As we have only ratios, this will be unnecessary, and the arc shown is the true theoretical curve for a series of independent columns.

If we assume these columns replaced by blocks of masonry we will have Fig. 23.

In an actual wall we would have shear operating in all these lines o—e, with power to compel any two adjoining columns to act in unison, the result being that decrement of length in A^6—P^6 would affect A^5—P^5, and in A^5—P^5 would affect A^4—P^4, and each and all of these would affect A^3—P^3, A^2—P^2 and A^1—P^1, and in this way additional loads would be thrown on columns A^3—P^3, A^2—P^2, and A^1—P^1 with the result that the actual versed-sines would be reduced at P^7, ^{6} and ^{5}, and increased at P^3, ^{2} and ^{1}, so as to give a movement that would be represented by a straight line with a maximum movement at the top.

Shear acting alone could not do this, but the face of the wall would act as a beam, assuming its own necessary depth, such as x—y, and in this way distribute loads from P^6, ^{5} or ^{4} to P^3, ^{2} and ^{1}.

It will be clearly seen that the columns at P^1, ^{2} or ^{3} are not provided for any loads but their own, and any increase will put tension in the fibres connecting A^1 with A^2, A^2 with A^3, etc., which would be undesirable, and it would be better to load the point A sufficiently to take up the extra load, but it is impossible to determine what this extra load is.

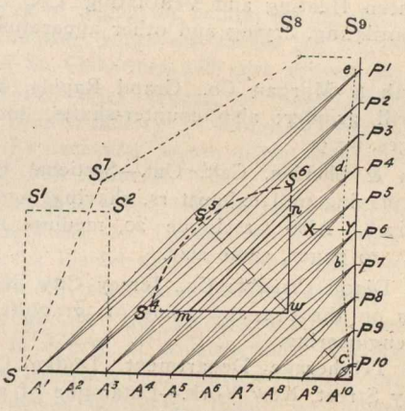

FIG. 22

If we take out the centre of the wall, as shown by the triangle m n w, we can more definitely determine the loads on A^1, A^2 and A^3.

In loading A^1, A^2 and A^3 we will be erecting another wall S, S^1, S^2, somewhat similar to the face wall.

This is additional proof that considerable height of wall is required at the down-stream face of dam, and is in line with arguments adduced on pages 14, 16, 50 and 51.

A curved line through S, S^2 P^1, with a hollow space S^4 S^5 S^6, would evidently give a stable structure.

The line may also take the course S, S^7, S^8, S^9, Neither of these sections need exceed in area the amount of wall contained in the original triangle A^1 P^1 c, but will be in all respects very much better and stronger.

Returning to Fig. 1, we find that we have resilience of

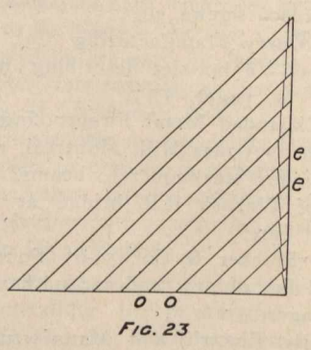

FIG. 23

the sub-base still to consider. This may be infinitesimal, but it must be borne in mind that the fact of a mass of solid material having resilience has been proven, and our plain duty is to search for any movement that may result therefrom.

The first apparent fact in connection with the sub-base, then, is that it is more heavily loaded towards A^{10} than towards A from weight of mass.

It will be similarly treated under loading from pressure of the water, but if A^1, A^2 and A^3 receive more than their share of pressure from P^1, P^2, P^3 from causes spoken of above, then we may assume extra decrement of length of sub-base under A^1, A^2 and A^3. Also, if tension be set up in the lower horizontal fibres so as to increase the distances between A^1 and A^2, A^2 and A^3, etc., then the position of the base of columns A^1—P^1, A^2—P^2 having been moved, the top ends of such columns will move in sympathy therewith. These unknown and apparently infinitesimal movements may all be factors in making up the total summation of movement known to occur in high masses of masonry.

In this investigation the overturning movement is, for the purpose of discussion, not taken into account.

(To be continued.)

MUNICIPALITIES AND THE TELEPHONE.

The Union of Canadian Municipalities is co-operating with the House of Commons Telephone Committee by obtaining statistics that will be of service to the committee. Municipalities are being requested by the Union to answer the following questions:

Have you a municipal telephone system? If so, please send all particulars of capital cost, operation, extent of business, progress, satisfaction, and all other useful particulars. What telephone company or companies are operating within your municipality? Have you any agreement with the company? If so, what are its terms? What is the annual charge by the company (a) for business phones, (b) residences, or (c) party-line services? Any other charges? What is the annual contribution of the company to the funds of the municipality? Does the company furnish free phones for corporation use? If so, how many? When does the franchise expire? Is the company subject to any right of the municipality as regards placing of poles and wires, character of poles, conduits, opening up of pavements, etc. If so, what are the facts? If there are more than the two systems, what are the facts? Is your municipality interested in telephone questions? If so, why?

The offices of the Union are at 107 St. James St., Montreal.

ENGINEERS' CLUB OF TORONTO WILL NOT AMALGAMATE.

The following resolution, recently passed by the Engineers' Club of Toronto, is self-explanatory:

Moved by F. L. Somerville, seconded by A. B. Barry: "That the Canadian Society of Civil Engineers be requested to withdraw the proposition to constitute the Engineers' Club of Toronto as the Toronto Branch of the Canadian Society of Civil Engineers (conforming to the methods and by-laws of the Society). Should, however, a local branch of the Civil Engineers be formed in Toronto, and the Club's privileges be asked therefor, the same to be granted upon equitable terms, to be agreed upon at a special meeting of the Club called for that purpose."—Carried.

LITERARY NOTICES.

Modern Gas Engines and Producer Gas Plants.—By R. E. Mathot, M.E.; authorized translation by Waldemar B. Kaempffert. 300 pages, 7x9; 175 illustrations. New York: Norman W. Henley Publishing Co., 132 Nassau Street. Price, $2.50.

This book is a guide for the gas engine designer, user and engineer in the construction, selection, purchase, installation, operation and maintenance of gas engines. Above all Mr. Mathot's work is a practical guide. Recognizing the need of a volume that would assist the gas engine user in understanding thoroughly the motor upon which he depends for power, the author has discussed his subject without the help of any mathematics and without elaborate theoretical explanations. Every part of the gas engine is des-