for the iron bars proposed by Mr. Smart. At a much later period his plan was substantially adopted in wrought iron.

Mr. William Fairbairn of Manchester, in 1832 applied wrought iron in the construction of floor beams, but it was not until 1841 that the first wrought iron girder bridge was erected. This was on the Pollock and Govan railway in Scotland, where a small tubular girder bridge of 31½ feet span was built by Mr. A. Thompson for the Govan Iron works. In 1846 Mr. Fairbairn obtained a patent for "improvements in the construction of iron beams for the erection of bridges and other structures," and shortly after built one on the Blackburn and Bolton railway of 60 feet span. In the same year a boiler plate girder bridge of 50 feet span was built by Mr. James Millholland on the Baltimore and Susquehanna railroad. In this structure beams of timber 12×12 inches were used in the top chords, in connection with iron plates, to resist the compressive strains, while the sides and bottom of the girders were composed wholly of riveted plates.

About this time, 1845-6, a series of very extensive and complete experiments, which cost about $150,000, were being made under the direction of Robert Stephenson, Esq., C. E., with a view to devise means for carrying the Chester and Holyhead railway across the Menai and Conway Straits. These experiments were made by Mr. Fairbairn, Mr. Hodgkinson, and Mr. Edwin Clark, and developed properties in wrought iron to resist compression as well as tension, which were almost entirely unknown before. Our present knowledge of the capabilities of wrought iron for the construction of bridges is mainly due to these investigations.

The successful completion of these bridges, the Conway with a span of 400 feet, and the Britannia with two central spans of 460 feet, and two side spans of 230 feet, was a marked epoch in the history of engineering, and since their completion an increasing preference has been given to the employment of wrought iron in engineering and architectural structures.

In England, at the present time, there are not less than forty establishments which are largely devoted to the construction of iron bridges, not only for home and colonial use, but to be sent to all parts of Europe, Asia, Africa, and South America, wherever, indeed, the railway and locomotive engine have penetrated. One firm alone in London, within the last few years have constructed