Eliminating the Tower Grove Grade Crossing at St. Louis

SYNOPSIS—This complicated crossing involved two intersecting streets (with car tracks), two groups of steam railways, and spur tracks to several industries. The railways were lowered and the streets raised, crossing the tracks by an X-shaped viaduct of reinforced concrete, the two legs of this being of different design. The work was done by the two railways and was carried on without interrupting street traffic. One railway did all its work with its own forces, while the other let contracts for a part of the work.

The elimination of the grade crossings at Tower Grove is the most extensive of the works of this kind at St. Louis, Mo. It involved special problems and difficulties due to the location and the traffic conditions, as may be seen from the plan, Fig. 1.

Tower Grove Ave. and Vandeventer Ave. are two wide intersecting thoroughfares with car tracks and heavy street traffic. At their intersection they are crossed by the numerous tracks of the Missouri Pacific Ry. and the St. Louis & San Francisco Ry. The former has a suburban branch (to Oak Hill) which crosses the latter at grade, and both lines have spurs serving several industries. Each has a station at the crossing. There are about 56 passenger and freight trains on the St. Louis & San Francisco and 70 on the Missouri Pacific passing over the crossing every 24 hours, while the street cars number 519 in the same time.

Some years ago the city passed a grade-separation ordinance under which the railways would have had to lower their tracks about 25 ft., leaving the street level unaltered and throwing the entire expense upon the railways. The industries objected to this, as it would have made it impracticable to serve them by spurs to the ground level, and two of these industries obtained an injunction to prevent the railways from carrying out the work. It was finally decided by the State Supreme Court that, while the city had power to order grade separation, it had no power to compel the work to be done in the most expensive manner and in such a way as to interfere with the facilities enjoyed by the industries.

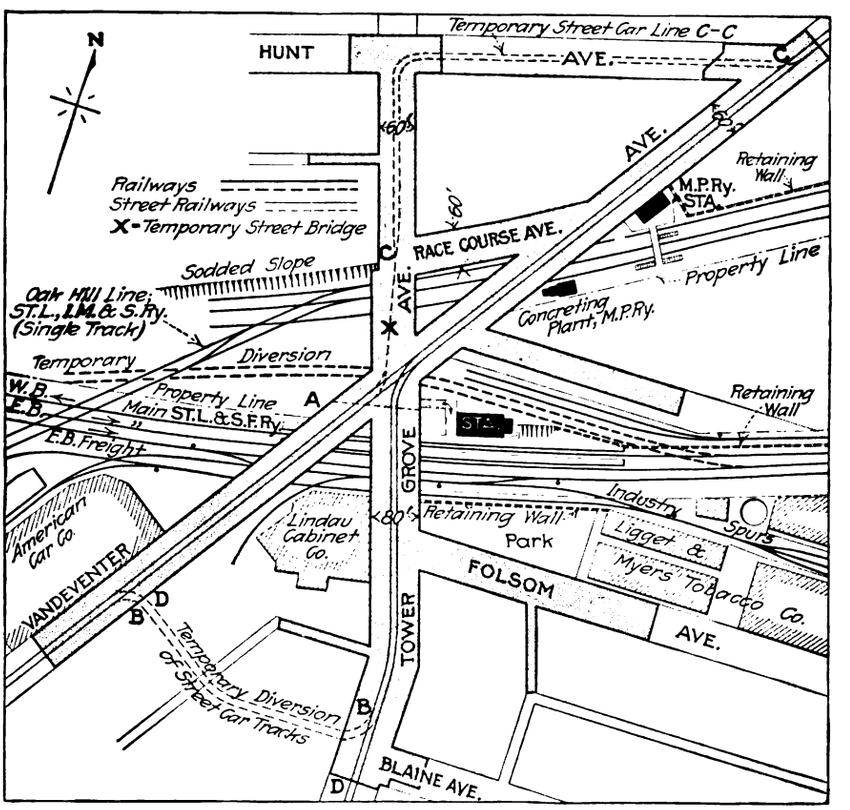

FIG. 1. PLAN OF TRACKS AND VIADUCTS AT THE TOWER GROVE CROSSING, ST. LOUIS, MO.

The layout of the Missouri Pacific Ry. tracks is tentative only. At present it has only the two tracks adjacent to the station, and a single track on the Oak Hill line. Additional tracks will be laid later

The railways had shown that a cheaper method would be to carry the streets beneath the tracks. After the above defeat the city prepared a compromise ordinance, under which the railway tracks were to be lowered 12 ft. and the streets elevated 13 ft., and providing that the city would assume the consequential damages to abutting property. This ordinance was accepted by the railways in 1913. Work was commenced early in 1914.

