

business, during the period of his connection with it, was matter of more than local knowledge. While there, Mr. May invented the method of compressing the wooden treenails used as fastenings for railway chairs, a system which has been all but universally adopted, on both British and foreign lines. During the same period, under the superintendence of Professor Airy, F.R.S., (Hon. M. Inst. C.E.), the Astronomer Royal, he constructed, with an accuracy never previously attained, the great transit circle, and the altazimuth, at the Greenwich Observatory. He also erected an observatory for his own use, and furnished it with a transit instrument and clock, and a Merz achromatic telescope, $6\frac{1}{2}$ inches in aperture. Amongst other improvements introduced by him, may be cited the process of 'chilling,' for the pivots of large instruments.

In the year 1851, the wider scope presented for the branches of engineering and the theoretical department to which he had devoted himself, induced him to settle in London, where, for a short time, he was in partnership with Mr. Hawksley (M. Inst. C.E.). That connection was soon dissolved, and Mr. May's individual practice so rapidly increased, that for many years before his death, there were few important lawsuits, connected with patents, on which he was not consulted, and he was engaged, either on one side, or the other, in most of the contested engineering cases involving important results. Mr. May was a Fellow of the Royal Society, and of the Royal Astronomical Society. His connection with the Institution of Civil Engineers dated from 1836, when he became an Associate; in 1846, he was transferred to the class of Members, and in 1848, he was elected a Member of the Council, upon which he served up to the end of 1855. He was a very regular attendant at the Meetings, and he frequently took part in the discussions, his observations being characterised chiefly by their practical bearing. He was a natural mechanic, and he possessed perseverance in the acquisition of knowledge, which would have enabled him to take a high position in the engineering world, if he had been regularly brought up for the profession.

He was much esteemed by his family and friends, who were grieved by seeing him for some years gradually sinking under a painful disease, which eventually proved fatal on the 10th of August, 1860.

MR. JOSEPH MILLER was born at Carlisle, in the year 1797, and he there received the ordinary education of the period, no special attention being devoted to the direction of his studies, although the bent of his mind was sufficiently evident, as from a very early period he was a thinking, meditative boy, avoiding the companionship of children of his own age, and seeking the society of men, from whom he could learn something connected with his

favourite study—the construction of machinery. He thus early became thoroughly acquainted with the mechanism and the theory of the two Boulton and Watt steam-engines, then working in Carlisle. Great interest was at that time requisite to enable an apprentice to be received in the already celebrated Soho Works; but on Mr. James Watt having laid before him the memorandum-books and sketches of the would-be engineer, and finding from his conversation that his acquirements were above the average, he consented to his being articed to the firm, and Joseph Miller entered the Soho Works at the age of about fifteen years. His mother having died when he was very young, his father went to America, to prosecute a claim to an estate which he eventually recovered through the influence of President Jefferson; thus young Miller was left to fight his way alone and without any aid, save that of his own persevering spirit. Soon after his admission to Soho, John Barnes, a godson of Mr. Watt's, was received there as an articed pupil, and between these two young men, of very nearly the same age, an intimacy sprung up, which in after-years ripened into a sincere friendship, and ultimately led to their partnership in business. Their tastes were similar, and they pursued their studies and took their recreations together. Their progress in the acquisition of mechanical knowledge was very rapid, and when it was deemed advisable that Barnes should go to Edinburgh to study at the university, he was very anxious that his friend Miller should accompany him. This could not however be accomplished, and Miller remained at Soho, where, under the able tuition and guidance of Murdoch, Southeron, John and Henry Creighton, Brown, and others, whose names are intimately connected with the early history of the steam-engine, he rapidly acquired a degree of proficiency which, in 1817, at the early age of twenty years, induced an offer from the late Mr. Jessop to intrust to him the management of the mechanical portion of the Butterley Iron Works. That offer he accepted, and he thus had ample scope for the exercise of his talents; and the steam-engines designed by him soon deservedly acquired a high reputation. He there adopted the use of steam at an increased pressure, working with expansive gearing; and not only in the construction of the engines, but in the consumption of fuel, he arrived at considerable economy. This principle he extended to the marine engine constructed at Butterley for the 'Lord Melville' and the 'Royal Sovereign,' vessels which, under the guidance of Messrs. Jolliffe and Banks, formed the nucleus of the General Steam Navigation Company.

