ticing as a consulting engineer as well. In order to acquire a knowledge of the companies' methods, the last five months of 1886 were spent in their works at Phœnixville, Pennsylvania, preparing competitive designs and estimates for several important bridges, at least one of which was built.

Realizing that he was quitting permanently the life of a professor, he prepared a very comprehensive paper on "Civil Engineering Education," which was published in Engineering News. It appeared in the issues of January 1st and 8th, 1887, and was discussed in later issues by a number of prominent engineers and educators. It is reprinted, with these discussions, in the pages which follow. It is noteworthy that, while the extremely thorough five years' course advocated has not been adopted, the advance in engineering education has been largely along the general lines laid down in this paper.

January 1st, 1887, Dr. Waddell opened an office in Kansas City, and, from the first, was successful in obtaining contracts for the companies he represented and engagements as a consulting engineer. The street railway companies and several other parties gave him contracts for metal work to be built by the Phœnix Bridge Company, while, as a consulting engineer, he reconstructed the bridge over the Missouri River at Fort Leavenworth, Kansas. The bottom chords of this structure, which is of the Post truss type, had been seriously injured a year or two earlier by a fire which destroyed the wooden floor system; and, though unscientific detailing in the original design made the task difficult, the work of reconstruction was so satisfactorily done that the bridge is still in service.

While representing the Phœnix Bridge Company, he obtained in competition several noteworthy pieces of work, among which may be mentioned the designing of an elevated railroad (valued at about half a million dollars), connecting the Merchants' Bridge and the Union Depot in St. Louis, and the Red Rock cantilever bridge over the Colorado River between California and Arizona. After preparing the preliminary plans, making the estimate, and taking the contract, in a very limited time on the ground, Dr. Waddell was retained by the Railway Company as its Consulting Engineer, to supervise the detailing of the Red Rock bridge at Phœnixville. At the time of its construction this was the longest cantilever span in America, and, until very recently, has only been surpassed by the Memphis Bridge over the Mississippi River. The loads which now pass over the structure greatly exceed those for which it was designed, but it is still doing good service.

As mentioned above, our author sometimes occupied the dual position of representative of the Phœnix Bridge Company, for which he took the contracts, and consulting engineer for the railway company which purchased the structure. As his consulting practice grew, the excellence of design received increasing attention, and it became more and more difficult to bring into agreement the construction which, as consulting engineer, he should