closed faced timber work. It was next employed *en masse* for abutments and bridge piers that stood divested of all outer shield or covering; also for retaining walls exposed in like manner, and later for the building of arched bridges. Examples of abutments and piers of concrete work can now be seen in every county in the Province. The retaining wall is built with alternating arched panels and buttresses. It stands in front of the Provincial Building in the city of Halifax. An arched concrete bridge of two small spans of fourteen feet each, is built from the shingle sand of the sea beach at Cow Bay, near Halifax, and there is an oblique arch of 30 feet span at Acadia Mines, Londonderry. The author is aware that these are small examples to refer to, still it should be considered that the aim of the paper is merely to bring to the notice of the Society how exposed surfaces of concrete have so far withstood the climate, and to what extent concrete may be relied upon as a substitute for masonry.

The concrete work forming the arches was built in courses radiating same as dressed stone in courses for arch work, so as to prevent any horizontal tendency to set flakey as the work went on. Each course was moulded on the lagging of centers, by securing theron a board in the true radial line between soffit and extrados, and the concrete was placed therein in its final position to form the course. When sufficiently set the board was removed and placed again for the next succeeding course. A setting templet, the same as masons make use of when laying vousseirs or arch stones on centres, gave readily the inclination of the board. The foreman in charge was cautioned not to allow any course to be partially filled up and allowed to set before the whole was completed. In this way each course was expected to have the same consistence throughout. The concrete used in the arches was of the same admixture as described in this paper as "fine concrete." The writer, however, considers that rubble concrete can be made use of for arched work as advantageously and far more cheaply, if the rough stone concrete and grout are conformably and proportionately equalized and adjusted.

The symptom of failure in the piers of one bridge already referred to, occurs in a tidal stream at Petite Rivière, in Lunenburg County. Two piers of concrete support an iron bridge of 100 feet span. At low tide there is not more than one foot of water. Ordinary neap tides rise five feet, springs generally about six and one half feet. The outer shell or matrix of fine concrete, where exposed to the tidal fluctuations, exhibits fissility, and will crumble at a slight blow. Above high tide it is solid and impervious. Two fragments cut from pier above and below tide are exhibited for examination. The bridge was erected in the summer of 1885, about eighteen months ago. Although erected by a careful foreman and with the usual component parts of material for submerged work, viz., two of gravel, one of sand, and one of cement, it never attained the same degree of coherence as other work of the same character, and it has now become so friable as to point to the necessity of renewal at no very distant day. The concrete work in fresh water streams, as well as in salt and brackish water, had already given such evidence of permanancy that one was loath to acknowledge a failure, or with M. Vicat, ascribe the result to the presence of magnesia in the sea water, which acts injuriously on the lime. In this instance the failure cannot be attributed to carelessness in the selection and admixture of the concrete ingredients employed in building, because the disintegration and brittleness extend upwards only as far as the tides reach. Above that level it is compact and firm. There is no sulphur or sulphate of lime in the neighborhood. The gravel and sand are from the slates and quartzites of the Lower Silurian or Cambrian formation, the auriferous rocks of Nova Scotia.

Now Portland cement being a mixture of chalk and clay, which is supposed to be burned to the extent of driving off the carbonic acid thus becoming a hydraulic lime, nevertheless through imperfect calcination may not form a cement which would resist the action of salt water, although it might succeed well enough in fresh water. Again, if there was any sulphate of lime in the clay it would not at once enter into combination with the lime, and would be likely to cause the disintegration experienced at Petite Rivière.

If the material from which the Portland cement is made was under burnt or imperfectly decarbonated, and contained an excess of free or disengaged lime, which, not being united with the silica and alumina, would absorb moisture largely, and would fall to pieces in water; in this case, says Mr. G. F. White, the silicate of lime and alumina had not been formed, and the result would be an incomplete cement characterized by a light yellow color, moderate specific gravity, immediate setting, and imperfect induration.

Three briquettes of the cement employed at Petite Rivière bridge, after seven days' setting gave a tensile test of 329½, 358, and 396 lbs. respectively to the square inch. The color and gravity were not noted at the time. The cement was quite fresh.