About the year 1820, Mr. Barnes, who had been commissioned to superintend the construction, at Butterley, of a pumping-engine on the Cornish principle, visited the works, and renewed his ac-

quaintance with his former friend, who was then married and apparently settled. Mr. Barnes there met the sister of Mrs. Miller, whom he eventually married, and this additional bond doubtless contributed to induce the proposition on his part for Miller to join him in establishing in London a manufactory for marine steam-engines. This project was accomplished in 1822, and between that period and the year 1835, when the partnership was dissolved, both Barnes and Miller were very actively and successfully engaged in the production of marine engines, for the numerous steam-packet companies then springing up on all sides. The new factory was established in Glasshouse Fields, Ratcliff; and for the Southampton and Havre, and the Dover and Calais stations, they were early and fully engaged. Barnes and Miller next turned their attention, so early as in 1826-27, to the navigation of the River Soane, where they attained great success, which led to their being employed on the Rhone, where, with their vessel the 'Pioneer,' they succeeded for the first time in navigating that river without assistance from the shore.

In the Memoir of Mr. John Barnes there occurs the following passage:¹—

"Before this period (1826-27), the introduction of steam power for the propulsion of passenger vessels on the Rhone and the Soane, had been scarcely deemed practicable, and the endeavour to employ it for towing barges, had been attended with very moderate success. When attempted by some French Engineers, by Messrs. Manby, Wilson, and Co., of Charenton, and by Messrs. Steele and Atkins, of La Gare, a member of this latter firm was killed by the explosion of the boiler, in an attempt to propel the vessel against the stream; and the Writer of this memoir (who had gone on board to aid his countrymen in overcoming a difficulty,) only saved his life and those of his workmen, by ordering them in great haste from the boat, on perceiving that the working engineer had fastened down the safety-valve, by a strut between the end of the valve lever and the deck carline; the explosion occurred, before the party reached the shore, and the unfortunate cause of it perished, with a number of persons of some importance in Lyons.

"This catastrophe and the general indifferent success of the previous attempts, had so depressed all speculative enterprise at Lyons, that when a Company was formed, for the navigation of the Rhone, Messrs. Barnes and Miller felt themselves called upon to make a considerable investment in the affair, to impart to it some degree of confidence, which still was very wavering; when however, on the first upward voyage, intelligence was sent by courier, from each station, that the steamer was overcoming all

¹ *Vide Minutes of Proceedings, Inst. C.E., vol. xii., p. 140.*

difficulties, the value of the shares rose, as the solution of the problem approached, and when the boat reached Lyons, in two days less than the time guaranteed by the Engineers, the securities had reached a premium, and were eagerly purchased from Messrs. Barnes and Miller, who immediately secured extensive orders for engines and machinery for France, and subsequently for this country, where the reputation of the machinery from the works thus established, has been worthily maintained to the present time."

Extensive engagements followed rapidly, and the Mediterranean packets from Marseilles soon afforded them a large sphere of action. Then the Havre boats occupied their attention; and in 1834 the series of Star Company's Gravesend packets was commenced by the construction of the engines for the 'Comet,' the 'Star,' and the 'Planet,' vessels which attained speeds previously considered impracticable, and which subsequently, between 1837 and 1852, in the 'Vesper,' 'Satellite,' 'Meteor,' 'New Star,' 'Jupiter' and 'Mars,' was raised to upwards of fifteen miles per hour. Early in the year 1835 the partnership with Mr. Barnes was dissolved, and Mr. Miller, having become the purchaser of the establishment in Glass-House Fields, was joined in March of that year by Mr. Richard Ravenhill. The firm of Miller, Ravenhill, and Co. continued until the year 1846, when, by the introduction of Mr. Salkeld, who had been connected with them for some years, the firm became Miller, Ravenhill, and Salkeld.

In 1835 the 'Iberia,' the first vessel of the fleet of the Peninsular and Oriental Company, was intrusted to the firm, and Mr. Miller exhibited his usual skill in the engines, as in 1840 he did in the oscillating engines of large size for the 'Ripon,' the 'Indus,' and the 'Pottinger,' the first iron vessels constructed for that Company.

In the year 1844 the firm secured the services of Mr. Pasco as their naval architect, and at their new waterside premises at Blackwall, they subsequently constructed some very successful iron steamers, which attained great speed; the 'Prince of Wales,' London and Margate packet, reached upwards of sixteen miles per hour, which was considered very remarkable, until in 1846, the 'Llewellyn' Holyhead mail packet attained, on her trial trip, a speed of upwards of eighteen miles per hour. In 1835 the 'Tancrède' and the 'Léonidas' were constructed for the French Government Post-office service in the Mediterranean; then followed the 'Ichnusa,' a vessel fitted with Morgan's feathering paddle-wheels for the Sardinian Government; and in the year 1843 the engines of the 'Cuvier,' French vessel of war, were confided to the firm, whose reputation was at its zenith.

Many other equally successful works were also accomplished, such as the Mediterranean packets the 'Phœnicien,' the 'Phoca,' and the 'Charlemagne' between 1836 and 1840; and the

'Argonaut,' the 'Pylades,' and the 'Orestes,' in 1840, for the Russian Government, for the navigation of the Black Sea.

