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978-1-108-06977-9 - Reports of the Late: John Smeaton: Made on Various Occasions, in the Course of his Employment as a Civil Engineer: Volume 1

John Smeaton

Frontmatter

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Reports of the Late John Smeaton

Celebrated for his construction of the Eddystone Lighthouse near Plymouth, John Smeaton (1724–92) established himself as Britain's foremost civil engineer in the eighteenth century. A founder member of the Society of Civil Engineers, he was instrumental in promoting the growth of the profession. After his death his papers were acquired by the president of the Royal Society, Sir Joseph Banks, Smeaton's friend and patron. Using these materials, a special committee decided to publish 'every paper of any consequence' written by Smeaton, as a 'fund of practical instruction' for current and future engineers. These were published in four illustrated volumes between 1812 and 1814. Volume 1 contains correspondence with and reports for clients regarding waterworks, canals, bridges, lighthouses and other engineering works, including harbour improvements at Christchurch, Bristol and Whitby. It also contains descriptions of some of Smeaton's inventions, such as an improved fire engine.

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Reports of the Late John Smeaton

*Made on Various Occasions,
in the Course of his Employment as a Civil Engineer*

VOLUME 1

JOHN SMEATON



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OF THE LATE

J O H N S M E A T O N , F . R . S .

V O L . I .

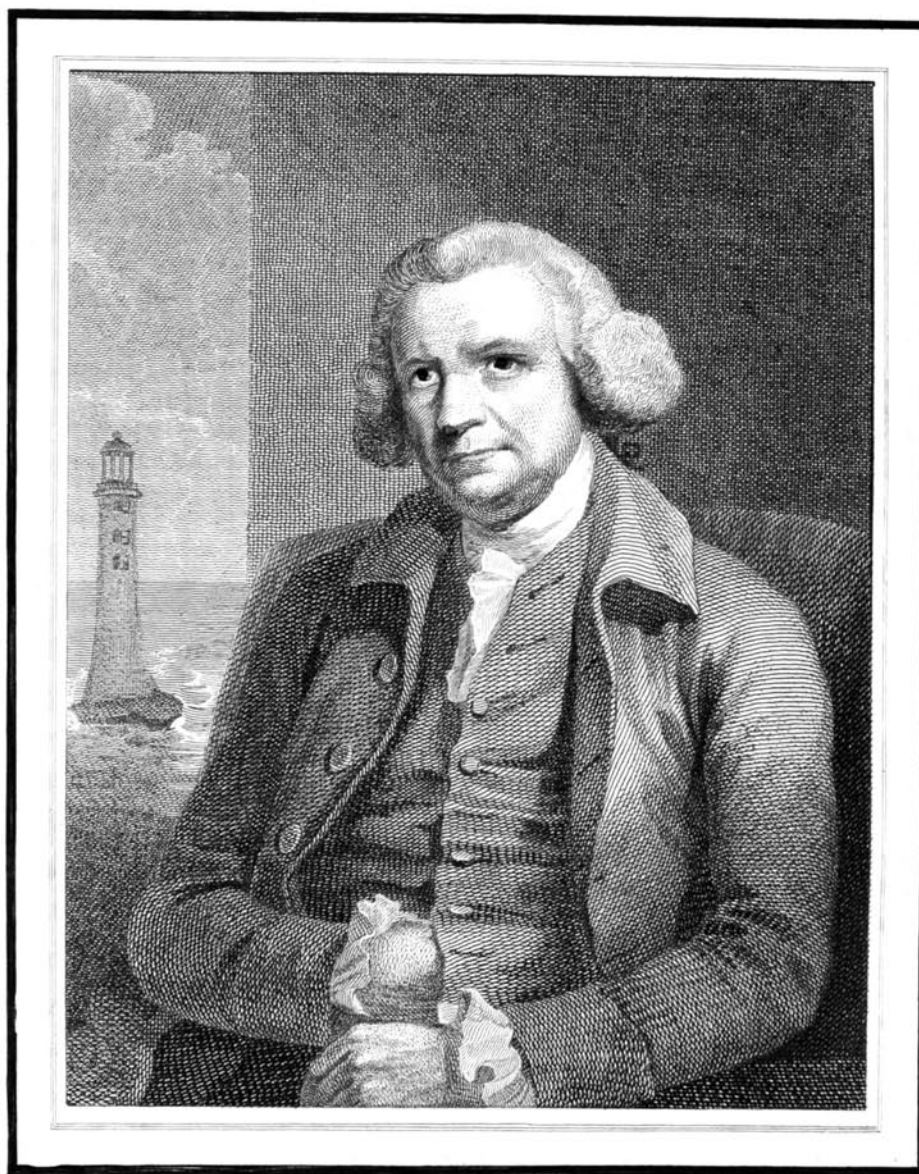
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John Smeaton

