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## Canadian Society of Civil Engineers.

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### AN UNRECORDED PROPERTY OF CLAY.

(By H. J. CAMBIE, M. Can. Soc. C.E.)

To be read December 4th, 1902.

Some years ago the writer found that ordinary clay, such as used in the manufacture of bricks, and commonly spoken of as plastic clay, would, if dried sufficiently to remove nearly all its moisture, lose its cohesive properties, and would, if water were afterwards applied to it in considerable quantities, become an almost liquid mud. On the other hand, clay which has not been so dried will not absorb any more water, and will lose only some of its outside particles in the washing. The writer has been unable to find any reference to this property of the material in question in the text books at his disposal.

It came to his notice under the following circumstances:—

The main line of the Canadian Pacific Railway runs for nearly 150 miles through a portion of British Columbia, situated between the eastern slope of the Cascade Range, and the western slope of the Gold Range. There is no regular rainfall over this area, and crops cannot be grown without irrigation. A good many thunderstorms do occur in the summer, but only over very limited areas, and the rainfall from them runs away quickly without soaking into the ground to more than a depth of one or two inches, and is dried off

in a few hours by the rapid evaporation incident to the region. These characteristics are especially pronounced in the central part of the area mentioned. The farming lands are situated on benches, sometimes two hundred feet or more above the level of the railway, which runs along the valley of the Thompson river, and at no great distance from the bank. Hay is the most valuable crop raised, and is used to winter cattle, and, with sufficient irrigation, several crops of it can be obtained in each season. Water has, therefore, been lavished upon the fields for nearly forty years, and has, in the opinion of the writer, been the cause of numerous land slides, one of the greatest of which occurred in 1881, when about 100 acres slid forward for nearly a quarter of a mile, falling in that distance about 300 feet, and completely blocking the Thompson river for about three days by forming a dam seventy-five feet or more in height. Many similar slides on a smaller scale have occurred since that date, but, generally, with slower movement and less disastrous effect. One of these is of large area and includes a portion of the railway line; it has required constant watching and has been a cause of much anxiety to the railroad officials, because, although its forward progress has been slow, it has begun to move, year after year, at a date about three months after the beginning of the irrigation season, and has continued moving for about the same period of time. In 1886 the Canadian Pacific Railway Company took legal proceedings against the parties irrigating the fields above this slide, and it devolved upon the writer to furnish the legal advisers for the Company with evidence to prove that the slide was due to the action of irrigation water. An investigation was made by the writer in consultation with Messrs. Stanton and Schuyler, who were employed by the Company, as experts in hydraulic engineering and, particularly, in irrigation practice, and with Mr. H. J. Warsap, manager of the Canadian Pacific Railway Portland Cement Works at Vancouver, an expert in clays. At the slides were found beds of clay so exceedingly dry and hard as to have the appearance of soft sand stone, and still retaining the marks of picks in the slopes of railway cuttings, where dressed many years ago. When a block of this dry indurated clay was placed in a soup plate and water dropped upon it the clay absorbed 50 per cent of its own weight without any change of form or other visible effect, but when it had absorbed about 60 per cent of water, its structure completely collapsed, and it became as fluid as water. This was considered by us as conclusive

evidence that the irrigation water which had been poured for weeks and months on these beds of clay had been the cause of the slide, but, in court, this argument was met by a demand from the opposing counsel to be told why the bluffs of this material, which were washed at their base by the river, did not disintegrate and slide. Several ingenious theories were offered to account for this, but were not convincing, and the writer now thinks that it was because these bluffs had never been dried out below high water mark, and the material in them, therefore, did not possess the property of soaking up water and of finally collapsing. In all probability the jury was influenced by the evidence that no slides had occurred before the commencement of irrigation, and that there was irrigated land in the rear of each slide.

A year or more after the trial, the writer, while experimenting with Mr. Warsap on some clay, which had been dried for other purposes, found that it gave the very same results as the dry clay from the interior of the Province. This led to experiments with other clay, and it was found that they all lost their cohesive properties when the moisture was removed.

It is probable that this property of clay has been the cause of many of the landslides which have occurred this year in the valley of the Oldman and Belly Rivers, between Medicine Hat and the Crow's Nest Pass, for there has been an exceedingly heavy rainfall over these valleys during the year for the first time since they have become known.