The navigation of the Rhine had been often attempted, but only with comparatively indifferent success. Mr. Miller studied the case carefully, and in 1837 supplied the engines for the 'Herzog von-Nassau,' and in 1839 for the 'Comet;' in the latter year he also constructed the engines for the 'Victoria,' an iron vessel, built by Ditchburn; and in 1841, for the 'Elberfeld,' another iron vessel by the same builder. Between 1844 and 1847 were also constructed the engines for the new 'Elberfeld,' the 'Concordia,' and the 'Joseph Miller,' for iron vessels designed by Pasco, which attained great success. It was on board of one of these vessels, of very light construction, and drawing only a few inches of water, that Mr. Miller nearly met his death. He had invited a party of select friends, comprising Mr. Thomas Landseer, with his wife and cousin, Messrs. C. Landseer, T. H. Wyatt, the late Frank Stone, R. Perring, and some others, to accompany him in a trial trip from the Thames to the Rhine; and when about mid-channel, foggy and heavy weather came on, which obliged them to lie off the coast until daylight. The slightly-built vessel showed signs of weakness amidships, and would doubtless have broken up, under such a heavy trial, but for the presence of mind of Mr. Miller, who, although suffering severely from rheumatic gout, calmly ordered timber struts to be placed between the boilers, and between them and the sides of the vessel, and then, with a chain and screw-coupling, to brace all together, thus the buckling of the sides of the vessel was prevented and the mouth of the river Rhine was safely reached, contrary to the anticipations of many on board, who had given up all hope of ever again seeing terra firma.

So early as in 1842 the engines of the 'Trent' and the 'Isis' were built for the Royal West India Mail Packet Company, and these were followed in 1852 by the oscillating engines with feathering paddles for the 'Solent,' and the 'Tyne,' for the same company; vessels of 1,800 tons burden, which, with only 400 H.P., attained respectively, on their trial trips, the speeds of 13·945 knots and 14·6 knots per hour.

When every Steam Packet Company in England, and every foreign government had become fully convinced of the excellence of the engines designed by Mr. Miller, the authorities at the Admiralty awoke to the probable utility of trying his skill, and in 1835 a pair of engines of 120 H.P. were allowed to be put on board H.M. ship 'Blazer,' then followed in—

1837 the 'Tartarus,' 120 H.P.

1841 the 'Infernal,' 320 „

1842 the 'Gladiator,' 400 „

The two latter pairs of engines were on the direct-action principle, and those for the 'Gladiator' had the air-pumps placed at an angle, an innovation which arose from an accident. When Mr. Miller sent in the design for these direct-acting engines with the air-pumps placed vertically and side by side between the cylinders, an objection was raised, that the engines occupied so much space athwart ships that the guns could not be trailed fore and aft. Mr. Miller, being determined to meet and conquer the objection, instantly produced another design, in which the cylinders were brought up close together, and the air-pumps were worked fore and aft in inclined positions to the main shaft, thus inducing an improved design of engine, whilst defeating a less worthy design of another kind.

Between 1844 and 1847 were produced the engines for H.M. ships 'Amphion'—the first direct-acting horizontal screw-engines placed beneath the waterline, for the British navy—the 'Minx,' 'Teazer,' 'Rifleman,' 'Sharpshooter,' 'Plumper,' 'Triton,' 'Basilisk,' 'Furious,' 'Valorous,' 'Buzzard,' and 'Barracouta'—a goodly list, and all of successful engines.

It should be noted that the original notion of the 'Amphion's' engines, as a means of driving the screw-propeller, then a new introduction, direct and without the intervention of gearing, and so placed as to be underneath the waterline, was submitted to the Lords of the Admiralty, by Count Rosen: this crude idea was also laid before Mr. Miller, who willingly undertook to arrange the details, and be responsible for the action of the machinery, the order for which was forthwith given to Messrs. Miller and Ravenhill, who had thus the merit of introducing a most useful innovation into the Royal Navy.

The part taken by Mr. Miller in the introduction of the Screw Propellor should not be forgotten. In 1837 he was consulted by Mr. F. P. Smith, and was much pressed to construct the engines and machinery for the 'Archimedes,' which was designed by Pasco and built by Wimshurst in 1838. Being, however, too much occupied to undertake the construction of the engines within the desired period, Mr. Miller could only give his friendly advice to the ingenious projector of the novel system of propulsion, and it was only in 1839 that Messrs. Miller and Ravenhill had intrusted to them, with the consent of Messrs. Rennie, the contractors, the repairs of the boilers and engines of the 'Archimedes' after an accident. From that period Mr. Miller's attention was devoted to the subject of screw propulsion, and to such an extent did he carry his enthusiasm, that he spent nearly three months on board of H.M. ship 'Amphion,' when on foreign service, for the purpose of fully examining the working of the new propeller under all circumstances. Indeed it may be doubted whether even the deter-