The general plans and the designs for the viaduct were prepared by the railways jointly and approved by the city authorities. The work is under the direction of F. G. Jonah, Chief Engineer of the St. Louis & San Francisco Ry.; C. E. Smith, Assistant Chief Engineer of the Missouri Pacific Ry., and C. E. Talbert, Street Commissioner. The engineers in direct charge are Perry Topping, Assistant Engineer of the St. Louis & San Francisco Ry.; E. S. Wonson, Bridge Engineer of the Missouri Pacific Ry., and L. R. Bowen, Bridge Engineer of the city's Street Department.

The railways pay all construction cost, amounting to about $600,000. This includes industry connections, no part of these being paid for by the industries. The city pays all consequential damages, as before noted, and pays also for the paving. At the north end the elevation for the viaduct approaches made it necessary to raise several buildings to the new grade. As this compelled closing some stores, etc., during the change, the city undertook to pay a portion of the rent in such cases. The street-railway company pays for its temporary track work and the shifting of the tracks, also the cost of track and overhead work across the viaduct. Each of the railway companies assumed the construction of that part of the viaduct over its own tracks, and the dividing line is shown at *A* in Fig. 1.

The ground is nearly level. The track depression extends for a distance of about 4500 ft. and reaches a maximum depth of about 16 ft. below the original level. The viaducts have a maximum elevation of about 12 ft. above the original level, or 9 ft. to the under side of the floor-beams, giving a clear headway of 22 ft. between rail level and the viaduct. It will be seen by the profile of the St. Louis & San Francisco Ry., Fig. 2, that the original crossing was a summit in the grades, so that the main line is improved by the lowering of the tracks, the grade through the depression being 0.75%. On the other hand, it introduces difficulties in the industry-track connections, for which grades of 1.85 and 3% are required to reach the surface.

The St. Louis & San Francisco Ry. did its grading, including steam-shovel work, with its own forces. The concrete work, including this railway's portion of the viaduct, was let to the Jarrett-Richardson Paving Co., of Springfield, Mo., while the additions and improvements to the passenger station were let to James Stewart & Co., of St. Louis.

During the excavation for the new grade, the two main tracks of the St. Louis & San Francisco Ry. were diverted to pass around the station (at the original level) as shown by the dotted lines in Fig. 1, thus facilitating both the traffic and the construction work. Fig. 3 shows this cut in progress, looking west from the crossing, with the temporary tracks at the right. The Missouri Pacific Ry. branch line is shown shifted beyond its original location and carried by a temporary trestle. With the lowering of the main lines this branch was replaced on its original location, but at the new grade.

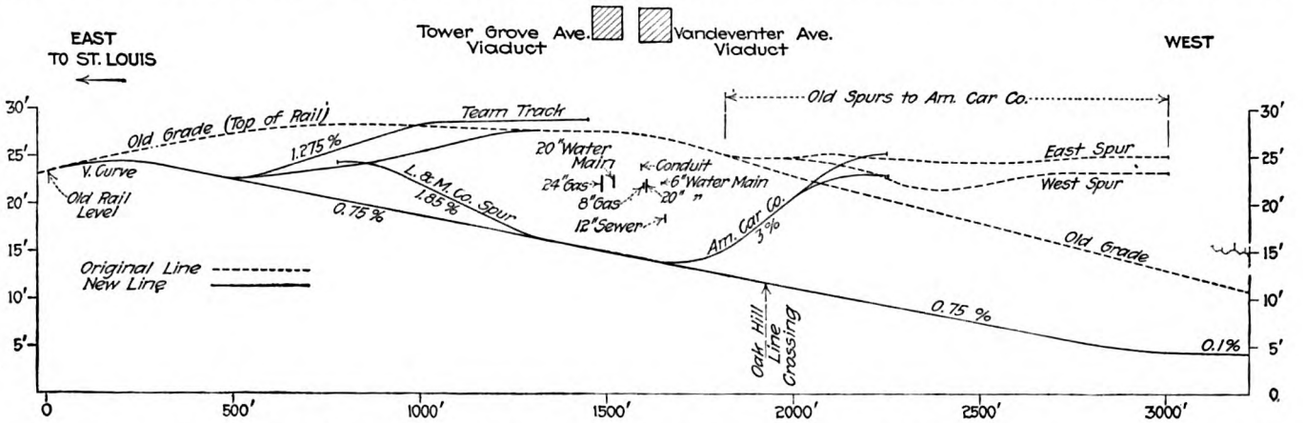

FIG. 2. PROFILE OF THE ST. LOUIS & SAN FRANCISCO RY. AT THE TOWER-GROVE CROSSING, ST. LOUIS, MO.

