THE "INVERTED ARCH."

TORONTO, August 20th, 1889, Editor Canadian Architect and Builder.

DEAR SIR,—Will you kindly give me a little information on the subject of "inverted arches?" As an amateur, I have been rather taken with the principle of this feature of construction, but my ideas on the subject received a rude shaking up recently when, in passing along Front street, at the north west corner of Front and Yonge. I came upon the basement walks of some rather large looking building that possibly you may have noticed some time, and which a little boy informed me was for the Board of Trade.

You must excuse me if you find it difficult to understand me, because your technical terms are rather hard for an amateur to remember, but I will try and describe as briefly as possible what I saw. There were some big upright piles of brickwork measuring about 7 feet in front. I suppose you would call them "piers" very likely, and these things were about 7 feet part. Well, between these, low down, was, and I suppose is, for that matter, the "inverted arch." which, according to my preconceived notions, ought to distribute a certain amount of the weight of the piers along the foundation. "Well," thinks I to myscelf. "devil-abit of weight will those things distribute." and then it occurred to me that perhaps I was wrong and the arches right, and when a workman told me that the architect was from some place in the States, and his name was Jimmy somebody, I for-



get what, I thought it would be to my peace of mind to find out from someone hkely to know, whether I was right or wrong in my ideas. Now I heard of your paper through a triend, and he told me you know all about this kind of thing, and that if I wrote to ask you, you would give me an answer in your next month's paper. I shall look out for it, I can tell you, for either I am wrong or else that blessed building will be very weak on its pins.

Now these arches, Mr. Editor, are made of (if I remember rightly) about four thicknesses of half bricks, ruther loose, with about an inch between each brick, filled up with what I took for mortar. The arch goes right through the wall, of course, from front to back, or back to front, I am not sure which way you would sny, and then funnily enough, upon the upper curve of the arch which, poetically speaking, I may call its "bosom," stood a pile of brickwork filling up between the two piers. I'll get my son to try and draw the thing as it is, and then as I thought it ought to be, for I'm blessed if I don't think I'm right after all. Well, as I looked at the thing, I said to myself, if that mortar was to take it into its head to get squeezed out from between the brick-ends by reason of the brickwork above pressing down upon it, the part of the pier on the arch at each side will go down about two inches, while the middle of the pier which does not touch the arch will stand where it is put ; and all that brickwork lying in the "bosom" of the arch will only help to add to the discomfort of the poor crushed arch bricks, which, if it was not for the brickwork below, would certainly give way under it. As I was told that the drawings for all this work came from the architect perhaps this is the American way.

This, which is coming now, is the way I thought it ought to be done in. To stop the pressure of the piers the arch ought to be in some way proportioned to the width of the piers, and the joints ought to be very fine so that there might be no squeezable stuff, only the hard bricks, and for this coment would be better than mortar. If the arch only supports a narrow bit of the pier on each side, the rest of the pier must be standing on the foundation, and part of each pier would then be on a different foundation to the other part, which I was thinking was not the object of the arch. I was



told once by an engineer, --I don't mean the driver of an engine but the man that, so to speak, drove the men that drove the engine, or drove the men that made the engine (something like that his work wns)--well, he told me, that if it was not for the gravity of the bricks, that was, he said, the drawing of them towards the earth, one might build piers with an arch at the top and an inverted arch at the bottom, right up in the air of the ground, because you see the weight of one pier comes down to the arch, runs round it and goes up the other

pier. and the weight of the other pier counterbalances it, and so there's no weight at all in this method of construction. I could not understand that, and I told him that if it was not for the gravity of the bricks he spake of, it should have thought them uncommonly *risible* things; but perhaps you will know what he meant.

If one wanted very much to pile on the bricks between the piers, would it not be better to make them stand on a good thick stone, or on another arch turned right way up leaving a round or oval space between, according to the form of the arch? Well as to the thickness of the arch, or the number of hall brick or brick rins, that depends on the width of the pier on "face," and the length of the "skew-backs" (is not that what you call them?) together should in my humble opinion be made to balance the width of the centre part of the pier—that is, I mean, they should bear in their length a relation similar to that borne by the width of the pier to the width of the space.

Another point which is of importance I should have thought, would be the equalizing of the weight of the piers as much as possible, and a good way to bring this about is to put

a stone as my son has shown in this sketch at the foot of the piers against which the skewbacks of the arch would abut. You see by this means, the pressure of each pier would be conveyed by the arch to the next pier, and along the stone to the next arch, and so on all along the building; but of course, each pier having an equal weight. the pressure of the pier mentioned would meet the other. and would be stopped and counterbalanced by the other. Now then you will see my point without your glasses-if the arch is made in mortar and with wide joints, with the weight of half of each of the piers on each side of it, that mortar is going to have a bad time. It will be squeezed



OR BETTER STILL, THIS WAY.

out and the bricks will close together and the piers will move. I should have said that my stone ought to be pretty thick from top to bottom, because otherwise I should think it would be likely to crnck from the lower part of the "skew-back" upwards.



Picase tell me what you think of my son's drawings at the same time. He calls the last one a "perspective view" and that shows how the stone above the "skew-backs" goes right through the wall, like the arch, which is what I wanted you to understand.

I hope you will be able to find time to write me an answer, and waiting for it. I am.

Yours truly,

AMATEUR.

[Answer. We are very pleased to tell you that your suggestions as to the construction of the inverted arch are quite correct, and you are right in your opinion of its importance and its functions. The inverted arch is a dangerous thing to play with, because unless it is constructed with the greatest care, it is worse than useless-it becomes a trap. Many men employ it, and it looks simple enough, and so it is, but to those who do not understand its principle and make use of a clumsy substitute for it, it is a delusion and a snare ; in fact what they think is an inverted arch is nothing of the kind and will never answer its purpose. We are sorry to hear that the arches at the particular building you mention have been roughly put in, but as it is all covered up now and out of sight, we have been unable to see them for ourselves and we hope the architects noticed the defects and had them remedied. But the proof of the pudding, you know, is in the cating. When the piers are built up, if the arch is not strong enough to support them, defects will very soon appear. Do not be disappointed when we say that we can hardly give a fair opinion of your son's draughtsmanship from the few specimens before us, but if he will call and show us some more of his own work we shall be pleased to tell you what we think of them,-THE EDITOR.]

According to Indian Engineering the tensile strength of a rope is only one third when it is wet of the strength of same rope when dry. When saturated with grease or soap the strength is even less, the lubricants permitting the fibres to alip on one another more readily. Hemp rope contracts greatly when wet, a twenty-five foot tope contracting to 24 feet.