expect it to be even greater than of ^{4}He, if the same isotopic relations exist as between protium and deuterium (κ of $^1H = 480 \times 10^{-6}$ megabars vs. $D = 300 \times 10^{-6}$!). The *liquid* atomic volumes of ^{3}He and ^{4}He, under their respective saturated vapour-pressure, at 1·2° and 1·6°K are known[20] and are as follows:

		^{3}He	^{4}He
Atomic volume, (cm^3/g atom) . . . @	1·2°K	37·11	27·515
@	1·6°K	37·77	27·504

Thus, the atomic volume of ^{3}He is by a factor of $1\frac{1}{3}$ greater than ^{4}He, an exceptional situation for isotopes. In solid form both ^{3}He and ^{4}He exist each in a body centered cubic (space group $-O_h^9$ or $I\ m3m$ 2 atoms/cell, $d_0 = 1{\cdot}0911\ .\ v_0^{-\frac{1}{3}}$) and hexagonal close packed ($D_6{}^4h$ or $C6/mmc$, 2 atoms/cell, $d_0 = 1{\cdot}1224\ .\ v_0^{-\frac{1}{3}}$) lattice and their atomic volumes and cell dimensions have been accurately measured.[21–24] They are correlated in Table 5.

TABLE 5.—PROPERTIES[21–24] OF SOLID ^{3}He AND ^{4}He

	^{3}He	^{4}He
Atomic volume of b.c.c., (cm^3/g.atom)	20·060	20·928
Atomic volume of h.c.p., (cm^3/g.atom)	20·060	20·737
Density, (g/cm^3) b.c.c.	0·1504	0·1913
Density, (g/cm^3) h.c.p.	0·1504	0·1930
Conditions for above °K	0°	1·73°
Conditions for above atm.	98·5	29·01
a_0 of b.c.c., (Å)	4·054	4·111
a_0 of h.c.p., (Å)	3·612	3·655
c_0 of h.c.p., (Å)	5·898	5·954
c_0/a_0	1·633	1·629
Atomic weight (^{12}C = 12·0000)	3·01596	4·00259

Table 5 shows that both isotopes of solid helium have, in contrast to all other groups of the Periodic System, a substantially higher atomic volume (i.e., 20 and 21 cm^3/g atom) than their next homologue—neon (13·07 cm^3/g atom, see Table 1). It is this fact which is responsible for the "*retrograde*" or *upper part* of the curve of the solid noble gases in Fig. 2.

In conclusion, a few remarks regarding the reason for this singular behaviour of the noble gas family when compared to the families of *metals* in the Periodic System. First of all, there is a big difference in the nature of forces holding the atoms together in the lattice; in the case of noble gases—weak van der Waals forces, as against much stronger metallic bonding (see Table 6).

However, in both cases, the distances between atoms and the forces or energies holding them together describe the behavior of the solid; these are determined by the atomic volume (or v_0, or a_0 and d_0) and the heat of sublimation of the solid at 0°K. The latter gives directly the energy required to separate the lattice atoms from each other and convert it to a gas.

[20] See K. R. ATKINS', *Liquid Helium*, Cambridge Univ. Press (1959).
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