present work. A model was constructed, and the expe­riments made with it placed the correctness of the theory, and the advantages of the invention, beyond the reach of doubt.

In the course of these trials he was much struck by the great heat communicated to the injection-water by a small quantity of steam ; and he proceeded by a very simple ex­periment to satisfy himself upon that subject, when he dis­covered that water converted into steam will heat about six times its own weight of water at 47° or 48° to 212°. He mentioned this extraordinary fact to Dr Black, who then explained to him his doctrine of latent heat, to the support of which Mr Watt had afterwards the satisfaction of con­tributing his experiments. From some of these he was led to suppose the latent heat of steam to be above 1000°, but he afterwards considered 960° a more accurate determina­tion. From others, he deduced the important conclusion, that the sum of the latent and sensible heat of steam, at different temperatures, is a constant quantity, the latent heat increasing as the sensible heat diminishes ; or, in other words, that a given weight of water in the state of steam contains nearly the same quantity of heat, whatever may be the bulk or density of the steam.

He also, at this time, made experiments upon the capa­cities of different bodies for heat, and upon the heats at which water boils under various pressures ; from which he ascertained, that where the heats proceeded in an arithme­tical, the elasticities proceeded in a geometrical ratio, the curve of which he laid down. These he repeated some years after with more accuracy.

We have been thus minute in our details of the succes­sive steps by which Mr Watt proceeded to his great im­provement upon the principle of the steam-engine, in order to convey some idea of the sagacity, ingenuity, and science, with which he conducted the investigation. Our limits will oblige us to be more brief in our narrative of his sub­sequent improvements.

From this period (the early part of 1765), his mind be­came very much engaged in contriving the machinery for executing his improvement upon a large scale ; but the want of funds prevented his attempting it, until he was in­duced to address himself to Dr Roebuck, who had a short time before completed his establishment of the Carron Ironworks, and who, in addition to his known qualities of ingenuity and enterprise, was considered to be possessed of ample means of introducing the invention to the public. He agreed to enter into the plan, upon having the proceeds of two thirds of the invention assigned to him ; and an en­gine upon a large scale was then constructed by Mr Watt, at Kinneill, near Borrowstounness, where the doctor then resided ; the trials made with which gave satisfaction. But the introduction of the invention to the public was retarded, on the one hand, by the pecuniary difficulties in which the doctor became involved, by the failure of several of his multifarious undertakings ; and, on the other, by the em­ployment which the rising reputation of Mr Watt, for knowledge and skill in the line of a civil engineer, pro­cured him.

He was employed in 1767 to make a survey for a canal of junction between the rivers Forth and Clyde, by what was called the Lomond Passage, and attended parliament on the part of the subscribers, where the bill was lost. An offer was then made to him of undertaking the survey and estimate of an intended canal from the Monkland Collieries to Glasgow ; and these proving satisfactory, the superin­tendence of the execution was confided to him. This was quickly followed by his being employed by the Trustees for Fisheries and Manufactures in Scotland, to make a survey of a canal from Perth to Forfar, through Strathmore ; and soon afterwards by the Commissioners of the Annexed Estates, to furnish a report and estimate of the relative ad­vantages of opening a communication between the Firth of Clyde and the Western Ocean, by means of a navigable canal across the isthmus of Crinan,@@1 or that of Tarbert. Business of this description now crowded upon him ; and surveys, plans, and estimates, were successively undertaken by him for the harbours of Ayr, Port-Glasgow, and Green­ock ; the deepening of the river Clyde ; the rendering na­vigable the rivers Forth and Devon, and the water of Leven ; the making of a canal from Machrihanish Bay to Campbeltown, and of another between the Grand Canal and the harbour of Borrowstounness ; the building of bridges at Hamilton and at Rutherglen, &c. &c. In these surveys he made use of a new micrometer, and a machine for draw­ing in perspective, which he had invented to facilitate his operations. Our limits do not allow us to go into the de­tails of his Reports, which are remarkable for their perspi­cuity and accuracy, although the work of a self-taught engineer. The last and greatest work upon which he was employed was the survey and estimate of the line of a ca­nal between Fort-William and Inverness, since executed by Mr Telford upon a larger scale than was at that time pro­posed, under the name of the Caledonian Canal.

Whilst engaged upon this survey, in the latter part of the year 1773, Mr Watt received the account of the death of his affectionate wife, who left him a daughter and a son. He appears soon after to have made up his mind to adopt the advice of his friend Dr Small of Birmingham, and the invitation of Mr Boulton, to settle in England. He had secured his title to his Improvements for saving Steam and Fuel in Fire-Engines, by patent, in the year 1769; but all hopes of carrying them into effect by the assistance of Dr Roebuck being at an end, he had induced that gentleman to agree, for certain considerations, to transfer his share of the patent to Mr Boulton of Soho, near Birmingham ; a gentleman equally distinguished by his knowledge of the arts and his enterprising spirit, who had some years before established his manufactory upon a scale as unrivalled for extent and elegance as for the variety and perfection of the processes carried on. In conjunction with him, an appli­cation was made to parliament for an extension of the term of the patent, and an act prolonging it for twenty-five years was obtained in the year 1775, when the business of making steam-engines was commenced by the firm of Boul­ton and Watt.

Mr Watt now married for his second wife Miss Macgri- gor, the daughter of an old friend at Glasgow, and devoted himself to the improvement of the details of the engine with a degree of application and exertion not to be expected from his delicate and infirm state of health ; and he found in his partner a zealous and able coadjutor. Some engines for pumping water were soon made upon a large scale, and the savings in fuel were demonstrated by repeated compara­tive trials to amount to three fourths of the quantity con­sumed by those of the best construction previously in use. A deputation from the mining interest of Cornwall was sent to ascertain the fact, and their report led to the in­troduction of the improved engines into that county, to which they have proved of such vast utility.

The immediate application of the powers of steam to giving a rotary motion to mills had formed an early object of Mr Watt’s attention, and he had deeply considered the various means of effecting this. One method of producing a continued movement in one direction was by a steam-wheel, described in his patent of 1769. Various others of a similar kind suggested themselves to him, of some of

@@@1 The Crinan Canal was executed several years afterwards, under the direction of his friend Mr Rennie, with some variations.