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JOHN · SMEATON ·
CIVIL · ENGINEER · F · R · S ·

Died Oct. 28. MDCCLXXXII. Aged 68 Years

*Painted by M^r Brown for A^c Aubert Esquire.
Engraved by M^r Bromley and Published for the
Society of Civil Engineers, by W. Faden. Feb. 1st 1798.*

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REPORTS

OF THE LATE

JOHN SMEATON, F.R.S.

MADE ON

VARIOUS OCCASIONS,

IN THE COURSE OF HIS EMPLOYMENT

AS

A CIVIL ENGINEER.

IN THREE VOLUMES.

VOL. I.

LONDON:

PRINTED FOR LONGMAN, HURST, REES, ORME, AND BROWN,
PATERNOSTER-ROW.

1812.

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P R E F A C E.

IT is with much satisfaction, the COMMITTEE OF CIVIL-ENGINEERS have, at length, so far accomplished their long wished for object, as now to present the public, with the first part of the works, of their late worthy and ingenious brother, Mr. JOHN SMEATON; one of the greatest Engineers, that this, or perhaps any country, ever produced.

As, the members of *this society* have interested themselves so greatly, in the publication of the present work; and the author of it had so great a share in the first establishment, as well as, the subsequent management of the society, it may not be amiss in this place, to employ a few words, in giving a short account of it, before any thing is said more particularly of the publication itself.

The origin of the *Society of Civil-Engineers*, took its rise from the following circumstances. Before or about the year 1760, a new æra in all the arts and sciences, learned and polite, commenced in this country. Every thing which contributes to the comfort, the beauty, and the prosperity of a country, moved forward in improvement, so rapidly, and so obviously, as to mark that period with particular distinction.

The learned societies extended their views, their labours, and their objects of research.—The professors of the polite arts associated together, for the first time; and they now enjoy a protection favourable to improvement, and not less honourable to real merit than to the *public*, and the THRONE, which have, with one accord, promoted their prosperity.

Nor have these exertions failed of producing the adequate effects, comparing the present with the past state of things.

Military and naval establishments were made, or enlarged, to promote and extend the true knowledge on which these sciences depend.

The *navy of England* sails now uncontrouled in every part of the habitable world; and her ships of war defy the combined power of all other maritime nations.

It was about the same period, that *manufactures* were extended on a new plan, by the enterprize, the capital, and, above all, by the science of men of deep knowledge and persevering industry engaged in them.

It was perceived, that it would be better for establishments to be set down on new situations, best suited for raw materials, and the labour of patient and retired industry, than to be plagued with the miserable little politics of corporate towns, and the wages of their extravagant workmen.

This produced a new demand, not thought of, till then, in this country,—*internal navigation*. To make communications from factory to factory, and from warehouses to harbours, as well as to carry raw materials, to and from such establishments, became absolutely necessary. Hence arose those wonderful works, not of pompous and useless magnificence, but of real utility, which are, at this time, carrying on to a degree of extent and magnitude, to which as yet there is no appearance of limitation.

