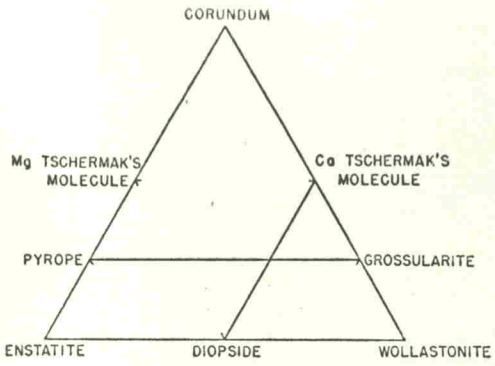

Fig. 3. Solid phases in the plane $CaSiO_3$-$MgSiO_3$-Al_2O_3.

sized, although Boyd and England (*Year Book 59*, p. 49) have made enstatites with at least 15 mole per cent Al_2O_3 in solid solution.

The plane in figure 3 contains a number of phases with a striking variety of crystal structures, all characterized by a metal-to-oxygen ratio of 2:3. Their densities are closely correlated with the structure. Densities of diopsidic pyroxenes mentioned in the ensuing paragraphs have been calculated from X-ray data discussed below. Cell edges of the grossularite-pyrope series of garnets were given by Chinner, Boyd, and England (*Year Book 59*, p. 77), and the densities of other phases were taken from the literature, using X-ray data whenever possible.

Wollastonite and the pyroxenes are chain-type silicates. The lightest, wollastonite, has a density slightly greater than 2.9 g/cm³. The density of enstatite is 3.212 g/cm³, that of diopside is 3.281 g/cm³, and that of lime Tschermak's molecule is 3.437 g/cm³. The garnet structure is composed of isolated silica tetrahedra, connected by irregularly coordinated cations. The density of pyrope is 3.566 g/cm³; that of grossularite is 3.603 g/cm³. The densest structure is that of the closely packed oxide corundum, 4.02 g/cm³.

It has been suggested that pyroxenes might undergo transitions to the corundum structure at very high pressures, and this inversion has been reported in $MgGeO_3$ (Ringwood and Seabrook, 1962). It does not seem to have been remarked that garnets also have the metal-to-oxygen ratio appropriate to undergo a transition to a corundum structure. Such an inversion may take place deep in the transition zone in the mantle.

Two other comparisons of density are interesting to make. The first is between the density of crystalline lime Tschermak's molecule ($CaAl_2SiO_6$) and the densities of its low-pressure breakdown products gehlenite (ρ = 3.038 g/cm³), anorthite (ρ = 2.765 g/cm³), and either "β alumina" or corundum. The density of "β alumina" is not well known, but neither alumina phase is present in large amounts. The mean density of the breakdown products cannot be far from 2.9 g/cm³. Lime Tschermak's molecule is 18 per cent denser than this. The density change between the pyroxene and garnet at the intersection of the two joins shown in figure 3 is 6 per cent (3.368 versus 3.592 g/cm³).

X-ray data for diopsidic pyroxenes. In order to set up suitable determinative procedures for complex solid solutions such as those shown by diopsidic pyroxenes, careful crystallographic work must be done. The fine-grained nature of synthetic crystals precludes single-crystal studies, and care must be taken that determinative peaks on powder patterns can be unambiguously indexed. Otherwise errors from effects of preferred orientation may influence measurements of unresolved multiple reflections.

In crystals of low symmetry it is all but impossible without the aid of a high-speed computer to be sure that all indexing allowed by the space group has been compared with the observed reflections. Only by being certain that all possibilities have been considered can one be sure that a reflection is not multiple. Such precautions have not always been taken in the past.

All data processing was carried out on