ment of some amount would take place, and if any movement took place the wall would be permanently weakened.

Now, assume that at the point named the stress approaches the limit of strength—the only thing that can help that point will be tensile strength on one face acting in conjunction with compressive strength on the opposite face, transmitting part of its load along the portions of the wall that may not be so hard pressed by the current, and may be stronger and better bedded. It is hard to see where tensile strength sufficient for this purpose can be got without recourse to metal.

A great deal could be said in regard to this matter of unequal loading, but I will simply state that I would consider a dam to be the same as unequally loaded, even if the pressure along its face were uniform, if its power of resistance varied, and this condition becomes dangerous if the variation in power of resistance is considerable.

In regard to a steel dam, let us assume a structure placed upon a river bed of hard impervious clay. By the use of steel this can be made to be practically all of one piece, being precisely the same as if we could get one of the huge trees of the western coast, and after hewing it to a size of say 30 square feet and the full length of the dam, say 120 feet, we could lay it across in the bed of clay and attach it to either bank in a thorough manner, and thus impound the water. It is quite evident that this dam would not break, but would have to be carried away bodily before it would yield. Its strength can be in two directions, viz., refusal to change its shape in a horizontal plane, and refusal to change its shape in a vertical plane. If it is anchored in such a way as to prevent its rising, or is made of such a shape that the water will help to hold it down, it will have stability. Now, let us place a steel truss upon the bed of the river, with its greatest strength in a horizontal plane and imbed it thoroughly with clay and concrete, and upon this truss erect another one on its centre, then complete these by sloping sides vertically, as shown in diagram 1.

Plank over the tops of these slopes, having first filled in on top of concrete base with stone or earth to any height desired. There would then be a dam that could not fail from any action of musk-rats or moles, or from the starting of a small leak carrying away a part, and then more and more until it collapsed entirely and let go all the water.

A dam such as this, so well provided with strength in tension planes, could only be pushed bodily from its position. The problem then becomes one of head and force of water as against inertia given to the dam in the simple design of its dimensions, resulting in a certain total weight of materials and the friction upon the clay. The weight of the shore cribs up and down stream would also be available in this sum since the dam itself would be attached securely to them.

It is my belief that a dam so constructed would be permanent beyond any doubt, and if the shore cribs were carried the proper distance up stream and the usual precautions taken to puddle behind them and under the whole structure, so that it would always be tight, an extraordinary freshet would have no more effect upon it than an ordinary one. This dam could have a row of piles at intervals of 20 feet apart, to be anchored to, at what would be practically the panel points of the flat truss, so that if the assumed co-efficient friction of the mass in the clay should not be correct the piles would hold it. But an ideal dam would be one that could be examined at intervals and a positive opinion obtained as to whether it was absolutely tight or not, and if leaking on the up stream face the water should be intercepted before it could get underneath all of the dam. Thus a good co-efficient of stability could be relied upon for the lower portion at least. To do this lay down a truss and imbed it on the clay and fill in with concrete, leaving a trench down the centre. (See diagram 2.)

This trench could be lined with porous material, and if the upper portion of the dam A leaked, it would intercept the water. Now, upon this erect two concrete walls, one over A and one over B, and imbed a light system of vertical and diagonal bracing in each, these to connect with the flat imbedded truss, and also to a similar truss at the top. We would then have a section like diagram 3.

Now, we may also connect B D and A C with light diagonal bracing and put in cross walls of concrete E E. The space can now be filled in with earth, and the top planked over with earth or paved with concrete.

There should be a layer of silt or gravel extending completely across the inside filling leading to tile drains and emptying outside the wall on down stream side, m n x, so as to intercept any water getting over the top of the dam at flood time, or soaking down during rain falls. All that remains to be done is to build suitable abutment walls in either bank and connect to them in a way to give maximum strength, provide spillways, etc., and then carry the main drain M to any suitable point where it can always be ascertained if water enters. To ensure a small quantity finding its way to the extreme end the lower portion of this drain should be of iron, and it should be given a fall.

If it is found that water enters, we will know then that the co-efficient of friction for portion of wall A is at the minimum, but that for B will be a maximum until the water rises to the top of the drain. This could be prevented by pumping or providing drainage to some lower point. If it should get full, however, it would be a signal for lowering the head of water and thus reducing the pressure on the foundations of the dam.

This design of dam could be used for any height required, also for any length. To go into all the rules or assumptions that would be best to adopt for different cases would take up too much space for this article. I would say, however, that this construction should not cost any more than a masonry or earthen dam of usual strength, and should be more reliable and stronger than could possibly be obtained in masonry or earth, and the one feature of possessing tensile strength in a high degree should recommend it to the theoretical and practical engineer alike.

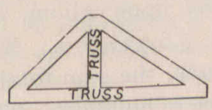

DIAGRAM 1.

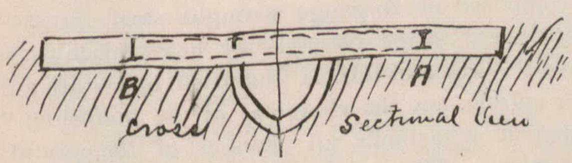

DIAGRAM 2.

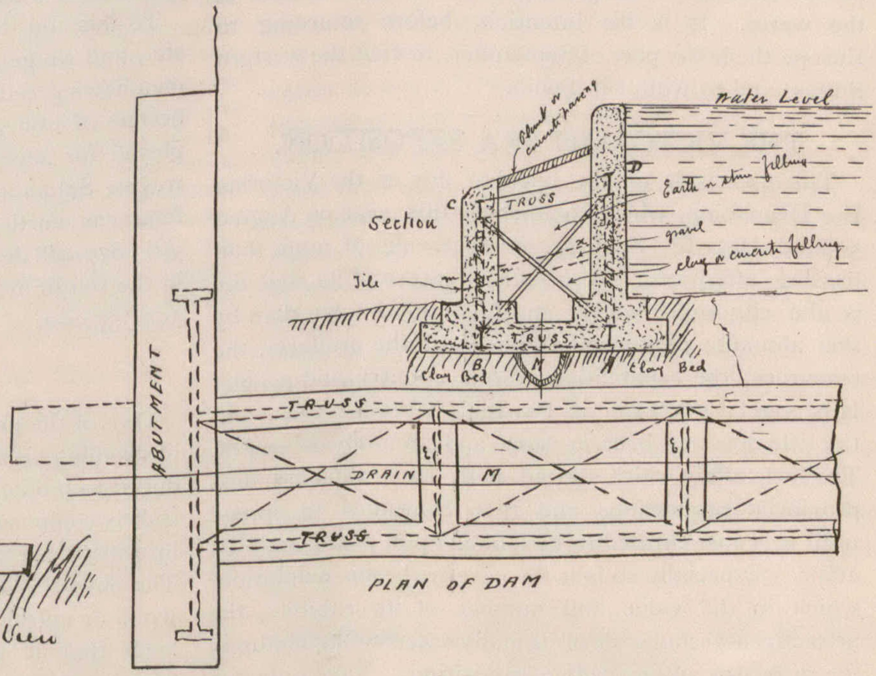

DIAGRAM 3.
