

OBITUARY.

HENRI TRESCA¹ was born at Dunkirk on the 12th of October, 1814, and died in Paris on the 21st of June, 1885, in his seventy-first year. In many respects a remarkable man, his chief claims to recognition lie in his researches on the "Flow of Solids," a branch of scientific inquiry of which he may be said to be the founder, and to the prosecution of which he brought all the resources of a singularly powerful and active mind.

Tresca's life-work may be divided into three parts: first, the period of preparation, during which, while engaged with success in the ordinary pursuits of an engineer, he was assimilating and storing up the results of experiment and observation, which youthful enthusiasm and love of work enabled him to accumulate to an extent simply marvellous in its amount and far-reaching. Second, his long association with General Arthur Morin, at the Conservatoire des Arts et Métiers, the result apparently of accident, but towards which his previous training would seem to have been unconsciously directed. Third, his position as an independent investigator and man of science.

Of the first of these divisions it will suffice to speak in general terms. The future brilliant Professor pursued, at the Lycée Louis le Grand, and afterwards at the École Polytechnique—the ordinary curriculum of a young French collegian—with credit, but without betokening extraordinary promise, excepting always that he manifested astonishing powers of rapidly learning his lessons. In France, the student-period usually endures longer than in England, and it is no uncommon thing to find a bearded man of twenty-four still submitting to the restraint of a discipline almost military; but by overtaking his "courses," Tresca was enabled to enter the École des Ponts et Chaussées, in 1835, in his twenty-first year. He would doubtless have begun his career at the bottom of the ladder as an engineer in the government corps of the "Ponts et Chaussées;" but a long illness determined him

¹ More detailed accounts of Professor Tresca's life and work will be found in the *Mémoires de la Société des Ingénieurs-civils*, Paris, July 1885, p. 130.

to abandon his prospects of advancement in the state service, and to become an *Ingénieur-civil*.¹

He was employed on various applications of engineering to the industrial arts for about fifteen years, when he was nominated as principal inspector of French products contributed to the Great Exhibition of 1851. In this capacity he made the acquaintance of General, then Colonel, Morin, professor of applied mechanics in the Conservatoire des Arts et Métiers, and director of that establishment. Meeting one day in the gallery of machinery in motion of the Exhibition in Hyde Park, they exchanged ideas as to the advantages which would accrue from a permanent institution of that character in Paris. Morin, struck by the sense and sagacity of his companion, offered him on the spot the position of engineer to the Conservatoire, a post which did not exist, but which he knew he could easily obtain authority to create, and which his knowledge of men told him intuitively Tresca was peculiarly fitted for. It proved, in fact, the realization of a happy thought of Morin's, for a laboratory of industrial-mechanics, the idea of which he had conceived many years previously; but which had awaited for its accomplishment the advent of an auxiliary, capable, assiduous, and enthusiastic. Tresca was the man.

Tresca had now reached the second and active period of his career. His yearning for some means of showing the stuff he was made of had been gratified. He had met in Morin a kindred spirit, and begun an ardent friendship which only death would interrupt.² He was in the midst of, to him, a fairyland of mechanical and physical appliances, most of which he was eager to test, to show wherein they were deficient, and probably to suggest the improvement thereof; above all to drag them from their obscurity, dissect, and make them a means of advancing mechanical knowledge.

To appreciate rightly the influence of Tresca's work on the

¹ "Ingénieur-civil" has a much more restricted meaning than civil engineer. In France the man who undertakes what we know as works of civil engineering (excepting railways) is a government official—Ingénieur des Ponts et Chaussées. The Ingénieur-civil is a free-lance, whose equivalent title in English would rather be "Industrial" engineer. The alma mater of the former is the École des Ponts et Chaussées; of the latter the École centrale des Arts et Manufactures, and the distinction is as sharply maintained as that between military and civil engineers in England.

