The experiments on double-angle members show that such a member with a stiff end plate is an excellent type in practice, the stress being almost uniformly distributed at the central section, but, unfortunately, it seems to be impossible to predict exactly what the distribution will be in any particular case.

The chief conclusions to which the paper leads are:

1. The only practicable experimental method at present available for investigating the distribution of stress in built-up members is by means of some form of extensometer, and the simplified mirror extensometer used in the tests described is very suitable for this purpose.

2. The assumption of a planar distribution of stress is justifiable in such members as are considered here, except perhaps close to the end connections, and the ordinary theory may therefore be applied to an analysis of the distribution of stress in these members.

3. In single and double-angle tension members connected at their ends by means of rivets to wide and rigidly held gusset plates the stiffness of the gusset plate in its own plane has a considerable effect on the distribution of stress in the member, there being in every case a particular stiffness which will give the least maximum stress in the member for a given load.

4. In such members lock angles are of very little, if any, value for the purpose either of giving a more equable distribution of stress in the member or of increasing the effective length of end connections.

5. A slight change in the line of application of the load to the gusset plates does not materially affect the distribution of stress in the member, except possibly close to the end connections.

6. The experiments on double angles bear out the theory that such members do not act as a single piece bending as a beam.

COMPLETION OF THE TRANSCONTINENTAL LINE OF THE CANADIAN NORTHERN RAILWAY SYSTEM.

RECENTLY the first train passed from Toronto to Vancouver over the rails of Canada's third transcontinental railway, making the trip in 91 hours. Taken altogether, the mileage of the C.N.R. is now approximately 10,000 miles, nearly 6,500 miles of which is in the West. Over 5,500 miles have been constructed since 1910, including about 2,000 miles of main line. It was in 1911 that the contracts were let for the greater part of the transcontinental and most of the main line between Montreal, Que., and Port Arthur, Ont., and between Edmonton, Alta., and Port Mann, B.C., has been constructed since that time, work having started almost simultaneously in Ontario and British Columbia. The last spike in the section between Sudbury and Port Arthur was driven on New Year's Day, 1914. But with its eastern lines joined to those in the west at Port Arthur, there remained to be completed a line from Edmonton to Vancouver, before the Canadian Northern could achieve its full status as a transcontinental system. The distance of the located line running west from the capital of Alberta through the Yellowhead Pass, and down the valleys of the Thompson and Fraser Rivers to Pacific tidewater at Vancouver, was approximately 775 miles. Construction commenced in British Columbia in July, 1910, and was proceeded with simultaneously on the several sections. By the close of 1912, 124 miles of grade had been built, and 28 miles of steel laid. During the following year the grade had been increased to 275 miles and the mileage of steel in place to 75. On December 31, 1913, the total of constructed grade was 361 miles, and that for trackage 239 miles. In the meantime the rails had been extended west from Edmonton through the Yellowhead Pass to a point six miles past the British Columbia boundary line. The work proceeded during 1914, despite the outbreak of hostilities in Europe and the actual connection of the rails of the entire lines was effected near Basque, a small station 182 miles west of Port Mann, on the 23rd of January, 1915. In all, 19 large steel bridges were constructed. At Yale, there is a tunnel 2,075 feet in length; at Black Canyon, one, 1,320 feet long; and at Battle Bluff, a third, 2,887 feet from portal to portal. The heaviest grading work occurred between Yale and Boston Bar on the Fraser River.

The Canadian Northern transcontinental system from Montreal to Vancouver will go into full operation at an early date. The road claims, with undoubted weight, a great advantage in possessing the easiest gradients of any line of similar national importance on the continent of North America. The first road in America to cross the Rocky Mountain barrier was the Central Pacific, and its line was carried through to the coast with grades of 113 feet to the mile. Reductions were made by the Great Northern and the Northern Pacific in the extent to which this maximum was used, but not in the maximum itself. The first transcontinental in Canada, the Canadian Pacific Railway, was built with heavy grades, necessitating a subsequent enormous expenditure in grade reduction. The next line in Canada to construct to the coast, the Grand Trunk Pacific, succeeded in obtaining maximum grades of 52 feet to the mile. The Canadian Northern, however, climbs the eastern slopes of the Rockies with grades of 26 feet to the mile. The grade is continuous in its fall for the entire 500 miles from the summit of the Great Divide to the Pacific Ocean, and nowhere does the maximum against eastbound traffic exceed 37 feet to the mile. For 450 miles out of the 500 the maximum is 26 feet against eastbound and practically nil against equipment moving to the coast. The difficulties from a standpoint of operation, therefore, are not any greater in the matter of grades than would be expected in Ontario. Nature provided the means of securing an easy grade in the Fraser River, which takes its rise in the Pass. To have followed that stream, however, would have entailed a very considerable sacrifice in mileage. The Canadian Northern determined to achieve the easy grade by a direct route. So the line leaves the Fraser a few miles west of the summit, surmounts a subsidiary divide of low elevation and reaches the North Thompson River, a tributary of the former, which it follows to the confluence of the two at Lytton, from which point the Fraser is followed to the coast.

Construction of railways capable of economical operation was a problem which was comparatively easy of solution in the southern and central portions of the provinces of Alberta, Saskatchewan and Manitoba. Although there were sections in the west where the engineers of the Canadian Northern were compelled to locate lines through territories fairly well populated, a large portion of their work was simplified because the railways were developmental in character and built through the country not closely settled.

It was between Port Arthur, Ottawa and Montreal, where difficult problems had to be solved, before the 26-feet-to-the-mile grade which had been demanded was secured. Four years were consumed in exploration by