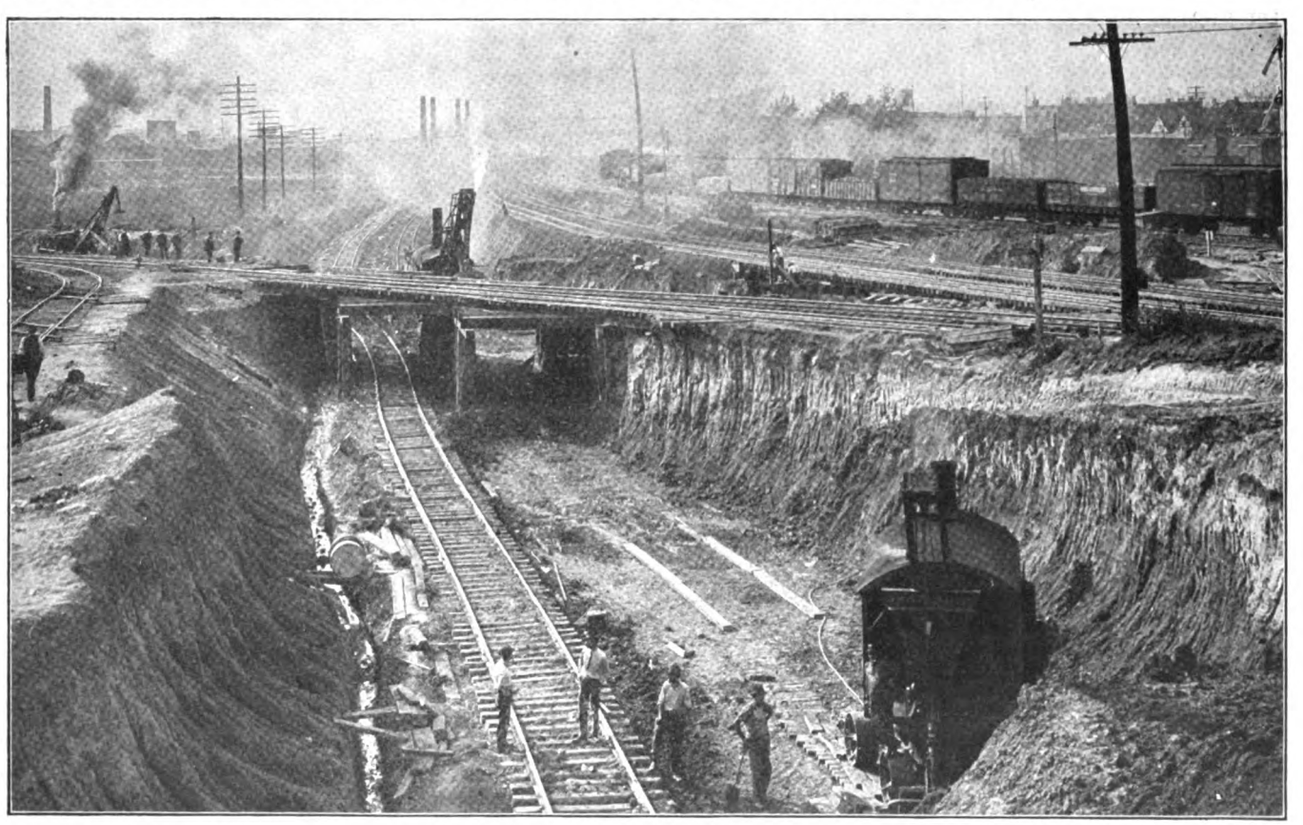

FIG. 3. LOWERING TRACKS AT THE TOWER GROVE CROSSING, ST. LOUIS, MO.

The view is looking west from the Vandeventer Ave. viaduct. The cut is for the St. Louis & San Francisco Ry., traffic being diverted to the two temporary tracks at the right. Beyond the temporary tracks is the main line of the Missouri Pacific Ry., while the line crossing the cut is the Oak Hill branch of the St. Louis, Iron Mountain & Southern Ry.

