On being deprived of his appointment by the purchase of the Oudh and Rohilkund Railway, Mr. MacAdam made an appeal to the Government of India, as the successors of the Company, for a solatium for the injury sustained by him in 1869 while in the execution of his duty. He based his appeal on the fact that the accident had deprived him of that activity which would be required of him in any future appointment, and had consequently debarred him from adding to his income in the interests of his family. After much consideration, the Government of India, admitting that he was deserving of special consideration, made him a gratuity.

Mr. MacAdam was elected a Member on the 4th of February, 1873.

RALPH HART TWEDDELL, whose name is associated with the application of hydraulic pressure to the working of machine tools, was born on the 25th of May, 1843, at South Shields, where his father, Mr. Marshall Tweddell, was at that time engaged in business as a shipowner. Ralph was educated at Cheltenham College, where he was specially prepared for the Royal Military Academy at Woolwich, it being intended that he should enter the Army. The proposed military career was, however, abandoned, and in 1861 he was articled to Messrs. R. and W. Hawthorn, of Newcastle-on-Tyne. There he had ample opportunity of obtaining a practical insight into machinery of various kinds, and the encouragement he received from the firm was largely instrumental in inducing him to devote his attention to that branch of engineering with which he was subsequently so closely identified.

It was during his apprenticeship, and when only twenty years of age, that Mr. Tweddell took out a patent for a small portable hydraulic apparatus for fixing the ends of boiler-tubes in tube-plates. The pressure of water employed varied from 1 ton to $1\frac{1}{2}$ ton per square inch. When the force-pump did not form part of the tool itself, the necessary connection was made by a small copper pipe, which proved sufficiently flexible and durable to allow of the free movement of the machine. The results were sufficiently encouraging to suggest the further employment of hydraulic power for machines used in boiler-construction.[1]

Owing to the introduction of high steam-pressures, the scantlings of marine boilers had to be considerably increased, and the

[1] Minutes of Proceedings Inst. C.E., vol. lxxiii. p. 65.

Downloaded from ftp.nowpublishers.com/jmipi/article-pdf/123/1896/437/2633904/imotp_1896_19683.pdf by guest on 10 September 2026

mechanical riveting-machines then in use did not, in the majority of cases, make steam-tight joints. It occurred to Mr. Tweddell that the application of hydraulic pressure would overcome the difficulty, and in 1865 he designed a stationary hydraulic riveting-machine. The plant, consisting of pumps, an accumulator and a riveter, was first used by Messrs. Thompson, Boyd and Company, of Newcastle-on-Tyne, with satisfactory results. The work was done perfectly and at about one-seventh of the cost of handwork. Not only could the surplus power, when the machine was not in use, be economically applied to hydraulic presses for such purposes as "setting" angle and tee-irons, but it was found that the material was much less strained by the new process, and that the wear and tear of the moulds and dies was greatly reduced.

The difficulty, however, in many cases of getting the work to the machine caused Mr. Tweddell to turn his attention to the design of a portable riveter. When his system was proved to be practicable for portable machines of moderate weight and power, bridge-builders and others demanded that the machinery should be not only of sufficient power to do the heaviest riveting, but of sufficient gap to span the largest girders. Such conditions involved machines of considerable weight, a matter of no real difficulty, however, since the hydraulic power which actuated them furnished the most convenient means of lifting.

Messrs. Fielding and Platt, of Gloucester, undertook the manufacture of Mr. Tweddell's first portable machine in 1871, and shortly afterwards several were brought into use, among the first to employ them being Messrs. Sir W. G. Armstrong, Mitchell and Company. Two years later these machine were used for riveting *in situ* the lattice-girder bridge carrying Primrose Street over the Great Eastern Railway at Bishopsgate Street Station. The work was quickly and successfully accomplished, and since that time the plant has been used for riveting bridges in all parts of the world. In this connection the Kistna Bridge at Bezwada, the Dufferin Bridge at Benares and the Sukkur Bridge may be specially referred to. Other opportunities for applying portable machines presented themselves in rapid succession: for the riveting of locomotive boilers, gun-carriages, agricultural machinery, wrought-iron underframes for railway wagons and carriages, and considerable progress has even been made in their application to the riveting of ships.

