Centenaries in January 1936.

Lagrange (Joseph Louis), 1736-1813.

TWENTY-FIFTH of January 1736 saw the birth at Turin of one of the greatest French mathematicians. At school his boyish interests were Homer and Virgil. At the age of seventeen, he chanced to read Halley's *A new, exact and easy method of finding the roots of any equations generally, and that without any previous reduction*, published in 1694 in volume 18 of the *Philosophical Transactions* of the Royal Society. This kindled the mathematical spark in him. Like Newton, but at a still earlier age, he reached to the heart of the matter in an incredibly short time.

INVENTS CALCULUS OF VARIATIONS.

In these days when our Universities and Departments of Education are vying with one another in fixing absolutely rigid age limits for admission to the University, it is specially interesting to note that at the age of 18, Lagrange was appointed professor of mathematics in the Royal School of Artillery at Turin. When he was but 19, his attack on the isoperimetrical problem led to his invention of the new *Calculus of Variations*. This Calculus is intimately related to the story of Least Action which began with the reflecting mirrors of Hero, interested Descartes, led to Hamilton's principle and is still persisting to-day in the development of Wave Mechanics.

FOUNDS TURIN ACADEMY.

In 1758, he was at the head of a youthful band of scientists who became the foundation members of the Turin Academy of Sciences and he contributed several papers to the *Miscellanee Taurinensia*, which was the organ of the Academy. He was awarded the prize of the French Academy of Sciences in 1764 for an essay on the *Libration of the Moon* in which he used his well-known equations for the first time. He won this prize in several later years, *viz.*, 1766, 1772, 1774 and 1778.

SUCCEEDS EULER.

In 1776, the great Euler of the Academy of Berlin recommended him to be appointed his successor. Frederick the Great accepted the recommendation with the remark that "The greatest king of Europe" should have "the greatest mathematician of Europe" in his court. While at Berlin, Lagrange contributed several learned papers, which culminated in the *Mechanique analytique*, which Hamilton described as "scientific poem". This was published at Paris in 1788 under the supervision of Legendre.

SETTLES IN FRANCE.

After the death of Frederick the Great, Lagrange accepted the invitation of Louis XVI to Paris. He was lodged in Louvre with a pension of 6,000 francs. In 1791 he was elected foreign member of the Royal Society of London. He commanded universal respect even in the crisis of the Revolution. He was one of the first members of the Bureau des Longitudes. He supported the adoption of the decimal and metrical system. When someone defended twelve because it has more factors, Lagrange remarked what a pity it was that the number eleven had not been chosen as the base, because it was prime.

LAST YEARS.

In his later life, mathematicians thronged to meet him and to show him every honour, but they were dismayed to find him distracted, melancholy and indifferent to his surroundings. The years of activity had told; and Lagrange was mathematically worn out. He directed his thoughts elsewhere—to metaphysics, religion, medicine and chemistry. He found chemistry, however, to be as "easy as algebra". He began his revision of his *Mechanique analytique* in 1810; but did not live to complete the revision. He died at Paris, 10th April 1813.

In the words of Turnbull "Lagrange is one of the greatest mathematicians of all times not only for the abundance and originality of his work, but for the beauty and propriety of his writings." His complete works were edited by Serret and Darboux and were published in fourteen sumptuous volumes between 1867 and 1892. His biography published in the *Memoires de l'Institute*, by Delambre in 1812 is reproduced in Volume I of the collected works. The last two volumes are also of biographical interest as they contain his correspondence with the chief mathematicians of his time such as Clairaut, D'Alembert and Euler.

S. R. RANGANATHAN.

Watt (James), 1736-1819.

SIX days before Lagrange was born, one of the front rank engineers, whose inventive talents have conferred immeasurable benefits on the human race, was ushered into the world at Greenock in Scotland. James Watt was jeered by his school fellows as being dull and spiritless. But even in his sixth year, he was solving geometrical problems, experimenting with a tea kettle and drawing machines. His father was a mathematical instrument maker and he was 'a diligent worker in his father's shop and gave early evidence of his manual dexterity'.

His Early Chances.

Having spent a year as an apprentice to John Morgan, the "philosophical instrument maker", he went to Glasgow in 1756 and tried to establish himself as an instrument maker. But the city guilds prevented this on some formal grounds. It was at this juncture that the University of Glasgow came to his assistance by appointing him as a mathematical instrument maker to the University and by allowing him to establish a workshop within its precincts. Here he worked from 1757 to 1773 and made the acquaintance of eminent men such as Joseph Black, the discoverer of latent heat. Here also, in 1764 occurred the well-known incident of the repair of the model of a Newcomen steam engine, belonging to the University.

His Invention.

While repairing this engine, he calculated the abnormal loss of heat and was filled with an ardent desire to reduce the heat losses. This desire was working in his mind till, one day in 1765, the fertile idea of the condenser appeared. The phase of sudden revelation, which followed several weeks of unconscious work, is best described in his own words. "It was in the Green of Glasgow. I had just gone to take a walk on a fine Sabbath afternoon. I had entered the Green by the gate at the foot of Charlotte Street—had passed the old washing house. I was thinking upon the engine.....and gone as far as the Herd's House, when the idea came into my mind that as steam was an elastic body it would rush into a vacuum, and if a communication was made between the cylinder and an exhausted vessel, it would rush into it and might be there condensed without cooling the cylinder. I then saw that I must get quit of the condensed steam and injection water, if I used a jet as in Newcomen's engine. Two ways of doing this occurred to me. First the water might run off by a descending pipe, if an offlet could be got at a depth of 35 or 36 feet, and any air might be extracted by a small pump; the second was to make the pump large enough to extract both water and air..... I had not walked further than the Golf House when the whole thing was arranged in my mind."

The invention was made. It remained to be completed by new experiments.. A series of condensers were made, each more perfect than its predecessor, until the first large-scale engine was erected near Linlithgow and the first patent was obtained in 1769.

Soho Ironworks.

In 1775, Watt entered into partnership with Mathew Boulton of Soho near Birmingham, when the manufacture of the condensing steam engine was commenced on a large scale. This partnership was a fortunate one for Watt — Boulton was bold and enterprising; Watt was timid and shrank from the commercial side of affairs.

Last Years.

He retired from business in 1800. But he showed the same alert and active mind even after retirement. His last work was the invention of machines for copying sculpture. We find him not many months before his death—the end came on August 19, 1819—presenting copies of busts to his friends as the work "of a young artist just entering on his eighty-third year".

The attic room of his house—the Watt Room—where he used to work alone is still preserved in its old condition. An exhaustive account of his many inventions is given by Edward A. Cowper in the pages of the *Proceedings of the Institution of Mechanical Engineers* for 1883.

In the field of pure science, Watt's paper entitled *Thoughts on the constituent parts of water and of dephlostigated air, with an account of some experiments on the subject* and published in the *Philosophical Transactions* of 1784 gives him the claim as a discoverer of the composition of water.

S. R. Ranganathan.