trate the most difficult questions of the higher analysis. No one, with the exception perhaps of Arago, ever produced this effect in the same degree."

His lectures at the College de France were attended by the *élite* of French mathematicians, and doubtless did much to keep alive the ardent spirit of pure mathematical research which still lives among his countrymen. Among those who either were his pupils or were indebted to his encouragement and patronage may be reckoned Le Verrier, Hermite, Bertrand, Serret, Bour, Bonnet, Mannheim, all of whom are or have been pillars of French science.

If we compare Liouville as an investigator with other great contemporaries whose rolls of achievement like his own are already closed, we can scarcely put him in the highest rank of all, along with Abel and Jacobi, whose fortune it was in the course of their discoveries to open up new fields of research and create new branches of the analytic art. Nevertheless, so profound are some of his isolated contributions, and so elegant is all his mathematical writing, that it will be long before the traces of his handiwork vanish from the fabric of mathematical science; and it seems certain that future generations will accord him all but the highest rank in the temple of mathematical fame.

Robert Wilson. By Professor Fleeming Jenkin, F.R.SS. L. and E.

Mr Robert Wilson was born in 1803 at Dunbar. In 1810 he lost his father, who was connected with the royal and mercantile navies. This brave man, after having twice reached the wreck of the "Pallas" frigate in the Dunbar life-boat, was drowned in the third attempt to reach the ship and rescue the remainder.

Mr Robert Wilson was apprenticed to a joiner, and, like many other distinguished Scotchmen of the same generation, he owed his high standing as a mechanical engineer almost entirely to his natural genius, since he does not appear to have received any special advantages in respect of education.

During his apprenticeship, and at a date considerably prior to the successful introduction of the screw propeller into our navy, he

made models of boats with various forms of screw, which worked successfully. He himself considered that the first idea of the screw propeller had occurred to him as a mere child; his first model was that of a ship $2\frac{1}{2}$ feet long, and a drawing which he published of it in later life shows a very good four-bladed screw propeller; he attempted unsuccessfully to drive this by a windmill on the boat. In 1821, after seeing the "Tourist" paddle steamer, he made some further experiments, but having to leave the sea coast he dropped the subject. In 1825 he returned to Dunbar, and again attacked the problem, trying first four blades, then three, and then two, driven by the main-spring of a clock. At first the screw was placed in front of the rudder, and the sketches since published by Mr Wilson show the exact arrangement now usually adopted. He abandoned this plan, however, in consequence of leakage at the stern tube; and in order to get the opening above water line he used two single blade right and left propellers immersed for less than half their diameter and driven in opposite directions, being placed one behind the other, and connected by bevel wheels.

In 1827 young Wilson was introduced to the Earl of Lauderdale, whose son saw a small boat about 3 feet being driven in this way. Lord Lauderdale appears to have brought the matter to the notice of the Admiralty, but the young inventor met with no encouragement in official quarters. He next exhibited his model before the Dunbar Mechanics' Institution. A record of the exhibition was made in the minutes of the institution for October 18, 1827; and the *Edinburgh Mercury* of the 29th December 1827 alludes to the invention. The Highland Society of Scotland in 1828 appointed a committee, which after seeing the small model made a grant of £10, to enable Mr Wilson to have propellers made on a larger scale. Consequently a boat 25 feet long was fitted with a pair of these screw blades, to be driven by two men with winch handles; the committee, which included two captains in the Royal Navy, reported very favourably on the performance of this boat, during a trip in Leith Roads, lasting $17\frac{1}{2}$ minutes. The model became the property of the Highland Society.

In 1832 a committee of the Society of Arts reported favourably on the trial of another model 18 feet long, fitted with the same arrangement of two blades revolving in opposite directions. The

prize committee of this Society awarded him a silver medal and a prize of five sovereigns, pointing out in their report that the stern paddles, as they call the propellers, "can be kept altogether under water and out of the reach of surf, and answer equally well in rough as in smooth sea."

Mr James Hunter of Thurston had introduced the invention successively to the Dunbar Institute, the Highland Society, and the Society of Arts. Notwithstanding the encouragement received from those Societies and the support given by various influential men, the Admiralty, to whom he again applied, declined to make any trial of the plan, and Mr Wilson had the mortification of seeing the simple screw introduced into the navy by Mr Smith of Hendon.

Mr Wilson was, however, by no means the first who had thought of a screw as the propeller of a boat, and it must be admitted that he pushed the right and left hand geared screws in preference to the simple plan which was ultimately successful. He met with some reward indirectly, becoming known to many influential persons as an ingenious and able young mechanic; and ultimately in 1880 he had the satisfaction of receiving a sum of £500 from the Admiralty for the use of his double-action screw propeller as applied to the fish torpedo.

In 1832 Mr Wilson was in business as an engineer in Edinburgh, in the North Back of the Canongate. A few years afterwards he went to Manchester, and in 1838 he was manager of the famous Bridgewater Foundry at Patricroft. That he should, with no educational advantages, have attained this position at thirty-five years of age, is perhaps as high a testimony to his ability as his connection with the screw propeller or even with his steam hammer itself. It is universally admitted that the conception of the steam hammer was due to Mr James Nasmyth, but Robert Wilson was the inventor of important details which he considered essential to its success. On the one hand, we must remember that a steam hammer at Creuzot, suggested by Mr Nasmyth's sketch, worked successfully with no assistance given by Mr Wilson; but on the other hand, there is no doubt that some details largely used in connection with the hammer, as commonly made in England, were due wholly or in great part to Mr Wilson. There was unfortunately some disagreement between him and Mr Nasmyth on this point; and indeed

it is nearly impossible, when men are working together at the improvement of a machine, to appraise with any exactness the precise share of merit due to each.

The first steam hammer made in England was delivered to the Lowmoor Iron Works in 1843. Mr Wilson left Patricroft, and became engineer to the Lowmoor Works, where in 1853 he added what is known as the circular-balanced valve to the original machine. This invention was patented by Mr Wilson. In 1856, when Mr James Nasmyth retired from business to follow the scientific pursuits by which he has greatly added to his reputation, Mr R. Wilson was recalled to Patricroft, where he became the managing partner of Messrs Nasmyth, Wilson, & Co.

Mr Wilson did not take much part in local affairs, but was for some years president of the Patricroft Mechanics' Institution. In 1873 he was elected a Fellow of the Royal Society of Edinburgh. He continued to apply himself to the management of his works until his death, which occurred on the 28th July 1882.

A list of no less than thirty patents stand in his name, either solely or jointly with others.

Mr Wilson will be remembered as worthy of mention among the group of able Scotch mechanicians who, by their power of invention, energy, and business capacity, have not only won distinction and wealth for themselves, but have added to the resources and strength of the empire

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JAMES YOUNG, LL.D., F.R.S. By Dr Angus Smith.

James Young was born in Glasgow, and on leaving school was engaged for some time in a joiner's shop. It is characteristic of his energy that at this time he would, during his holidays, make long journeys on foot, having on one occasion walked as far as Aberdeen, and on another having walked the greater part of the way to London, visiting places of historic interest on his way. His occupation in the joiner's shop was the occasion of his becoming a chemist. He attended the class of chemistry in Anderson's College, and his skill as a workman led to his being employed by Professor Graham, who then taught the class, in constructing