are analyzed by the structural

48 can be written

$= KS_y^{2n(m-1)/(n-2)} t^{-(n-2m)/(n-2)}$

a constant, or as

$$de/dt = b_1 t^{b_2} \qquad (49)$$

$KS_y^{2n(m-1)/(n-2)}$, $b_2 = -(n - 2m)/$
hen b_1 is the strain rate at unit time,
strain-hardening parameter measur-
e of decrease of the strain rate with

hat in the trivial case where m is
, b_2 is minus one; this leads to a
creep law [*Scholz*, 1968]. Another
e is that the creep rate is independ-
stress. Equation 48 also shows that,
close to minus one, small changes in
se large changes in the stress depend-
creep rate; the time dependence is,
nuch less sensitive. This emphasizes

$$S_{cr} \cdot r^{1/2}]^{2n(m-1)}\}^{1/(n-2)} M(y)v \qquad (48)$$

l nature of the logarithmic creep law,
$= b_1 t^{-1}$, which is transitional between
of the form

$$= [b_1/(b_2 + 1)] t^{b_2+1} \qquad b_2 > -1$$

re is no limit to the amount of tran-
with time, and the form

$$= [-b_1/(b_2 + 1)](1 - t^{b_2+1}) \qquad b_2 < -1$$

ep tends to a finite limit with time.
the creep strains at zero and one time

s in the value of m with stress are
usible in the structural theory, but
to complications. As two experiments
nt stresses are required to calculate a
m, and at least three are required to
ower-law dependence of strain rate on
and m cannot be determined if m
apidly with stress.
strain-hardening parameter b_2 is con-
r a range of stresses, n and m can be

estimated from the exponent of the power-law dependence of strain rate on stress, and from the mean value of b_2. *Cruden* [1969] reported a series of creep experiments on Carrara marble and Pennant sandstone.

The parameters of the fit of the law [equation 49] to these experiments are tabulated as a function of the percentage of the short-term failure stress in the uniaxial compression P_s at which the experiment was conducted (Table 1). The fit was performed by fitting the straight line $\log (de/dt) = \log b_1 + b_2 \log t$ by simple linear regression on the assumption that the times at which the strain rates are measured are without error.

All the experiments are satisfactorily described by the power law of creep above (equation 49) [*Cruden*, 1969]. *Scholz* [1968] has suggested that the true value of b_2 is -1. But none of the experiments in Table 1 have estimates of b_2 that are exactly -1. In two of the experiments (on Pennant sandstone at 65% P_s and on Carrara marble at 53% P_s), the possibility that the true value of b_2 is -1 can be rejected at the 1% confidence level.

In Figure 1, b_2 for these experiments is plotted against stress. The strain-hardening parameters of Pennant sandstone do not appear to be stress dependent, but there is a significant decrease of b_2 for Carrara marble below 70% of the failure stress. Unfortunately, the experiment at 53% P_s showed only 10 microstrains creep in eight days, and experiments at lower stresses would have been beyond the accuracy of the apparatus used.

In Figure 2, the logarithms of the strain rates in the experiments at a time h are plotted against the stress (on a logarithmic scale). Strain rates are, of course, most precisely determined by the regression at the mean of the logarithms of the times of the observations [*Hald*, 1952]. The time h is the weighted mean of the means of the logarithms of the estimated times of observation of the strain rates in the experiments.

If the strain rates followed a power-law dependence on stress, the data would plot on a straight line in Figure 2. The Pennant sandstone data fall on at least two separate straight lines, one from experiments at 35% P_s and below, and one for those above this value.

Because the strain-hardening parameters of the sandstone experiments are not significantly different, the weighted mean of the values of

TABLE 1. Parameters of Fit of Creep Law $de/dt = b_1 t b_2$ to Experiments on Pennant Sandstone and Carrara Marble

	$\%P_s$	$\log b_1$	b_2	dw	R_1	w	σb_2	σb_1
Pennant sandstone								
	15	1.77	−0.91	1.80	719.1	40	0.034	0.20
	25	2.15	−0.93	1.95	250.5	13	0.058	0.26
	35	2.48	−0.97	1.50	269.3	30	0.059	0.26
	45	2.61	−1.01	1.31	77.7	11	0.050	0.11
	50	2.42	−0.91	2.57	478.2	28	0.042	0.18
	65	2.50	−0.86	2.09	607.0	29	0.035	0.18
	75	3.27	−0.98	2.18	687.8	31	0.038	0.18
	85	3.12	−0.94	2.21	180.3	25	0.070	0.35
Carrara marble								
	53	4.77	−2.11	3.03	256.9	15	0.13	0.80
	64	1.67	−1.22	1.91	367.2	24	0.063	0.29
	70	0.31	−0.79	1.85	34.7	8	0.081	0.33
	77	2.11	−1.11	1.98	149.3	48	0.091	0.40
	83	2.21	−1.02	1.46	415.4	44	0.050	0.23
	86	0.77	−0.87	2.51	51.9	9	0.098	0.59

Notes.

$\log b_1$ is the natural logarithm of b_1 (b_1 is measured in microstrains per minute).
dw is the Durbin-Watson statistic [*Durbin and Watson*, 1951].
w is the weighting of the regression parameters.
σb_1 and σb_2 are the standard deviations of b_1 and b_2.