² The memoir of General Morin, Minutes of Proceedings Inst. C.E., vol. Ixii. p. 349, was written by Professor Tresca.

mechanical arts in France, the reverence of his countrymen for centralization must be taken into account. For long years the Conservatoire des Arts et Métiers has been an object of veneration for French mechanics all over the country, and the general public largely share the feeling. The sightseers who visit the curious nave of the church of St. Martin des Champs, in which is installed the machinery in motion annexed to the Conservatoire, notice only that which excites their curiosity. They are, perhaps, unconscious that in this place were carried out fundamental experiments and innumerable tests of machines and apparatus, all of which have directly or indirectly benefited themselves. It requires therefore the consideration of the improvements that have been made in all classes of machinery during the past thirty-five years, and the reflection that the germs of many of the most important are to be found in the silent, unobtrusive work done here by him, or under his supervision, in order to estimate Tresca's labours at their true value.

The experiments instituted at the Conservatoire, and executed with a skill and conscientiousness above all suspicion, have played a considerable part in the evolution of new inventions, whilst having regard to the older ones they were intended to supersede. By the aid, principally of instruments devised by General Morin, all the new motors and machines deposited at the Conservatoire were tested. None escaped this ordeal, and when the results were translated into figures no one ever contested their exactitude.

In a notice compiled in 1868, when he was a candidate for the Académie des Sciences, Tresca says: "My labours in connection with applied mechanics mainly consist of scientific and experimental researches concerning either the properties of materials or the mode of working, and the results yielded by the principal elements of industry. Numerous as these experiments have been, they were not made with any idea of creating a title to the consideration of the Academy, but were rather a compulsory adjunct of my lectures on applied mechanics at the Conservatoire des Arts et Métiers."¹ This record contains a detailed and precise classification of Tresca's various experiments. With its supplementary notice² it extends to 92 quarto pages of what, if his life-work had been one continuous lecture, would

¹ "Notice sur les Travaux Scientifiques de M. Tresca." Paris, 1868.

² "Notice supplémentaire sur les Travaux Scientifiques de M. Tresca, Professeur de Mécanique au Conservatoire des Arts et Métiers et à l'École Centrale des Arts et Manufactures." Paris, 1871.

constitute a syllabus of his labours. The classification is as follows:—

I.—*Strength of Materials.*

Crushing-strength; tensile-strength; resistance to tension; bending-strength; tests of construction.

II.—*Flow of Solids and its Application.*

III.—*Motive-Power and Motors.*

Animal motors; hydraulic accumulators; steam-boilers; steam-engines; gas- and atmospheric-engines.

IV.—*Mechanical Equivalent of Heat.*

V.—*Applications of Motive-Power.*

Traction of vehicles; hydraulic elevators; trimming of loads (employment of gearing for); agricultural machines; industrial machines.

VI.—*Various Mechanical and Physical Problems.*

VII.—*Weights and Measures.*

When it is considered that these experiments were but ancillary to his professorial work, and that each item includes the testing and description of unnumbered complicated machines, some conception may be formed of Tresca's powers of application. It will be noted that the section "Flow of Solids" makes no show above its fellows, but the description of his method of experimenting, and the materials chosen, occupy seven closely printed quarto pages. It was the substance of his constant thoughts from the time it first occurred to him in 1862, when observing the behaviour of a piece of iron being punched, to the day of his death, and was doubtless the most influential factor in obtaining his admittance to the Académie des Sciences.

Space does not admit of more than a passing reference to Tresca's labours in this direction. In constructing his theory of the flow of solids he relied mostly on synthetical methods; nothing was taken for granted. Slowly and laboriously he built up his theory from countless experiments on specimens of various metals, hard and soft; and not till after long years of patient inquiry did he feel justified in formulating his conclusions as follow:—

1. That pressure is transmitted in solids as in liquids, in every direction, with loss of pressure from one point to another.

2. That the deformations shown in solid bodies may be likened to the result of a flow occurring in the direction of least resistance.

3. That in every case where deformation can only occur by the passage of matter through an orifice there is formed a prismatic jet, adapting itself, like a liquid vein, to this orifice, and in which

must be recognised the mode of repartition of the matter proceeding from every part of the original solid.