The *ancient harbours* of this island, it may be said, have ever been neglected, considering the increase of its naval power, and a foreign commerce of which, there never has been an example, in the history of mankind. The *seaports* were, (I had almost said are,) such as nature formed, and providence has bestowed upon us; and they were but little better, previous to that period, notwithstanding some jetteés and piers of defence, ill placed, had been
made,

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made, and repeatedly altered, without knowledge and judgment, at *municipal*, not *government* expence.

This general situation of things gave rise to a new profession, and order of men, called CIVIL-ENGINEERS.

In all the polished nations of *Europe*, this was, and is, a profession of itself, and by itself.—Academies, or some parts of such institutions, were appropriated to the study of *it*, and of all the preparatory science and accomplishments necessary to form an able artist, whose profession comprehends the variety of objects on which he is employed; and of which, the present work, is an example and a proof.

In this country, however, the formation of *such artists* has been left to chance; and persons leaned towards the public call of employment, in this way, as their natural turn of mind took a bias —There was no public establishment, except common schools, for the rudimental knowledge necessary to all arts, naval, military, mechanical, and others.

CIVIL-ENGINEERS are a self-created set of men, whose profession owes its origin, not to power or influence; but, to the best of all protection, the encouragement of a great and powerful nation;—a nation become so, from the industry and steadiness of its manufacturing workmen, and their superior knowledge in practical chemistry, mechanics, natural philosophy, and other useful accomplishments.

When any one who has read the varied particulars of this publication, shuts, and lays it down for contemplation, he will reflect, on the natural talents and sagacity requisite in that mind, which applies to such a profession; on the patient application, necessary to acquire all the subservient learning, previous to the commencement of it; and, on the wonderful and varied powers, which this work exhibits.

This

The same period gave rise also to an association of some gentlemen, employed as abovementioned. They often met accidentally, prior to that union, in the Houses of Parliament, and in Courts of Justice, each maintaining the propriety of his own designs, without knowing much of each other. It was, however, proposed by one gentleman, to Mr. SMEATON, that such a state of *the profession*, then crude and in its infancy, was improper: and that it would be well, if some sort of occasional meeting, in a friendly way, was to be held; where they might shake hands together, and be personally known to one another:—That thus, the sharp edges of their minds might be rubbed off, as it were, by a closer communication of ideas, no ways naturally hostile; might promote the true end of the public business upon which they should happen to meet in the course of their employment; without jostling one another, with rudeness, too common in the unworthy part of the advocates of the law, whose interest it might be, to push them on perhaps too far, in discussing points in contest.

Mr. SMEATON immediately perceived the utility of the idea, and at once embraced it. In March 1771, a small meeting was first established, on Friday evenings, after the labours of the day were over, at the Queen's-Head Tavern, Holborn. And, from a few members at first, it soon increased; so that in the space of 20 years, they amounted to 65 and upwards. But of these, there were only about 15, who were real Engineers, employed in public works, or private undertakings of great magnitude,

Among these, we find the names, of YEOMAN, SMEATON, GRUNDY, MYLNE, NICKALLS, JESSOP, GOLBORNE, WHITWORTH, EDWARDS, JOS. PRIESTLY, Major WATSON, BOULTON, WHITEHURST, RENNIE, WATT, and some others. The other members were either amateurs, or ingenious workmen and artificers, connected with, and employed in, works of engineering.

This association declared itself A SOCIETY; and a register was kept, of the names and numbers of its members. Conversation, argument, and a social communication of ideas and knowledge, in the particular walks of each member,

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member, were, at the same time, the amusement and the business of the meetings.

In this manner, sometimes well attended, and at other times not so, as the members were dispersed all over England, THE SOCIETY, proceeded until May 1792; when it ceased to exist, by mutual consent of the principal members.

Some untoward circumstances, in the behaviour of one gentleman, towards Mr. SMEATON, gave rise to the disunion. No one, was ever more obliged than that gentleman, (who is now deceased,) to Mr. SMEATON, for promoting him in business, and many essential offices in life. The offence given, was done away by an apology, at the desire of the company, and by the good-nature of Mr. SMEATON; but the remembrance of it had an effect on all present.