Fig. 4 shows the work in progress for the St. Louis & San Francisco Ry. at the south end of the Vandeventer Ave. viaduct. The foundations of the viaduct were built in trenches before the general excavation was made. The remaining high-level track at the right is an industry connection (now lowered). Beyond the viaduct may be seen the temporary bridge carrying Tower Grove Ave. across the cut, at the original ground level. At the deepest part, the cut has retaining walls, and on the east side an incline will lead up to a double-track paved team yard at the present ground level, as shown in Fig. 1. The Tower Grove station also will remain at the present level, with stairways to the train platforms and to the viaduct.

On the Missouri Pacific Ry. the restricted space prevented diversion of the tracks, and running tracks had to be kept open while a preliminary cut was made for the first two tracks at the new grade. These were adjacent to the station and had a double-track junction with the single-track Oak Hill branch. The limited traffic on this branch did not warrant the cost of a diversion to secure an overhead crossing of the St. Louis & San Francisco Ry., but an interlocking switch and signal plant will be installed for the protection of traffic over the grade crossing.

South of this double-track cut, trenches were made for the foundations of the viaduct. The bents were built on these and the deck then built, leaving for the future the excavation of the ground to widen the cut for additional tracks. The Tower Grove station (M. P. Ry.) was raised to the level of the viaduct approach and placed against the sidewalk line, as shown in Fig. 1. Later, a bridge will extend from the station across the tracks, with stairs to the train platforms. The excavation of the cut was interfered with by sewers and water and gas mains, and the change of grade of the tracks was complicated by the necessity of maintaining a connection with the Oak Hill branch. The Missouri Pacific Ry. did all its portion of the work (including the viaduct) with its own forces.

In the concreting, the Missouri Pacific Ry. employed a stationary mixer plant with tall elevator tower and inclined chutes to the forms. Smaller intermediate towers supported the long runs of chutes. The plant was placed first near one end of the viaduct and later on the ground in the angle between Vandeventer Ave. and Park Ave. (Fig. 1). The contractor for the concreting on the St. Louis & San Francisco Ry. used a small portable mixer which was shifted as the work progressed. In building the retaining walls and viaduct bents, this outfit stood on the ground and had attached to it a truck with a telescopic elevator tower. For concreting the deck, the portable mixer was placed on the upper level and discharged the concrete directly into wheelbarrows for delivery to the forms.

