The difference in weight between a clay and a sandy soil for instance is due largely to the greater number of open spaces in the former and not to any material difference in the specific gravity of the grains.

A cubic foot of a very sandy soil contains about 40 per cent. by volume of air space, while a soil derived from limestone contains about 60 per cent. air space.

According to Whitney the percentage of open spaces in the following typical soils of Maryland are :—

TABLE III.

Light truck land	37.3	per cent.
Pine barrens chiefly sand	40.0	"
Sandy land	41.8	"
Wheat land	42.7	"
Tobacco land	50.0	"
Gummy land	58.5	"

Outside of the laboratory it is impossible to find soils completely saturated *i.e.* with all the spaces filled with water. These open spaces contain air and water in varying amounts. In dry soils there is a large proportion of air and a correspondingly small proportion of water, while in wet soils these proportions are reversed.

In irrigated regions where it is possible to control the soil moisture long experience has shown that the best crops can be raised when the open spaces contain nearly equal volumes of air and water. Thus the water-holding capacity of heavy clay soils is about 44 lbs. of water in every 100 lbs. of saturated soil and the most favorable condition for plant growth in such soils is when they contain from 16 to 24 lbs. of water in 100 lbs. of moist soil.

The following table gives the approximate number of grains in each classification of similar weights :

TABLE IV.

Fine gravel	1.4	grains.
Coarse sand	17.0	"
Medium sand	139.0	"
Fine sand	1370.0	"
Very fine sand	17360.0	"
Silt	274000.0	"
Fine silt	17280000.0	"
Clay	449280000.0	"

FORMING A COMPACT EMBANKMENT.

The belief is prevalent among laymen and engineers inexperienced in this kind of work, that any country road foreman who is familiar with the handling of earth, is qualified to superintend the building of earthen dams. They fail to understand the difference between an embankment capable of withstanding a load and one compact and stable enough to retain water. In highways, or railroad fills, little, if any, attention is given to packing the materials. The fill when completed is nearly as porous as the soils and sub-soils of which it is composed. When a cubic yard of earth is removed from the pit to the fill, its bulk is increased by about one and one-half in sandy soil to six per cent. in hard clay soil, and the subsequent shrinkage of from 5 to 15 per cent. finally reduces it from 90 to 95 per cent. of its original volume. But soils and sub-soils in their natural state contain from 35 per cent. to 60 per cent. by volume open space, and the ordinary highway, or railroad fills, are thus shown to be porous masses wholly unfit to impound water.

In the building of earthen dams something more is needed than the piling up of a mass of porous materials. The hydraulic engineer who desires to build a safe dam with a minimum amount of earth, must attend closely to the following features :—

1. The relative sizes of the grains.
2. The percentage by volume of open space.
3. The proportions of air and water contained in these open spaces.