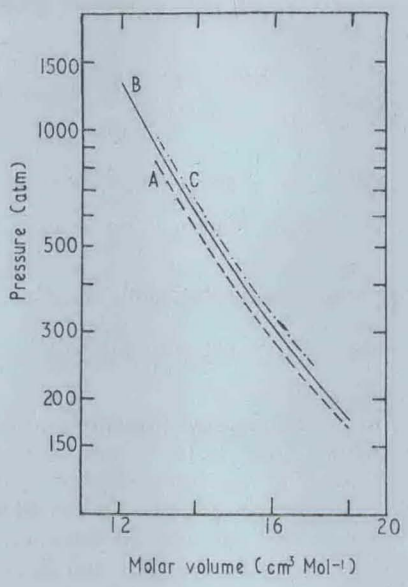

Figure 2. Pressure against molar volume for ^{3}He. Curve A, Horner (1970); curve B, P_{ISC}, present paper; curve C, Experiment (Dugdale and Franck 1964).

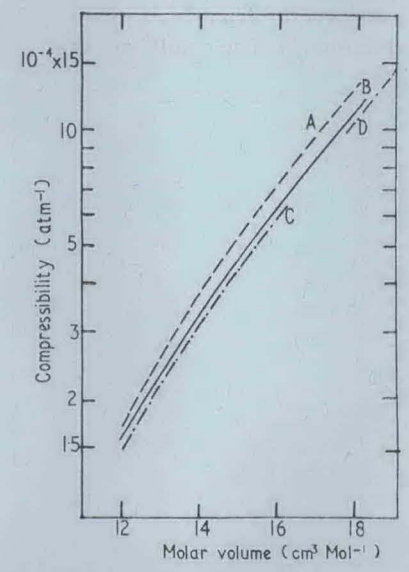

Figure 3. Compressibility against molar volume for ^{3}He. Curve A, Horner (1970); curve B, X_{ISC}, present paper; curve C, Experiment (Dugdale and Franck, 1964); curve D, Experiment (Straty and Adams 1968).

$$F_{sc} = \tfrac{1}{2}N \sum_{k} \langle \phi^k \rangle_{sc} + \sum_{qs} (f_{qs} - \tfrac{1}{2}u_{qs}) \tag{1}$$

and

$$\Delta F = -\frac{\hbar^2}{48M^3N} \sum_{1,2,3,} \frac{\Delta(q_1 + q_2 + q_3)}{\omega_1\omega_2\omega_3} W_{123} |\Psi(1,2,3,)|^2 \tag{2}$$

where

$$W_{123} = (n_1n_2 + n_2n_3 + n_3n_1 + n_1 + n_2 + n_3)(\omega_1 + \omega_2 + \omega_3)^{-1}$$
$$+ 3(n_2n_3 + n_3n_1 - n_1n_2 + n_3)(\omega_1 + \omega_2 - \omega_3)^{-1}$$

and

$$\Psi(1,2,3) = -4i \sum_{k} \exp\{i(q_1 + q_2 + q_3) \cdot R_k/2\} \sin(\tfrac{1}{2}q_1 \cdot R_k)$$
$$\times \sin(\tfrac{1}{2}q_2 \cdot R_k) \sin(\tfrac{1}{2}q_3 \cdot R_k)\, e_\alpha(1) e_\beta(2) e_\gamma(3) \langle \phi^{\,k}_{\alpha\beta\gamma} \rangle_{sc}$$

The ISC free energy, $F_{ISC} = F_{sc} + \Delta F$.

With these changes the ground state energy, pressure and compressibility of solid ^{3}He were calculated in the molar volume range 12 to 18 cm^3. In the computations it was found necessary to smear up to and including the third neighbours only, the effects of smearing the force constants beyond this point were negligible. ΔF was calculated using the frequencies of the all neighbour model but including only nearest neighbours in the lattice sums.

The contribution, ΔP, of ΔF to the pressure, P_{ISC}, and ΔB, to the bulk modulus, B_{ISC}, and hence the compressibility χ_{ISC}, were determined by numerical differentiation using the expressions

$$P_{ISC} = -\left(\frac{\partial F_{ISC}}{\partial V}\right)_T = P_{sc} + \Delta P$$

and

$$B_{ISC} = V\left(\frac{\partial^2 F_{ISC}}{\partial V^2}\right)_T = -V\left(\frac{\partial P_{ISC}}{\partial V}\right)_T \tag{3}$$
$$= B_{sc} + \Delta B = \chi_{ISC}{}^{-1}.$$

Subscript ISC refers to quantities calculated using the improved selfconsistent theory. P_{sc} was determined from the expression given in equation (2.2) of I, and B_{sc} by numerical differentiation of P_{sc} using equation (3). The results are shown graphically in figures 1 to 3.

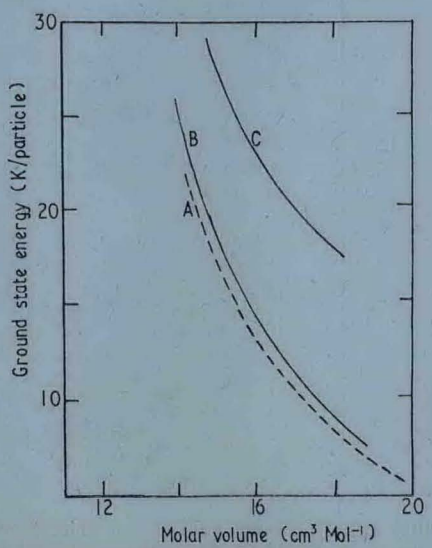

Figure 1. Ground State energy of ^{3}He against molar volume. Curve A, Horner, (1970); curve B, $F_{ISC} = F_{sc} + \Delta F$, present paper; curve C, F_{sc}, present paper.