Afterwards, it was conceived and intended to renew *this society*, in a better and more respectable form. Steps were taken for that purpose, and Mr. SMEATON agreed to be a member.—But alas! before the first meeting could be held, he was no more. He died the 28th of October, 1792; and their first meeting was in April, 1793.

It was conceived, it would be a better plan, that the members should dine together, at a late hour, after attendance in Parliament; and pass the evening in that species of conversation, which provokes the communication of knowledge, more readily and rapidly, than it can be obtained from private study, or books alone.

The first meeting of this new institution,
 THE SOCIETY OF CIVIL-ENGINEERS,
 was held on the 15th of April, 1793,
 by Mr. JESSOP, Mr. MYLNE, Mr. RENNIE, and Mr. WHITWORTH.

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The constitution was agreed on, and afterwards acceded to by all;—That there should be three classes in *the society*: The FIRST CLASS, as ordinary Members, to consist of real Engineers, actually employed as such, in public or in private service. The SECOND CLASS, as honorary members, to consist of men of science and gentlemen of rank and fortune, who had applied their minds to subjects of Civil-Engineering, and who might, for talents and knowledge, have been real Engineers, if it had not been *their good fortune*, to have it in their power to *employ* others in *this profession*; and also of those, who are employed in other public service, where such and similar kinds of knowledge is necessary.—And, the THIRD CLASS, as honorary members, also to consist of various artists, whose professions and employments, are necessary and useful to, as well as connected with, Civil-Engineering.

The meetings are held at the Crown and Anchor, in the Strand, every other Friday, during the session of Parliament. And the list of members are of the

F I R S T C L A S S.—ORDINARY MEMBERS.

ORDINARY MEMBERS.	}	WILLIAM JESSOP,
		ROBERT WHITWORTH,
		JOHN RENNIE, F. R. S. Ed.
		ROBERT MYLNE, F. R. S.
		JAMES WATT, F. R. S.—L. and Ed.
		JAMES GOLBORNE,
		Sir THOMAS H. PAGE, Knt. F. R. S.
		JOHN DUNCOMBE,
		Captain JOSEPH HUDDART, F. R. S.
		HENRY EASTBURNE,
		WILLIAM CHAPMAN, M. R. I. A.
JAMES COCKSHUTT.		

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SECOND CLASS.—HONORARY MEMBERS.

HONORARY MEMBERS.

The Right Hon. Sir JOSEPH BANKS, Bart. P. R. S.
 Knight of the Order of the Bath, &c.
 Sir GEORGE A. SHUCKBURGH EVELYN, Bart. F. R. S.
 MATHEW BOLTON, Esq; F. R. S.
 General BENTHAM,
 JOSEPH PRIESTLY, Esq;
 Doct^r CHARLES HUTTON, F. R. S.
 HENRY OXENDON, Esq;
 The Right Hon. the Earl of MORTON, F. R. S.
 JOHN LLOYD, Esq; F. R. S.
 Right Hon. CHARLES GREVILLE, Esq; F. R. S.

THIRD CLASS.—HONORARY MEMBERS.

WILLIAM FADEN, Geographer,
 JESSE RAMSDEN, F. R. S. Instrument-Maker, &c.
 JOHN TROUGHTON, Instrument-Maker, &c.
 JOHN FOULDS, Mill-Wright, &c.
 SAMUEL PHILLIPS, Engine-Maker,
 SAMUEL BROOKE, Printer,
 JOHN WATTE, Land-Surveyor, &c.

It may be mentioned, as a mark of the Society's regard, that a tribute is always paid, after dinner, *to the memory of their late worthy brother*, JOHN SMEATON. The publication of this work shews that their respect goes farther; by contributing a more substantial monument to his fame and character.

The Society having learnt that Sir JOSEPH BANKS had, for a considerable sum, purchased all the manuscripts, designs, drawings of every sort, and all

the papers of Mr. SMEATON, from his executors and representatives; with a conditional obligation, that if all or any of these papers should be published, and profit should arise from the publication, such profit or advantage should be made over to the said representatives, for their own use. This was a most liberal engagement on the part of Sir JOSEPH BANKS; and as his avocations, in all the walks of science and natural history, are so extensive, it was proposed to him, and most handsomely acquiesced in, that *the Society* should undertake to perform the task of publishing the Reports only, with the condition thereto annexed; and that the loss, if any, should be defrayed by themselves, as well as, that the profits, if any, should go to Mr. SMEATON's representatives.

