Steel Spans a River

The seventh of June, 1879, ushered in a new era in railroad engineering and construction, in so far as bridges were concerned. That day witnessed the ceremonies celebrating the completion of the first steel bridge in America, the famous "Hay Bridge" of the Chicago and Alton Railroad, spanning the Missouri River near the little village of Glasgow, Missouri. Here history was made, the full import of which can scarcely be overestimated.

Many attempts had been made throughout the country to construct railroad and other bridges of iron, but such efforts had resulted in many dismal and sometimes disastrous failures. The constant vibration, the repeated strain of impacts, and the changes in temperature soon caused the iron to crystallize, followed by breaking, often without warning and where least expected.

The story of the inception, planning, and construction of the "Glasgow Bridge" and the many engineering feats connected therewith, must ever remain one of the great romances of the history of early American railroads. The bridge was designed by Edward Hemberle of the American

Bridge Company of Chicago and consisted of five Whipple truss spans, each 314 feet in length, with some three thousand or more feet of approaches — quite a sizeable undertaking even in these modern days of superlatives.

It was typical of the Alton (now consolidated with the Gulf, Mobile and Ohio Railroad) that it pioneered many innovations in railroading. Celebrating its centennial in 1947, it lays claim to having operated the first sleeping car, in 1858, and the first "diner", in 1868, and of having constructed the first all steel bridge, in this or any other country, in 1879. The Chicago and Alton Railroad Company was chartered in 1847, the first division from Springfield to Alton being completed in 1852. Building northward the following year, it reached Joliet, where a physical connection was made with the Chicago and Rock Island into Chicago. Soon thereafter the Alton company built directly into Chicago on its own right-of-way.

At first the company operated a packet line from Alton to St. Louis, handling both passengers and freight. This arrangement was later superseded by rail connection, the first railroad to join these two important cities. Somewhat later, the line was extended westward in order to open the State of Missouri to settlers, and by 1872 a line

was completed from Roodhouse (Ill.) as far west as Mexico, Missouri, with a branch to Cedar City, just across the river from Jefferson City.

On April 10, 1877, a meeting was called at the Southern Hotel in St. Louis, and a group of prominent citizens discussed the organization of a company to build an extension from the western terminus at Mexico to Kansas City, a distance of approximately one hundred and sixty miles. As a result, the Kansas City, St. Louis, and Chicago Railroad Company was incorporated. Financing was promptly accomplished, and with equal promptness, the prospective railroad was leased in perpetuity to the Chicago and Alton Company so as to form a continuous line from Chicago to Kansas City.

The lease provided that when the Missouri River was reached, in the vicinity of Glasgow, Missouri, "a suitable ferry should be operated until such time as the construction of an iron bridge could be completed." This ferry service was actually inaugurated with two boats — the *J. C. McMullin* and the *W. H. Christy* — each having a capacity for handling six or seven cars and a locomotive.

To bridge the wide Missouri in those days was no small matter, and T. B. Blackstone, president of the Chicago and Alton Company, entrusted the

job to his chief engineer, General William Sooy Smith, a man of high ability who well understood the seriousness of the many problems involved. The American Society of Civil Engineers, meeting in Chicago in 1872, had taken special notice of the subject and had discussed the difficulties attending the construction and maintenance of iron bridges.

General Smith offered a resolution at this meeting calling for the appointment of a committee which should attempt to secure an appropriation from the United States government for building a "first-class testing machine" by means of which a selected group of army, navy, and civil engineers might make exhaustive tests to determine the quality of various metals which might be employed in the building of bridges in this country. Such a testing machine was later installed and served its purpose well.

The committee which was appointed, with General Smith as chairman, included such notable men as General George B. McClellen, James B. Eads, builder of the famous Eads Bridge across the Mississippi at St. Louis, and many of the country's most outstanding engineers. One day General Smith received a modest letter from A. T. Hay, a resident of Burlington, Iowa, who stated that for the past twelve years he had been quietly

engaged in experimenting with iron and steel, and that he had perfected a method of making new alloys which had exhibited some remarkable qualities.

Just a bit skeptical, perhaps, Chairman Smith showed the letter to the members of his committee and they were interested enough to invite Mr. Hay to join them in a conference. The invitation was promptly accepted and he brought with him to Chicago some specimens of his new steel. So convincing were his arguments and so pleasing was his manner of presenting the facts that the members of the committee are said to have sat enthralled by his story from two o'clock in the afternoon, until daybreak the following morning.

Speaking in an informal manner, Hay told them of the twelve years he had experimented with what he described as an electric furnace for fusing ores, and that by this means he had perfected formulas for fourteen different "mettaloids" in various proportions, each possessing distinctive and valuable properties of its own. General Smith became so enthusiastic that he visited Burlington where he made further personal investigation and tests of the steel produced by the "Hay Process" and became thoroughly convinced of its merits.