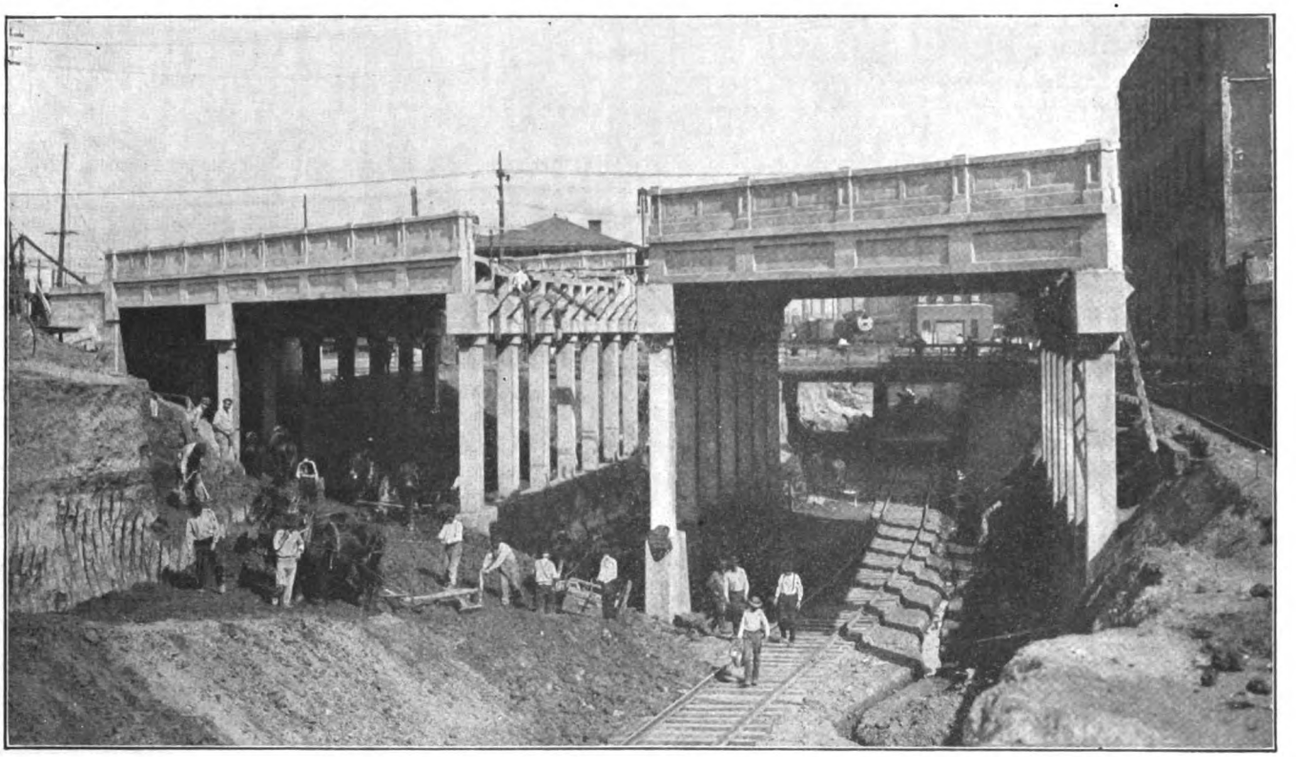

FIG. 4. BUILDING THE VIADUCT OVER TRACK DEPRESSION AT TOWER GROVE, ST. LOUIS, MO.

This is the five-span section of the Vandeventer Ave. viaduct over the St. L. & S. F. Ry. The foundations and bents were built in trenches, and the main excavation was done later, traffic being diverted to a temporary track

TYPE OF VIADUCT DESIGN

The viaducts are of reinforced concrete, with bents supporting a slab and beam deck. Together they form an X-shaped structure, with a solid fill at the intersection (between the two railways). The approaches and lateral connections are solid fills with concrete retaining walls. Each of the four sections of the viaduct has five spans, alternately long and short, with ¾-in. expansion joints over two of the bents (Fig. 5). At these joints the ends of the slabs have zinc plates which rest upon other zinc bearing plates on the cap girder of the bent. Concrete trolley poles are used.

The bents have square columns and footings spaced 12 ft. c. to c., with a guard wall extending between the

columns to a height of about 5 ft. above the rails, to protect the structure in the event of a train being derailed beneath it. The columns are capped with a heavy girder, on the faces of which are formed skewbacks for the floor-beams. In the Tower Grove Ave. viaduct, which is at right angles to the tracks, the floor-beams are

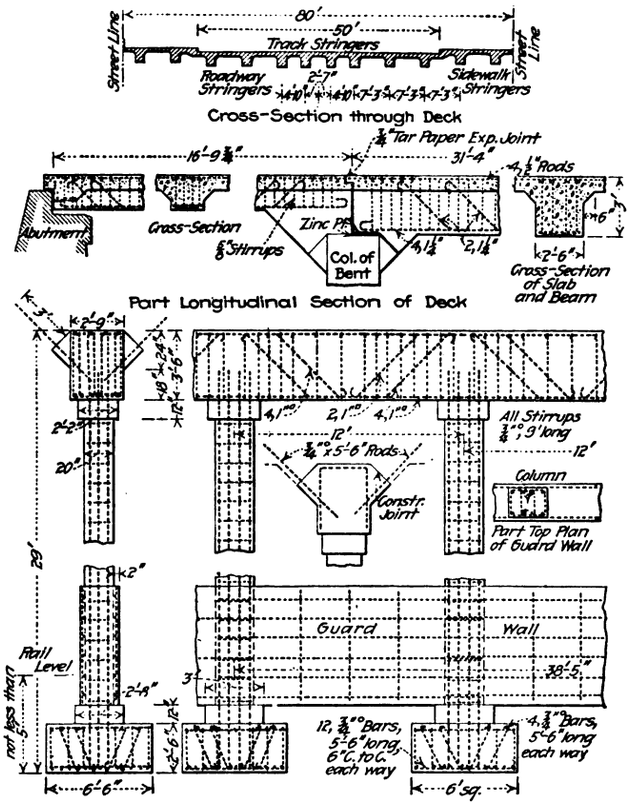

FIG. 5. THE TOWER GROVE AVE. VIADUCT

parallel to the line of the viaduct and are spaced to give two beams beneath each street-car track, as shown in Fig. 5.

