that there might be a vacancy or *combination* vacancy-interstiti situation. It is somewhat difficult to believe that the large ions o the same species are going into both *c* and *a* sites simultaneously eve though there is little evidence to the contrary. Perhaps the mos substantial evidence is given by the germanate garnets, with rar earth ions in *a* sites, made by MILL', which seem to require large *c*-site and smaller *a*-site ions. But there is evidence to support, at lea

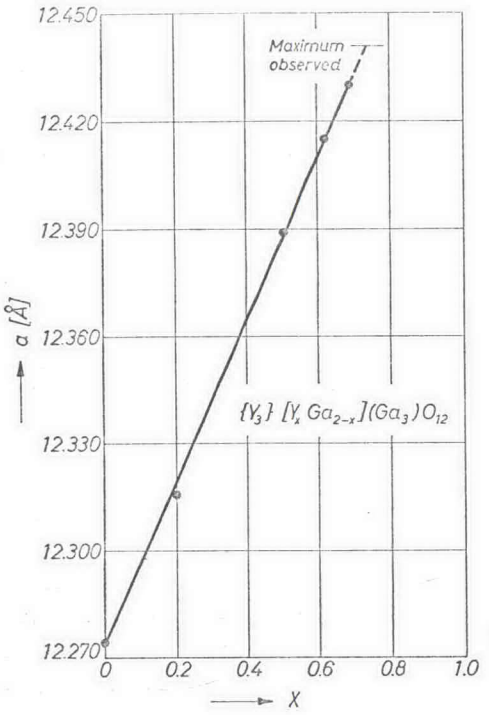

Fig. 5. Lattice constant vs x

tentatively, the substitutional or combined vacancy-interstitial hyp thesis, and this evidence is our own[45]. We have made several specimen with increasing Y_2O_3:Ga_2O_3 ratios. A plot of the lattice constant v composition is given in Fig. 5. The lattice constant of the ideall stoichiometric garnet is 12.274 Å while that obtained for the "garnet in the 3:3.25 specimen, which was not single phase, was 12.438 Å a very large increase indeed. The maximum lattice constant, 12.441 Å in the system was reported by SCHNEIDER *et al.*[57] for the 1:1 rati The maximum solid solution probably has the ratio 3:3.42 or th formula $Y_{3.74}Ga_{4.26}O_{12}$. The specimen with Y_2O_3:Ga_2O_3 of 3:3.5

i.e. $Y_{3.69}Ga_{4.31}O_{12}$, was also not quite single phase. On the powder-diffractometer pattern taken with Cu$K\alpha$ radiation, there are some extra lines with very low intensity at spacings: 4.17, 3.05, 2.88 Å. Nevertheless, the density of the specimen was measured pycnometrically and found to be 5.73 g/cm³. Now if the formula of the specimen is written $\{Y_3\}[Y_{0.69}Ga_{1.31}](Ga_3)O_{12}$, assuming eight of these per unit cell with lattice constant 12.430 Å, the theoretical x-ray density would be 5.67 g/cm³ in good agreement with the measured value. Any other formula requires oxygen as well as Ga vacancies and would result in lower density. The x-ray density, 5.80 g/cm³, of ideally stoichiometric yttrium gallium garnet is higher than that of $\{Y_3\}[Y_{0.69}Ga_{1.31}](Ga_3)O_{12}$, but this is actually to be expected.

I think that it would still be very interesting to examine the structure of a single crystal of this compound. It must, of course, have uniform composition if such an investigation is to be worthwhile. But obtaining such a crystal does not appear to be a simple task.

In the Tables 3—5 inclusive, I have not put down all values by all investigators. In some cases, I have shown more than one to indicate priority for the particular investigators even though I may believe their value is poorer than a later one. In some few cases, I have seen no point in adding a later one if it appears to be poorer than an earlier one.

Survey of the ions which enter garnets

While I shall try to cite most references, I do not expect this survey to be exhaustive of the references. I hope, however, to succeed in covering all the ions known to enter the garnets. But for a few cases, I shall not be considering slight amounts of ions that by fine spectroscopic measurements are found in a site.

Group I*A*

1. Li^+: *a* and *d* sites

$\{Ca_3\}[LiM^{2+}](V_3)O_{12}$ [70], M ≡	Mg	a = 12.412 Å
	Co	12.404
	Ni	12.340
	Cu	12.398
	Zn	12.420

[70] G. BAYER, Vanadates $A_3B_2V_3O_{12}$ with garnet structure. J. Amer. Ceramic Soc. 48 (1965) 600.