Following this visit, General Smith recom-

mended to President Blackstone of the Alton Railroad that a bridge, crossing the Missouri at Glasgow, should be built of "Hay Steel", by which name the product had then come to be designated. The approval of this recommendation by the Alton stirred up a veritable hornet's nest within the engineering profession. Iron bridges had everywhere been collapsing, while wooden ones had held secure. It seemed incredible that men in their right minds should come to such a decision! Engineer Pope of the Detroit Bridge Company said, "My heavens, Smith, you are not going to build a steel bridge are you?" The answer was, "Certainly, why not?" Mr. Pope promptly responded, "The first frosty morning that comes, it will go into the drink."

Such criticism and ridicule, however, did not deter the Alton's engineers from going to work promptly on the project. A contract was entered into with the Hay Steel Company of Chicago to furnish the steel for the structure which was to be cast and fabricated at the Carnegie Edgar Thompson Works, according to the formula set forth in the specifications and approved by Mr. Hay and the committee. More than 800 tons of metal were needed for the structure. The company set to work on the order on September 9, 1878, under the personal supervision of Mr. Hay.

Work on the foundations and piers had been started the preceding May and crews were soon at work on the bridge proper. Its construction, however, did not take place entirely without mishap and some anxiety. One unfortunate accident occurred during construction, when one of the 314-foot spans collapsed about six hours before its completion, due to a failure of the cribbing supporting it and about 160 tons of steel fell into the Missouri River. The top chord was 102 feet above the water, "but while many of the members were bent and twisted into all sorts of shapes, none of them showed a fracture." This event fully indicated the toughness of the steel which had been employed.

Due to this misfortune, the American Bridge Company, which held the contract for the erection of the bridge, was financially unable to continue the work of construction and subleased its Chicago plant and the equipment on the job at Glasgow to the Chicago and Alton Railroad Company, which completed the work begun by the Chicago firm. It may be said, in passing, that the present-day American Bridge Company, which was organized in 1900, has no connection, either directly or otherwise, with the former company.

In spite of this accident, the fallen span was

dismembered and reërected within a remarkably short time so that there was no great delay in the final completion of the bridge proper, which was completed by the first of May, 1879. It was not dedicated and placed in service, however, until June 7th, owing to necessary delays in completing the approaches, tieing in with the main line of track, the final testing and approval of the work, and other more or less obvious details involved in any undertaking of such magnitude.

The "Hay Steel", employed in the construction of the bridge, received the highest praise even from its former critics. It was described as "a metal of peculiar structure, in that it possesses in common many of the qualities of both iron and steel. It has the tensile strength and hardness of steel, and yet the elasticity and flexibility of iron. It is capable of being produced in all grades from the highest edge-tool steel down to the lowest grade of common steel." So superior did it prove to be in every respect that the difference of deflection between the five spans of the Glasgow Bridge was only one-fifth of an inch, an almost incredible record.

It seems, too, that it promised to be a versatile product and, according to one comment, for a railroad rail, "it has all the wearing qualities of the Bessemer, with all the elasticity and pliancy

of the toughest iron rail. It makes a railroad rail that will not snap asunder in cold weather or break from concussion. In the judgment of eminent railway men it will be the railroad rail of the future."

