contribution, based on the assump-
sented by equation 1, comprises two
s:

$$t_f = c \exp [b(F_m - F_a)] \qquad (12)$$

$$t_f = d \exp (E/KT) \qquad (13)$$

n 12 described the static fatigue of the
at constant temperature; equation 13
their static fatigue at constant stress.
ggested that equation 12 could be
y experiments on the static fatigue
eneous specimens of silicates such as

RITICISM OF SCHOLZ'S THEORY

then, has assumed that a creep speci-
nposed of a number of elements of the
ensions and with similar physical and
properties (that is, they all obey the
of static fatigue). The stress distribu-
ch element is assumed to be uniform,
lements are each stressed to different
n the range from zero to the instan-
compressive-strength of an element.
mpression of the specimen, tensile
re assumed to be absent.

are immediate difficulties with these
ns. One of these is the definition of
ntaneous compressive-strength of an
Fracture of bodies under compression
bly attributed to tensile stresses at
d other stress concentrations within
Scholz [1968, p. 3298] was clear, how-
t there are no tensile stresses within
nen; it is therefore difficult to envisage
rence of a fracture.

also, that the stress distribution
e specimen is specialized. If the stress
on within the elements is uniform,
r boundaries will be free of shearing
for instance. Scholz has not discussed
angement of the elements would pro-
s stress distribution. However, if the
are to have perfectly smooth margins
ate shearing stresses, then the specimen
cohere.

s theory can also be criticized for the
equation 12. Taking logarithms of equa-

$$\log t_f = \log c + b(F_m - F_a) \qquad (14)$$

From equation 14, a plot of the logarithm of the time to failure of the fatigue specimen against the applied stress should therefore be linear.

The three main groups of data that Scholz quoted, *Charles* [1959], *Mould and Southwick* [1959], and *Glathart and Preston* [1946], were collected to determine the relationship between F_a and t_f. All these authors displayed the data on $F_a - \log t_f$ plots. To connect data collected under similar environmental conditions, they drew best-fit curves, not straight lines, through the data. The curves were generally concave upwards.

Glathart and Preston [1946, p. 189] explicitly rejected equation 12: 'Baker [*Baker and Preston*, 1946] adopted the rather natural method of plotting (F_a against $\log t_f$) and obtained very definitely curved-lines, the curvature being more obvious because of his longer range of time intervals.' They reported that the data were adequately explained by equation 15

$$\log t_f = -a + b/F_a \qquad (15)$$

Mould and Southwick [1959] considered four proposed static-fatigue laws to explain their data and that of *Glathart and Preston* [1946]. In addition to equation 15, they tried equations 16, 17, and 18.

$$\log t_f = a - (b/F_a) - \log F_a \qquad (16)$$

which was suggested by *Stuart and Anderson* [1953],

$$\log t_f = -a + (b/F_a^2) \qquad (17)$$

from the work of *Elliott* [1958], and

$$\log t_f = -a - b \log F_a \qquad (18)$$

where a and b are positive constants (though not the same constants in each equation). Equations 15 to 18 are predicted by various models of the corrosion process at the crack tip.

Equation 18 was the only static-fatigue law 'in complete agreement with the data obtained in the study' [*Mould and Southwick*, 1959, p. 591].

Charles [1958] reported that his data were well fitted by equation 18.

Unfortunately the full experimental data have not been published by any of the authors, and the graphical representations are too small to describe the data accurately. Charles conducted tests on groups of soda-glass specimens at the same pre-set stress. He then selected the mode of the logarithm of the time to failure, and plotted it against the logarithm of the stress.

It is doubtful whether the stress in the other two groups of experiments was sufficiently closely controlled to allow it to be treated as an independent variable. Notice, also, that 'averages' of the times to failure of the groups of specimens were plotted. Because the averages were unidentified, it is probable that they are arithmetic averages of the times to failure. The form equation 18 would require that the arithmetic averages of the logarithms of the times to failure be plotted against the logarithm of the stress.

Thus the fit of various functions to the static-fatigue data remains a matter of opinion, but the weight of evidence seems to favor equation 18 over equation 12. Charles's theory of static fatigue might form a more satisfactory basis for a theory of brittle creep than that of Scholz [*Charles*, 1958].

CHARLES'S THEORY OF STATIC FATIGUE

To provide background for this theory, it will be necessary to review very briefly the data on static fatigue of silicates, the principal rock-forming material.

Charles and Gurney and Pearson demonstrated that static fatigue in glass was negligible in a vacuum. It has also been shown that vacuums reduce the effects of static fatigue on basalt [*Krokosky and Husak*, 1968], on ceramics [*Baker and Preston*, 1946], on sintered alumina [*Pearson*, 1956], and on fused silica-rods [*Le Roux*, 1965; *Hammond and Revitz*, 1963]. *Charles* [1958], *Schoening* [1960], and *Gurney and Pearson* [1949] demonstrated that static fatigue of glass was accelerated by high concentrations of water vapor. *Le Roux* [1965] demonstrated the same effect of water vapor in the fatigue of fused silica; Gurney and Pearson showed that the presence of carbon dioxide in the surrounding environment accelerated fatigue of glass. These studies show that the fatigue of a wide range of brittle materials is dependent on the ambient environment.

The common hypothesis of these experiments was that static fatigue is due to stress-aided