Various lines of evidence indicate that soil colloids are commonly composed of a considerable number of different substances. In the first place, more than one type of clay mineral is likely to be present in a given soil; secondly, other types of definitely crystalline materials are common, such as quartz, zircon, and hydargillite, especially in lateritic soils; thirdly, at least three types of inorganic materials occur in soils which, for the present, we can probably best look upon as being amorphous. We do not wish to insist that such materials are necessarily amorphous in an absolute sense, but with present methods of investigation they do not give evidence of crystallinity as do the other soil constituents. The materials referred to are hydrated iron oxides, silica, precipitated permutite-like substances, etc. The colloid of certain alkali soils appears to contain substantial amounts of this last-named kind of material, and it is possible that other immature soils, particularly in the semiarid region, also contain more or less material of the same type.

Various determinations may give useful information concerning the properties of soil colloids. Among these are chemical analysis, together with the calculated molecular ratios, base exchange capacity, adsorption of water vapor, \( \text{NH}_3 \), and dyes, swelling, particle size, degree of base saturation, titration curves, etc. However, none of these determinations is capable of yielding positive identification of the specific components present, and thus frequently they have been left out of investigations where identification of the clay minerals was the only object. For a complete understanding of soil colloids, however, more is required than an identification of the clay minerals, and several of these determinations may yield valuable information and contribute much toward an understanding of the integrated properties of the soil colloid.

**Limitations of Molecular Ratios**

Of the aforementioned methods, the calculated molecular ratios have been most frequently used as criteria for mineralogical composition. However, there are two reasons why these ratios may be unreliable as determinative criteria of the clay minerals. First, with respect to heterogeneity of the soil material, it is obvious that the molecular ratios are isomorphism. The best available evidence indicates that isomorphism is a very real feature of clay minerals.

**DEHYDRATION CURVES**

Ordinary dehydration curves have value in identifying soil colloids, since they not only furnish information concerning the integrated property of the material with respect to water relationships, but they also give some indication as to what clay minerals are present. A striking feature of such curves is the indication of a relatively large amount of water that is given off by many soil colloids at comparatively low temperature. This is adsorbed water and, since present in all types of colloids adsorb water to a greater or less extent, the adsorbed water is not strictly distinctive of any one type of soil material. As is well known, montmorillonite adsorbs very much more water than kaolinite, but certain amorphous materials absorb water to a marked extent. The water loss is not a simple dehydration, but it is caused by the partial disruption of the lattice, with the resulting loss as water of its contained OH groups. It is quite characteristic of the different minerals that the usual dehydration curves are influenced by the adsorbed water and also by particle size, as well as lattice OH ions. Small differences in the temperature of water loss may be obscured by the usual methods of making the measurements at set intervals of temperature. As usually carried out, the dehydration method is not sufficiently accurate to permit identification of closely related minerals. The differential thermal method, which will be discussed later, is designed to give greater accuracy, and it enables the investigator to follow with great detail the whole process of dehydration.