In February, 1795, four gentlemen stepped forward for this purpose, who, together with Sir JOSEPH BANKS as one, and at the head of it, under the denomination of a Special Committee, have agreed to perform this service, such as it is, to the public; and to do it at their own risk, though not to their advantage, as abovementioned.

This Committee consists of

Sir JOSEPH BANKS, Bart. Knight of the Order of the Bath, President of the Royal Society, &c. &c.

Captain JOSEPH HUDDART,

WILLIAM JESSOP, Esq;

ROBERT MYLNE, Esq; and

JOHN RENNIE, Esq;

The Reports, only, were the great object of this Society, and of their Special Committee. These, they thought, would be of the greatest use to the profession, to teach actual and practical knowledge; as well to conceive advice and opinions given, as to convey them, with perspicuity and energy, to others.

Of these Reports, the present volume contains about one half; the remainder being intended for a second volume, if the present shall be approved by public encouragement.

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The manner in which the reports are here arranged, is in chronological order, or the time in which they occurred, for each subject; with this variation, that all the several reports on the same subject, when there were more than one, made at different times, are here brought together, and placed immediately following each other, as may be observed in several parts of this volume, particularly the concluding subject of it, namely, the machinery at the *Carron* iron-works, upon which there were several reports.

As to Mr. SMEATON's style and language, he had a particular, and in some degree a provincial way of expressing himself, and conveying his ideas, both in speaking and writing; a way which was very exact and impressive, though his diction was far from what may be called classical or elegant. A good workman or artist, of humble pretensions, in that respect, is however always eloquent on the subject of which he is truly master. His language and words, therefore, and even the orthography, have been closely adhered to, without taking the liberty to make any alterations, unless perhaps sometimes in the change of a letter or a word, where a manifest deviation from grammar occurred, such as the author would of himself have altered, had he been the editor.

To this volume is prefixed a short account of the life and writings of Mr. SMEATON, taken partly from Dr. HUTTON's Dictionary, and partly from additional Information supplied by the gentlemen of the committee.

A table of contents is also prefixed, and a general index is intended to be given at the end of the work.

SOME

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SOME ACCOUNT
OF THE
LIFE, CHARACTER, AND WORKS,
OF
MR. JOHN SMEATON, F. R. S.

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SOME ACCOUNT
OF
THE LIFE, &c.

MR. JOHN SMEATON, F.R.S. a very celebrated Civil Engineer, and author of the ensuing Reports, was born the 28th of May, 1724, at *Austhorpe*, near *Leeds*, *Yorkshire*, in a house built by his grandfather, where the family have resided ever since, and where our author died the 28th of October, 1792, in the 68th year of his age.

Mr. SMEATON seems to have been born an Engineer. The originality of his genius and the strength of his understanding appeared at a very early age. His playthings were not those of children, but the tools men work with; and he had always more amusement in observing artificers work, and asking them questions, than in any thing else. Having watched some mill-wrights at work, he was one day, soon after, seen (to the distress of his family) on the top of his father's barn, fixing up something like a windmill. Another time, attending some men who were fixing a pump at a neighbouring village, and observing them cut off a piece of bored pipe, he contrived to procure it, of which he made a working pump, that actually raised water. These anecdotes refer to circumstances that happened, when he was hardly out of petticoats, and probably before he had reached the 6th year of his age. About his 14th or 15th year, he made for himself an engine to turn rose-work, and he made several presents to his friends of boxes, in wood and ivory, turned by him in that way.

His friend and partner in the *Deptford* Water-works, Mr. JOHN HOLMES, visited Mr. SMEATON, and spent a month with him at his father's house, in the year 1742, when consequently our author was about 18 years of age.