To obtain the full advantages due to the application of hydraulic pressure to machine-tools, it is desirable that the system should be applied as far as possible throughout the works. The first

Downloaded from ftp.nowpublishers.com/jmipi/article-pdf/123/1896/437/2633904/imotp_1896_19683.pdf by guest on 10 September 2026

opportunity of doing this completely presented itself at the naval dockyard of Toulon. In 1874, the French government ordered iron and steel war-ships of the largest size to be built at Toulon. This necessitated the erection of new workshops, and, on the recommendation of Mr. Marc Berrier-Fontaine, Director of Naval Construction, who made an exhaustive examination of the practice obtaining in this country, Mr. Tweddell's system was adopted in its entirety. The installation was fully described by Mr. Berrier-Fontaine in a Paper read before the Institution of Mechanical Engineers at Paris in 1878.[1] This opportunity of testing the economy of the system on a large scale proved successful. A similar plant was subsequently erected at the shipyard of the Forges et Chantiers de la Loire at Penhouet, near St. Nazaire. The largest of the machines at Penhouet exerted 50 tons pressure; but one was constructed in 1883 for the naval arsenal at Brest with a pressure equal to 100 tons.

Convinced that by the use of hydraulic pressure for flanging plates much greater accuracy in the fitting and putting together of boilers would be ensured, Mr. Tweddell introduced the Piedbœuf flanging-press into this country. The economical advantages arising from the use of this class of machinery are felt not only in the process of flanging, but throughout the whole construction of a boiler.

Mr. Tweddell was always ready to make known the results of his work. To this Institution he contributed two Papers:—"On Machine-Tools, and other Labour-Saving Appliances, worked by Hydraulic-Pressure,"[2] and "Forging by Hydraulic Pressure,"[3] a process which he strongly and persistently advocated. For the former of these Papers he was awarded a Telford medal and premium. To the Institution of Mechanical Engineers he presented three Papers:—"On the Application of Water-Pressure to Shop-Tools and Mechanical Engineering Work,"[4] "On the Application of Water-Pressure to Driving Machinery and Working Shop-Tools,"[5] and "On the Application of Direct-Acting 'Pressure-Intensifying' Apparatus to Hydraulic-Presses";[6] and as a member of the Committee on the Form of Riveted Joints, he compiled a Table showing the rules of practice used by various manufacturers for riveted joints entirely in iron.[7] The Society of Arts gave him

[1] Proceedings Inst. Mechanical Engineers, 1878, p. 346.
[2] Minutes of Proceedings Inst. C.E., vol. lxxiii. p. 64.
[3] *Ibid*, vol. cxvii. p. 1.
[4] Proceedings Inst. Mechanical Engineers, 1872, p. 188.
[5] *Ibid*, 1874, p. 166.
[6] *Ibid*, 1878, p. 45.
[7] *Ibid*, 1881, p. 293.

Downloaded from ftp.nowpublishers.com/jmipi/article-pdf/123/1896/437/2633904/imotp_1896_19683.pdf by guest on 10 September 2026

a gold medal, under the Howard Trust, "for his system of applying hydraulic-power to the working of machine-tools, and for the riveting and other machines which he has invented in connection with that system."[1] In 1890 he was awarded a Bessemer Premium by the Society of Engineers for a Paper entitled "The Application of Water-Pressure to Machine-Tools and Appliances."[2] Mr. Tweddell was a member of the French Société des Ingénieurs Civils, and he and Sir Joseph Whitworth were the only English engineers who received a *grand prix* in the machine-tool class of the Paris Exhibition of 1878. His connection with this Institution commenced in 1873, on the 2nd of December of which year he was elected an Associate; on the 25th of February, 1879, he was transferred to the class of Member.

It is difficult, perhaps, to over-estimate the importance of the change in the methods of construction of boiler, bridge and ship-building work with which Mr. Tweddell was so closely connected. Hydraulic riveting and the application of hydraulic-pressure to machine-tools may be said to have revolutionized engineering workshops. Not only is the work turned out of a better and more reliable description, but without the aid of such machinery much of that now produced could not be accomplished. Moreover, the intelligence required to direct a machine producing superior work raises the status of the labourer, while the demand created for work of this class materially increases the employment of men. In his several Papers he displayed considerable literary ability in the clear and terse language with which he stated his experience and views; and while he was careful not to speak unless he had useful information to impart, he enlivened discussion with a good-natured humour which made his remarks doubly welcome.

Mr. Tweddell died at his residence, Meopham Court, near Gravesend, on the 3rd of September, 1895, from aneurism of the heart, the result of an accident some few years ago: he was riding with his daughter, when his horse, taking fright, jumped on a rotten bank, fell and rolled over him. He was a keen sportsman and believed that he did better work for an occasional day's hunting, shooting or fishing. Mr. Tweddell was on the Commission of the Peace for Kent. He married in 1875 Hannah Mary, the third daughter of the late Mr. G. A. Grey, J.P. and D.L., of Milfield, Northumberland.

[1] Journal of the Society of Arts, vol. xxxiii. p. 949.

[2] Trans. Society of Engineers, 1890, p. 35.

Downloaded from ftp.nowpublishers.com/jmipi/article-pdf/123/1896/437/2633904/imotp_1896_19683.pdf by guest on 10 September 2026