On the Vandeventer Ave. viaduct, however, which makes a skew crossing with the tracks, the floor-beams are diagonal to the deck, as shown in Fig. 6. In this case, the ends of the beams and deck slabs are carried by deep facia girders, which are not required in the Tower Grove Ave. viaduct. It will be seen that for the longer skew spans (46 to 55 ft. long on the skew) steel facia girders are used, but these are incased in concrete so as to harmonize with the remainder of the structure.

HANDLING STREET TRAFFIC ACROSS THE WORK

One of the difficulties in construction was the necessity of keeping the streets open for pedestrians, street cars and vehicles. It was proposed at first to stop the cars at either side of the crossing, and let passengers walk across, placing temporary footbridges over the track-depression cuts. This would have been dangerous on account of the track crossings and would have caused much confusion owing to the different lines of cars that run on these two streets.

The car tracks were maintained therefore, and the temporary bridges over the cuts (which were built by the steam-railway companies) were made large and strong enough to carry the street cars. The bridges had to be shifted three times as the work progressed, so that very sharp curves had to be fitted for the track connections. Extra watchmen and policemen were provided to control traffic movements over the crossing, as long as the steam cars, street cars and other vehicles were operated on the same level. During the construction of the south end of the Vandeventer Ave. viaduct, street cars were diverted to the Tower Grove Ave. surface line by a temporary connection through property owned by the street-railway company. This is shown at *BB*, Fig. 1.

Later on, with the north end of Tower Grove Ave. viaduct built and the south end of Vandeventer Ave. also built, a timber bridge was built somewhat higher than the viaduct level, so that all street cars and vehicles could be carried above the work. This eliminated the grade crossing entirely, but introduced steep grades for the temporary approaches. The street cars were then run on a temporary track laid on the paving along Hunt Ave. and the viaduct approach (*CC*, Fig. 1) to a single track over this temporary bridge, and then diverted again through the connection noted above, but with the curves reversed (*DD*, Fig. 1).

For controlling traffic over the single-track temporary bridge, a pole at each end of this track carried a box containing two groups of incandescent electric lamps. Half the lamps were red and the others white. These were controlled by a man in a cabin at the center of the

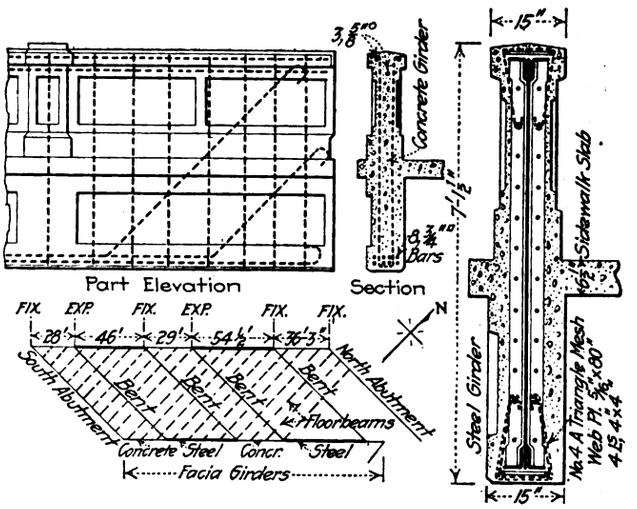

FIG. 6. THE VANDEVENTER AVE. VIADUCT (WITH FACIA GIRDERS SUPPORTING DIAGONAL FLOOR-BEAMS)

bridge, the movement of a handle causing the red lamps to be lighted at one end and the white lamps at the opposite end of the bridge.

United States-Canada Boundary Survey—Since 1908 surveyors have been at work marking the boundaries between the United States and Canada. The land surveys are nearing completion and the water lines of international lakes and rivers have been established. Charts of the international boundary, where the surveyors of the two countries have laid it down on maps of the water frontier, were on June 11 presented to Premier Borden by J. W. Stewart, head of the Canadian Hydrographic Survey. The Canadian Prime Minister, in receiving the charts of the boundary line from St. Regis Island in the St. Lawrence through Lakes Ontario, Erie, Huron and Superior to the head of the Lake of the Woods, referred to the happy relations existing between Canada and the United States as follows:

The fact that two great nations whose interests are concerned have chosen this method of bringing to a happy conclusion every possible difference is not only an example but a happy augury of future good relations. I trust that the work of delimiting the land boundary will be equally successful, and when this is done there will be set at rest every possible cause for dispute or controversy over the boundaries between the two countries.