Mr. HOLMES

Mr. HOLMES could not but view young SMEATON's works with astonishment: he forged his own iron and steel, and melted his own metals: he had tools of every sort for working in wood, ivory and metals. He had made a lathe, by which he had cut a perpetual screw in brass, a thing very little known at that day.

Thus had Mr. SMEATON, by the strength of his genius, and indefatigable industry, acquired, at 18 years of age, an extensive set of tools, and the art of working in most of the mechanical trades, without the assistance of any master, and which he continued to do a part of every day when at the place where his tools were; and few men could work better.

Mr. SMEATON's father was an attorney, and was desirous of bringing his son up to the same profession. He was therefore sent up to London in 1742, where for some time he attended the courts in *Westminster-Hall*; but finding that the profession of the law did not suit *the bent of his genius*, (as his usual expression was,) he wrote a strong memorial to his father on the subject, whose good sense from that moment left Mr. SMEATON to pursue the bent of his genius in his own way.

Mr. SMEATON after this continued to reside in *London*, and about the year 1750 he commenced philosophical instrument maker, which he continued for some time, and became acquainted with most of the ingenious men of that time.

This same year he made his first communication to the Royal Society; being an account of Dr. KNIGHT's improvements, of the Mariner's Compaſs. Continuing his very useful labours, and making experiments, he communicated to that learned body, the two following years, a number of other ingenious improvements, as will be enumerated in the list of his writings, at the end of this account of him.

In 1751 he began a course of experiments, to try a machine of his invention for measuring a ship's way at sea; and also made two voyages, in company with Dr. KNIGHT, to try it, as well as a compaſs of his own invention.

In

LIFE OF MR. JOHN SMEATON.

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In 1753 he was elected a member of the Royal Society; and in 1759 he was honoured with their gold medal, for his paper concerning the natural powers of water and wind to turn mills, and other machines depending on a circular motion. This paper, he says, was the result of experiments made on working models in the years 1752 and 1753, but not communicated to the Society till 1759; having, in the interval, found opportunities of putting the result of these experiments into real practice, in a variety of cases, and for various purposes, so as to assure the Society he had found them to answer.

In 1754, his great thirst after experimental knowledge led him to undertake a voyage to Holland and the Low Countries, where he made himself acquainted with most of the curious works of art so frequent in those places.

In December 1755, the *Edystone Lighthouse* was burnt down, and the proprietors, being desirous of rebuilding it in the most substantial manner, enquired of the Earl of MACCLESFIELD, then President of the Royal Society, who he thought might be the fittest person to rebuild it; when, he immediately recommended our author. Mr. SMEATON accordingly undertook the work, which he completed with stone in the summer of 1759. Of this work he gives an ample description in a folio volume, with plates, published in 1791; a work which contains, in a great measure, the history of four years of his life, in which the originality of his genius is fully displayed, as well as his activity, industry and perseverance.

Though Mr. SMEATON completed the building of the *Edystone Lighthouse* in 1759, yet it seems he did not soon get into full business as a Civil Engineer; for in 1764, while in *Yorkshire*, he offered himself a candidate for one of the receivers of the *Derwentwater* estate; in which he succeeded, though two other persons, strongly recommended and powerfully supported, were candidates for the employment. In this, he had the faithful and friendly support of Sir FRANCIS GOSLING, Alderman of *London*, and one of the Commissioners. That estate was forfeited in the year 1715, and the revenues thereof were applied by Parliament, towards the fund of *Greenwich Hospital*. It consists of mines of lead, containing much silver, as well as lands.

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It required, better than common management, and above all, that knowledge absolutely necessary to bring mines of lead and coal to the most productive effect. This was the object of the Commissioners, and it has been amply repaid. Machines of all kinds, and better means on a great plan, were devised for a more easy and ample working these mines, by Mr. SMEATON: while, the correct judgment, patient industry, and great abilities and sincerity of Mr. WALTON the younger, of *Farnacres* near *Newcastle*, (his partner in the duty of receiver,) taking upon himself the management and the accounts, left Mr. SMEATON, leisure and opportunity, to exert his abilities on these works, as well as to make many improvements in the whole of this estate of *Greenwich Hospital*.

