the failure load, where shorter cracks will be making their contribution to creep, there is no need to suppose that m is negative, and the number of cracks can then be supposed to decrease with their length. Thus the crack-length distribution has a maximum grouped around the cracks that propagate early in transient-creep experiments at about 64% of the failure load.

If the experiments on Carrara marble at 64% of the failure load and below are omitted from the analysis, b_2 can reasonably be supposed to be constant. The reduced body of data can, again, be examined by regressing logarithms of the strain rates against the logarithms of the loads. The results are

$$2n(m - 1)/(n - 2) = 2.36$$

$$(n - 2m)/(n - 2) = 0.976$$

The equations lead to estimates of n as 98.5 and m as 2.16. The estimate of n is large. However, little confidence can be placed in the mean value of the strain-hardening parameter b_2; lower values of b_2 would lead to considerably lower estimates of n.

Conclusions

The creep data thus show distinctly different patterns of behavior for Pennant sandstone and Carrara marble. For Pennant sandstone, the value of b_2 is just greater than minus one, and the stress dependence of the strain rates is linear to a crude approximation. Carrara marble shows a stress-dependent, strain-hardening parameter, and the strain rates are roughly proportional to the square of the stress.

The structural theory attributes the difference in behavior to differing corrosion reactions in silicates and carbonates resulting in different values of n and to differing crack-length distributions. The length distribution of cracks in the two rock types can be derived from the calculated values of m.

The most pronounced difference between the two distributions is the relative deficiency of the marble in long and short cracks; the crack-length distribution has a maximum. *Brace* [1964, p. 153] suggested that the maximum crack length in a rock sample was a function of the grain-size distribution. Thus the clustering of the size distribution of the cracks about a broad maximum would appear a consequence of the equigranular texture of the marble described by *Ramez and Murrell* [1964].

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