4. That it is possible to express by suitable equations the surface into which will be transformed a given plane, or a cylinder, considered in respect of its primitive solid state.

5. That the same processes of calculation lead, in many cases, to the determination of the trajectory of a particular molecule, considered either as part of a solid or of a fluid.

6. That by means of this determination the domain of mechanical science is widened, and that as regards the strength of material, it can no longer be limited to considering the deformations resulting from the transmission of efforts in the elastic period alone, but can render account of all the circumstances accompanying any given deformation.

The records of most of these experiments are to be found in the "Annales du Conservatoire des Arts et Métiers," of which publication Tresca was the principal founder, but there are many scattered papers appearing in the Comptes Rendus of the Académie des Sciences, the "Bulletin de la Société d'Encouragement pour l'Industrie nationale" and other similar periodicals.

The Conservatoire des Arts et Métiers was an established Institution before Tresca's time, and it would be unjust to the memory of others, notably his dearest friend General Morin, to claim for him more than that he contributed to uphold its world-wide reputation; but his contribution was full measure, well beaten down. In the history of this latter great organization the name of Tresca will be associated with those of Charles Dupin and Arthur Morin as one of a triad who have done most to make it what it is. Besides his functions of Professor of Applied Mechanism and Sub-director of the Conservatoire, Tresca held numerous other official or quasi-official appointments. He was Professor of Applied Mechanics at the École Centrale des Arts et Manufactures, and Matriculation-Examiner at the same school, member of the Committee on the Mechanic Arts of the Société d'Encouragement, Honorary President of the Société des Ingénieurs-Civils, a life-honour created specially to mark the Society's sense of their indebtedness to one who had thrice held the position of President. In 1872 he was elected a member of the Académie des Sciences in the Mechanical Section, in succession to the veteran Combes. He was also "of" the Société Nationale d'Agriculture, and was entitled to place after his name a string of the mysterious symbols dear to Frenchmen as representing so many coveted orders. It has been mentioned that as a youth he was a quick learner. This

faculty he retained unabated through life, and a remarkable illustration of it occurred during the International Electric Exhibition held at Paris in 1881, when he was nearly seventy years of age. Tresca previously knew little of electricity, but in the fortnight that the Exhibition remained open he made such use of his time that it was remarked, "He entered it a novice, to leave it a master." That the epigram was justified may be inferred from the fact that he speedily became a recognized authority on the subject, especially that part of it connected with the electric transmission of energy, as to which his views were respectfully deferred to by many leading electricians.¹

Of Tresca's private character little need be said. He was a man of genius, and had the foibles and eccentricities attaching thereto. He appears to have found in Morin one on whom to lavish a more than brotherly affection, and, outside of his family, he was concerned little in minor friendships. His own great powers made him somewhat impatient of the duller perceptions of the multitude, and he was considered very strict in the examination of his pupils. It was generally expected that he would be appointed Director of the Conservatoire des Arts et Métiers on General Morin's death, but considerations of policy induced the Government to confer that distinguished office on Mr. Hervé Mangon. This was undoubtedly a great disappointment to Tresca, and to some extent embittered the remaining years of his life. Apart from this, he was respected if not loved, and a vast crowd accompanied his body to the Montmartre Cemetery, braving the heat of a tropical summer's day to listen bareheaded to the funeral orations pronounced over his remains by no less than five leading representatives of different scientific bodies to which he had belonged.

Professor Tresca was elected an Honorary Member of this Institution on the 4th of February, 1879, on the proposal of the chairman of the meeting, Mr. W. H. Barlow, F.R.S., his nomination, in accordance with established usage in such cases, being seconded by all the members of council then present.

FREDERICK BARRY, a younger son of Mr. Robert Barry, Chief Commissioner of Military Accounts in Ireland, was born in Dublin on the 15th of April, 1821, and was educated at Clifton, Bristol, and at Trinity College, Dublin.

¹ Minutes of Proceedings Inst. C.E., vol. lxxx. p. 455.