By the year 1775 he had so much business, as a Civil Engineer, that he was desirous of resigning the appointment for that Hospital, and would have done it then, had not his friends prevailed upon him, to continue in the office about two years longer.

Mr. SMEATON having thus got into full business as a Civil Engineer, it would be an endless task to enumerate all the various concerns he was engaged in. A very few of them however may be just mentioned in this place.—He made the river *Calder* navigable; a work that required great skill and judgment, owing to the very impetuous floods in that river.—He planned, and attended for some time, the execution of the great, or *Forth* and *Clyde*, canal in *Scotland*, for conveying the trade of the country either to the *Atlantic* or *German Ocean*. When this work had been executed from the *Forth* towards the *Clyde*, as far as a point intended for the junction of a collateral canal to *Glasgow*, the work stopped, and was discontinued a considerable time, by the funds being exhausted. Before that period, Mr. SMEATON had declined accepting his salary, which was five hundred pounds a year, that he might not be prevented from attending to the multiplicity of other business; and conceiving the resident engineer, Mr. M'KELL, was fully competent to conduct it afterwards. After a lapse of some time, the work was resumed, by public aid, and has been carried on, and lately completed, under the direction of Mr. WHITWORTH, to the great benefit of trade and that country.

On

LIFE OF MR. JOHN SMEATON.

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On opening the great arch at *London Bridge*, by throwing two arches into one, and the removal of a large pier, the excavation, around and underneath the sterlings of that pier, was so considerable, as to put the adjoining piers, that arch, and eventually the whole bridge, in great danger of falling. The previous opinions of *some*. were positive, and the apprehensions of *all* the people on this head were so great, that many persons would not pass over or under it. The Surveyors employed were not adequate to such an exigency. Mr. SMEATON was then in *Yorkshire*, where he was sent for by express, and from whence he arrived in town with the greatest expedition. He applied himself immediately to examine the bridge, and to sound about the dangerous sterlings, as minutely as he could. The Committee of Common Council adopted his advice; which was, to re-purchase the stones of all the City Gates, then lately pulled down, and lying in *Moorfields*, and to throw them pell-mell, (or *piere perdu*,) into the water, to guard these sterlings, preserve the bottom from further corrosion, raise the floor under the arch, and restore the head of water necessary for the water-works to its original power; and this was a practice, he had before, and afterwards adopted on other occasions. Nothing shews the apprehensions of the bridge falling, more, than the alacrity with which his advice was pursued: the stones were re-purchased that day; horses, carts, and barges were got ready, and the work instantly begun, though it was Sunday morning. Thus Mr. SMEATON, in all human probability, saved *London Bridge* from falling, and secured it till more effectual methods could be taken.

In 1771 he became, jointly with his friend Mr. HOLMES above-mentioned, proprietor of the works for supplying *Deptford* and *Greenwich* with water; which, by their united endeavours, they brought to be of general use to those they were made for, and moderately beneficial to themselves.

Astronomy was one of Mr. SMEATON's most favorite studies; and he contrived and made several astronomical instruments for himself and friends. After fitting up an observatory at his house at *Austhorpe*, he devoted much of his time to it when he was there: even in preference to public business, much of which he declined for the purpose of applying his attentions to private study, particularly to the subject of astronomy.

About the year 1785 Mr. SMEATON's health began to decline; and, in consequence, he then took the resolution to avoid new undertakings in business as much as he could, that he might thereby also have the more leisure to publish some accounts of his inventions and works. Of this plan, however, he got no more executed than the account of the *Edystone Light-house*, and some preparations for his intended treatise on mills; for he could not resist the solicitations of his friends in various works. Mr. AUBERT, whom he greatly loved and respected, being chosen chairman of *Ramsgate Harbour*, prevailed upon him to accept the office of Engineer to that harbour, an office established at that time, as, he had been occasionally consulted only, previous thereto; and to *their joint efforts* the public are chiefly indebted for the improvements that have been made there, within these few years; which fully appears in a Report that Mr. SMEATON gave in to the Board of Trustees in 1791, which has been published in various ways.

