same period the number increased from a few insignificant plants in the larger cities to 68 in 1888.* Since many water-works systems have each a number of earthen reservoirs, it is probable that the increase in the latter has been equally great.

The diversity of opinions among engineers on this subject is remarkable and difficult to explain. The wide differences in the kind and quality of the materials used may partially account for it, but apart from this, one is forced to conclude that the opinions held by many engineers regarding the best way to design and construct oarthen emb inkmonts to impound water are erroneous. For any given case the problem is : to store with safety to life and property a certain volume of water, on a particular site, within walls of earth. The task seems easy and simple, but in its design and execution the plans and specifications from a dozen or more competent engineers would show great dissimilarities. The general form, content and particular dimensions might differ 100 per One engineer would be willing to incur considerable expense in eent. procuring clay for the entire embankment ; another would use clay only as a centre core ; while a third would reject it as the most treacherous material in existence for that class of work, and would build a homogenous wall of a mixture of fine and coarse materials. Some would specify that the materials be packed dry, others that they be dampened, while some would call for an abundance of water. In regard to lining or paving there would likely be as many different kinds recommended as there were specifications. Some would be positive that the structure would be insecure without a heavy masonry core wall, while the advoeates of a homogenous embankment would consider it a waste of money.

The task of reconciling so divergent views is too great for the writer of this paper. The most that he can hopo for is that the opinions herein expressed, the suggestions offered, and the consideration of a few practical features relating to reservoir dams and the storage of water may aid, in some measure, our younger brethren.

CHARACTER OF THE MATERIALS.

Earth dams are composed of varying proportions of gravel, sand, silt, clay, organic matter and water. The same ingrodients which coustithe cultivated fields and their underlying strata are in nearly every case the most convenient and also the most suitable materials to use. A consideration, therefore, of the nature of the materials forming a reservoir embankment leads us directly to that of soils and subsoils. For this purpose, the physical and mechanical properties of soils are of much more importance than their chemical ingredients. It is not essential, for example, that we know the amount of potash, phosphorus or lime in any given case, but the size and weight of the grains, the amount of air-space they enclose, the percentages of air and water contained in these open spaces, and the effects produced by moisture, heat and frost, as well as the action of such forces as gravity, capillarity and evaporation, are of great importance. To such an extent is this true that one might say without exaggeration that the success of works of this character rests mainly upon the fact that they were designed and built in accordance with an intimate knowledge gained from a close study and earefully mado tests of the physical properties of the materials. For twenty years and over men have been testing the physical qualities of iron, steel, cements and the various kinds of timbers, and this knowledge, when coupled with the correct application of the principles ci mechanies, has given us our modern structures composed of a minimum amount of materials with a maximum of strength and efficiency. Reservoir embankments on the other hand have been built in most instances without the requisite knowledge, upon mere guess work, brawn and not brain predominating.

The site having been determined upon, samples of the underlying strata can best be obtained by test pits. They cost more than samples obtained by boring, but the additional information gained much more than compensates for the extra cost.