mined energy of Mr. F. P. Smith would have been successful in the introduction of the Screw Propellor to H.M. navy, had not such men as Joseph Miller taken up the question of its adaptation and its construction; and what was even more essential, had not Mr. Thomas Lloyd, then the Chief Engineer of the Royal Dockyard, Woolwich, so early recognised and fostered the invention. To this gentleman the country owes a deep debt of gratitude for the calm, careful manner in which he has encouraged this and all other really useful innovations, and for the warning voice with which he has fearlessly discouraged all wild and improbable schemes, however powerfully patronized.

Between 1846 and 1849 the engines were produced for the 'Blasco de Garry,' the 'Alesta,' the 'Vigilante,' and the 'Pizarro,' for the Spanish royal navy; and in the latter year the engines for the Egyptian frigate, the 'Sharkie,' were built with great success. It should also be stated that a number of engines were likewise constructed for the Austrian Lloyd's packets, which, until the establishment of the Electric Telegraph, brought the earliest Indian news by way of Alexandria and Trieste.

This long and somewhat dry enumeration of engines does not, of course, comprise all the works that were undertaken by Mr. Miller and his partners, nor is it possible within the limits of this sketch to trace the gradual development of the ideas which induced the improvements daily introduced into steam machinery.

Mr. Miller was possessed naturally of an appreciation of beauty of form and of proportion which enabled him to sketch the various parts of a machine almost with the accuracy of a drawing made to a scale, and hence the peculiar aptness of form and fitness of proportion which characterized all his engines. To him is, in a great degree, due the greater use of wrought iron, thus reducing the weight and augmenting the strength of the machines, as well as rendering them more compact, and putting them below the water-line out of the reach of shot. He was a pure mechanic naturally, he had carefully cultivated his tastes by study, and the daily practice of his art completed his qualifications; and if his health had permitted, he would have eventually taken a very high position. Unfortunately his health, which had been for some years very precarious, so failed that, in December of 1852, he was obliged to retire from the firm of which he had been so long the successful chief, and which now still retains its well-earned reputation.

In spite of his painful malady, Mr. Miller, after his retirement from business, continued to cultivate the companionship of artists and literary men, in which he had always taken pleasure; his home was ever open to them, and many brilliant and happy meetings are in the remembrance of his friends, as are also the more social evenings of the Shakespeare Club at an earlier period when many of the now great literary and artistic stars had scarcely

reached above the horizon. His taste exhibited itself in the formation of a small but choice collection of pictures, the works of modern artists, all of whom were his personal friends; and these works were his solace: when confined to his chamber, he could look around and, as he expressed it, still fancy that he could hear the well-remembered voices of his friends as he looked upon their works.

He was a Fellow of the Royal Society, and a Member of several other scientific bodies. He was a very old Member of the Institution of Civil Engineers, having been elected in the year 1834. He served for several years as a Member of the Council, and only retired when he was precluded by continued illness from attending the Meetings. That he was devotedly attached to the Institution was shown not only by his taking a vivid interest in all its proceedings up to the period of his last leaving England, but by his munificent legacy to it of Five Thousand Pounds. In recognition of this considerate liberality, the Institution unanimously concurred in the propriety of having a portrait of Mr. Miller suspended in the meeting-room, and establishing a 'Miller Medal,' to be given with the premiums bearing his name.

In spite of the best medical assistance, Mr. Miller's painful attacks of rheumatic gout grew more frequent and acute, and after repeated journeys to warmer climates, he was persuaded to accompany his sister and niece to South Carolina, where he purchased an estate; but he was not allowed to enjoy it for any length of time, as on the 23rd of February, 1860, he expired, after only a few days' illness, in the sixty-third year of his age.

This brief sketch will not permit a detailed account to be given of the progressive labours of a man whose whole energies were fixed on one object, the development of the powers of a machine in which 'he believed,' and to which he saw no limit. Such a believer was Joseph Miller: he was a man of philosophic spirit, and an inquiring mind, with a calm manner and apparently an unruffled temper, withal he possessed untiring energy and indomitable courage and perseverance; but more especially he was remarkable for his rare social qualities. There were few such warm friends as he; and few men have left behind them a name which will so long dwell in the memories of all who had the good fortune to enjoy his friendship.

MR. THOMAS PENSON, who joined the Institution as an Associate in the year 1839, was an architect in extensive practice, and held for a long period the appointment of County Surveyor for Montgomeryshire. Up to the present time it has not been possible to obtain the materials for his Memoir; but it is hoped that they may eventually be procured for future publication.