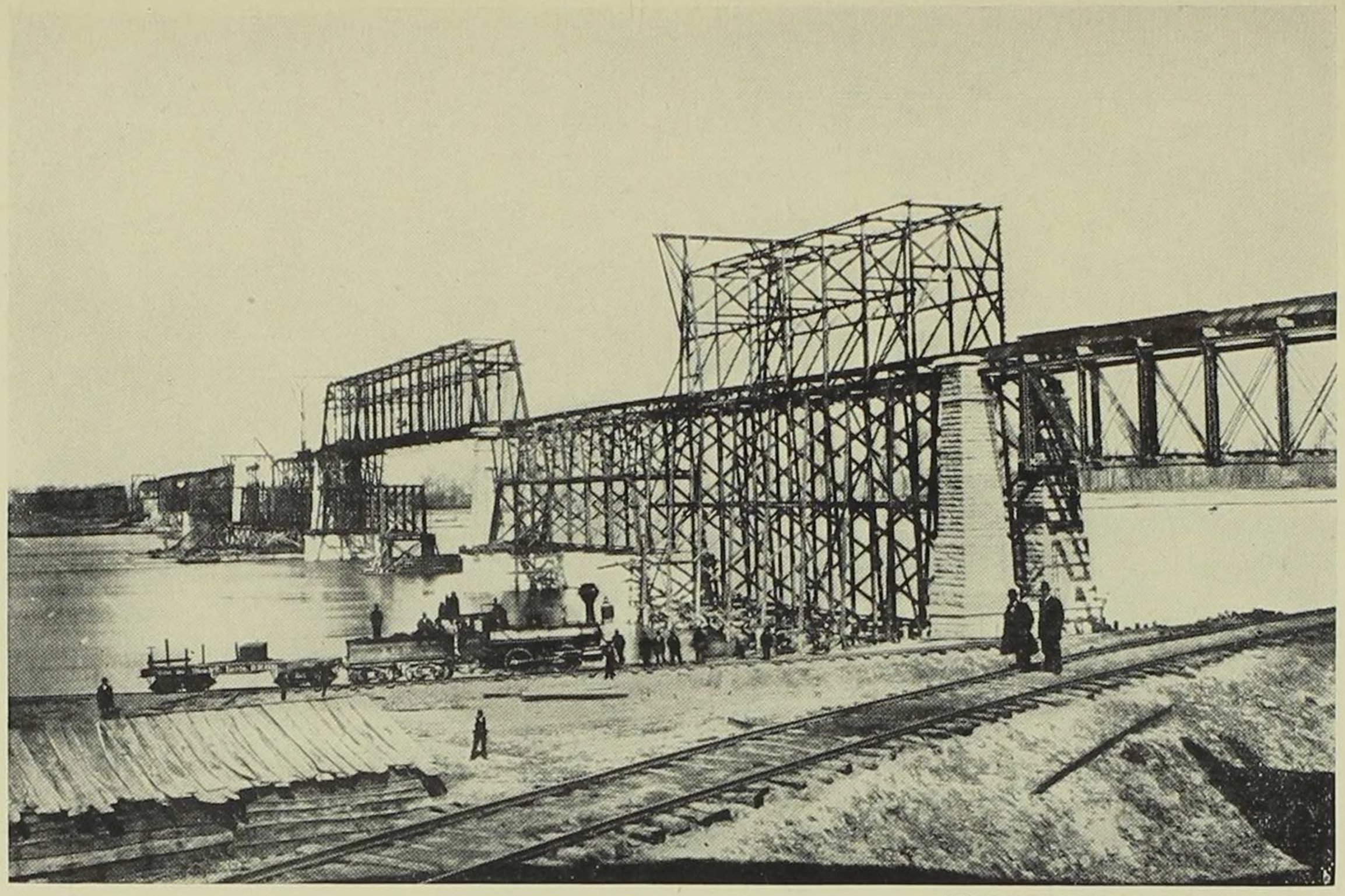
When the day for the formal testing and opening of the new bridge finally arrived, nearly ten thousand people gathered to witness the occasion. Many came by rail. Others came on horseback and by stagecoach, but the greatest number of spectators were carried by the many stern-wheeler steamboats plying the waters of the Missouri, whose very death knell was that day being sounded by the coming of the "iron horse".

Among the prominent men who took part in the ceremonies were J. C. McMullin, general superintendent of the Chicago and Alton Railroad, John J. Mitchell, president of the Kansas City, St. Louis and Chicago Railroad Company, William Sooy Smith, L. P. Moorehouse, E. S. Cheeseboro, and W. C. Dunham. But, no doubt, the proudest and most important guest of all was Abram Tuston Hay, of Burlington, Iowa, who had received a very special invitation from the Alton Railroad to be present on this occasion. The *Burlington Hawkeye* that day announced: "That Burlington has the honor of giving to the world an invention of such far-reaching results

is certainly cause of gratulation among our citizens and to the inventor." It also commented that the steel would "give the world safer bridges, more enduring railway tracks and machinery, and in a thousand ways benefit mankind."

As a matter of fact, the bridge unexpectedly had what was possibly its severest test at the very moment the engines and the superintendent's car, decorated with flags and bunting, were leaving the bridge in the midst of the celebration. The steamer, *Kate Kiney,* in attempting to pass underneath, struck the lower chords of the bridge and her smokestacks were completely swept away. This accident caused considerable excitement, but it neither injured the bridge nor interfered with the test in any way.

The bridge was designed to carry two 66-ton locomotives, pulling a load of 1,820 pounds per lineal foot. It successfully withstood these and other rigid tests, showing absolutely no signs of weakness. "In the preliminary tests as well as the tests yesterday," the *Hawkeye* stated, "the results have been surprising. They exceed anything heretofore attained in civil engineering and metallurgic processes. The bridge is not only stronger and safer, but it is lighter and consequently carries less dead weight. The new metal is already attracting a great deal of attention in



COURTESY CHICAGO AND ALTON RAILROAD

THE GLASGOW STEEL BRIDGE, APRIL 5, 1879

scientific and professional circles, and has caused a good deal of a flurry among parties interested in the old processes. In fact, they have waged a bitter warfare against the Burlington innovation and are as badly disappointed as we are pleased at the victory which the inventor has won over prejudice, jealousy and capital invested in existing metal works."

The Glasgow Bridge, in spite of the heavy toll imposed upon it by ever increasing traffic, showed no signs of weakness during the twenty years it remained in service and it was replaced in 1899 by the present modern structure only because of the ever-growing load of railway traffic. It thus survived by at least four years the life of Abram Tuston Hay, the genius whose long and heroic struggle, sometimes under most adverse circumstances, made its construction possible.

BEN HUR WILSON