offset method of computing τ_{III} adopted. Using the straight line intersection technique leads to larger values of τ_{III}, especially at high pressure where the rate of work hardening in stage III is reduced.

§ 4. Discussion

Except for the moderate decrease of θ_{II}, the influence of pressure on stages I and II of deformation observed is consistent with previous work (Davis and Gordon 1968, 1969 a) and thus will not be considered further. Based on the increase in elastic constants with pressure θ_{II} would be expected to increase slightly; apparently some other parameter, such as the slip distance, is mildly P sensitive.

Turning to stage III the parameter A in the cross slip equation (eqn. (1)), as derived by Wolf (1960) for the slip geometry of f.c.c. metals, is given by

$$A=(0{\cdot}352\,Gb^3)/\{(1+n/900)(1+180\gamma/Gb)\}, \quad . \quad . \quad . \quad . \quad (2)$$

where G is the shear modulus, b the Burgers vector and n the number of dislocations in a pile-up. As discussed by Thornton, Mitchell and Hirsch (1962) eqn. (2) is strictly valid only for $Gb^3/A \simeq 4$ to 7; for NaCl $Gb^3/A \simeq 47$. Thus numerically and due to differing slip geometry eqn. (2) is not appropriate for NaCl. However, to compute parameters of interest here one may simplify the expression for A to

$$A=G^2b^4/\beta\gamma, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where β is an unspecified parameter (Haasen 1965). Using Fontaine's (1968) calculation for γ (195 ergs/cm^2) and Hesse's data for A to calculate β one finds $(\partial \ln \tau_{III}/\partial P)_{1\,\mathrm{atm}} \simeq -0{\cdot}02\,\mathrm{kb}^{-1}$ for $\dot{\epsilon} \sim 10^{-4}$/sec (Haasen *et al.* 1970). On comparison of this result with the present data ($\partial \ln \tau_{III}/\partial P \simeq -0{\cdot}25$/kb, fig. 2) the relatively poor agreement is apparent.

Combining eqns. (1) and (3) one may derive an expression for the strain-rate sensitivity of τ_{III} given by

$$(\partial \ln \tau_{III}/\partial \ln \dot{\epsilon})=\beta\gamma kT/G^2b^4. \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Then

$$\partial(\partial \ln \tau_{III}/\partial \ln \dot{\epsilon})/\partial P = (\beta\gamma kT/G^2b^4)\{\partial \ln \gamma/\partial P - 2\partial \ln G/\partial P - 4\partial \ln b/\partial P\}, \quad (5)$$

assuming β independent of P. Setting the strain-rate sensitivity equal to Z one has for the relative change of Z with P,

$$(\partial \ln Z/\partial P)_{1\,\mathrm{atm}}=\{\partial \ln \gamma/\partial P - 2\partial \ln G/\partial P - 4\partial \ln b/\partial P\}_{1\,\mathrm{atm}}. \quad (6)$$

Inserting appropriate values for the derivatives: $\partial \ln \gamma/\partial P \sim 0{\cdot}028\,\mathrm{kb}^{-1}$ (Fontaine and Haasen 1969), $\partial \ln K_s/\partial P \simeq 0{\cdot}0147\,\mathrm{kb}^{-1}$ (inserting the more appropriate screw dislocation stress field elastic constant, K_s, for G) and $\partial \ln b/\partial P \sim -0{\cdot}0014\,\mathrm{kb}^{-1}$ (Davis and Gordon 1968) one finds

$$(\partial \ln Z/\partial P)_{1\,\mathrm{atm}} \sim +0{\cdot}005\,\mathrm{kb}^{-1};$$

the value computed from fig. 2, between 1 atm and 4 kb, is

$$-\ln(0{\cdot}22/0{\cdot}099)/4 \simeq -0{\cdot}2\,\mathrm{kb}^{-1},$$

i.e. the SBW theory predicts a small increase of strain-rate sensitivity of τ_{III} with pressure, while experimentally a very strong decrease is observed. This considerable discrepancy cannot be eliminated by any simple manipulation, e.g. if β is allowed to change with P in eqn. (5) to account for the observed large decrease of Z, then this simultaneously leads to the inadmissable requirement that τ_{III} must increase with P.

It is apparent, therefore, that a straightforward application of the SBW theory to the present data is not possible. As discussed by Aladag *et al.*, the only apparent alternative explanation for the reduction of τ_{III} with pressure requires that τ_{100}, the stress for motion of dislocations on the (100) plane, must decrease with pressure. This is theoretically unattractive because it requires a negative activation volume. In fact, it is now experimentally established (Davis and Gordon 1970, unpublished data) that pressure has no significant effect on the flow stress or work hardening of NaCl crystals oriented for (100) slip (compressed parallel to ⟨111⟩). Hence, our qualitative association of the decrease in τ_{III} with the enhanced recombination of dilated stacking faults apparently remains reasonable.

It is of interest, then, to consider the source of the discrepancy between theory and experiment further. Kocks, Chen, Rigney and Schaefer (1966) have indicated the difficulties encountered in establishing accurate τ_{III} values. In consideration of this Mecking and Lücke (1969) have proposed a method of analysis which uses the whole τ–ϵ curve rather than just τ_{III} to characterize dynamic recovery. In the present case, however, the change of strain rate sensitivity of τ_{III} with pressure is much too large to be attributed to any uncertainty in analysis. Turning to the theory, if eqns. (4) to (6) are taken as fundamentally correct and we expect correspondence between theory and experiment, it appears necessary to insert for τ_{III} in eqn. (1) some effective stress τ_{III}^*, rather than the applied stress. Gupta and Li (1970) have shown that the effective stress τ^* is a small portion of the applied stress in the work hardening of NaCl; if we may assume that τ_{III}^* is similarly small relative to τ_{III} it follows that a large change of τ_{III} would be required to produce a small change of τ_{III}^*. Similarly $(\partial \ln \tau_{\mathrm{III}}^*/\partial \ln \dot{\epsilon})$ could be relatively unchanged by pressure even though $(\partial \ln \tau_{\mathrm{III}}/\partial \ln \dot{\epsilon})$ decreases sharply. If τ_{III}^* should replace τ_{III} it follows that the calculation of Haasen *et al.* for $(\partial \ln \tau_{\mathrm{III}}/\partial P)_{1\,\mathrm{atm}}$, which requires the data of Hesse for τ_{III}, applied, versus T and $\dot{\epsilon}$, is questionable. Equation (6), however, does not require Hesse's data and thus could be a valid prediction of the relative change of $(\partial \ln \tau_{\mathrm{III}}^*/\partial \ln \dot{\epsilon})$ with pressure.