The powers of his mind were beginning to fail, in the observation of his intimate friends, and afterwards of all. He is known to have said, on talking of his health, that he found he had suffered more from the application he paid to the scheme, design, and proposition of a Canal from *Birmingham* to *Worcester*, (which was then very much contested in Parliament) than all the business he had ever met with.

Strong exertions were necessary; which, if he had been vigorous as he was wont, it would have sat easy upon him; but alas! with the deficiency then commenced, it was hard labour indeed, and thereby promoted, the ruin fast approaching, and much to be lamented.

This lamentable tale is told, for the instruction of *those* engaged, and so circumstanced, at that period of life, when the powers of the mind are borne down by the complication and vastness of an object submitted to it.

The bill for that work passed by a small majority; but the difficult and contested part of that work has not as yet been attempted. He was not the proposer, but the supporter of that proposition.

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It had for many years been the practice of Mr. SMEATON to spend part of the year in town, and the remainder in the country, at his house at *Austhorpe*. On one of these excursions in the country, while walking in his garden, on the 16th of September, 1792, he was struck with the palsy, which put an end to his useful life the 28th of October following, to the great regret of a numerous set of friends and acquaintance.

The great variety of mills constructed by Mr. SMEATON, so much to the satisfaction and advantage of the owners, will shew the great use he made of his experiments in 1752 and 1753. Indeed he scarcely trusted to theory in any case where he could have an opportunity to investigate it by experiment; and for this purpose he built a steam-engine at *Austhorpe*, that he might make experiments expressly to ascertain the power of the OLD or NEWCOMEN'S steam-engine; which he improved and brought to a much greater degree of certainty, both in it's construction and powers, than it was before.

During many years of his life, Mr. SMEATON was a constant attendant on Parliament, his opinion being continually called for. And here his natural strength of judgment and perspicuity of expression had their full display. It was his constant practice, when applied to, to plan or support any measure, to make himself fully acquainted with it, and be convinced of it's merits, before he would be concerned in it. By this caution, joined to the clearness of his description, and the integrity of his heart, he seldom failed, having the bill he supported, carried into an act of Parliament. No person was heard with more attention, nor had any one ever more confidence placed in his testimony. In the Courts of Law he had several compliments paid to him from the Bench, by the late Lord MANSFIELD and others, on account of the new light he threw upon difficult subjects.

As a Civil Engineer, he was perhaps unrivalled, certainly not excelled, by any one, either of the present or former times. His building the *Edystone Lighthouse*, were there no other monument of his fame, would establish his character. The *Edystone Rocks* have obtained their name from the great variety of contrary sets of the tide or current in their vicinity. They are
situated

situated nearly S. S. W. from the middle of *Plymouth Sound*. Their distance from the port of *Plymouth* is about fourteen miles. They are almost in the line which joins the *Start* and the *Lizard Points*; and as they lie nearly in the direction of vessels coasting up and down the *Channel*, they were unavoidably, before the establishment of a lighthouse there, very dangerous, and often fatal to ships. Their situation, with regard to the *Bay of Biscay* and the *Atlantic*, is such, that they lie open to the swells of the bay and ocean, from all the south-western points of the compass; so that all the heavy seas, from the south-west quarter, come uncontrolled upon the *Edystone Rocks*, and break upon them with the utmost fury. Sometimes, when the sea is to all appearance smooth and even, and its surface unruffled by the slightest breeze, the ground swell meeting the slope of the rocks, the sea beats upon them in a frightful manner, so as not only to obstruct any work being done on the rock, or even landing upon it, when, figuratively speaking, you might go to sea in a walnut shell. That circumstances, fraught with danger surrounding it, should lead mariners to wish for a lighthouse, is not wonderful; but the danger attending the erection leads us to wonder, that any one could be found hardy enough, to undertake it. Such a man was first found in the person of Mr. H. WINSTANLEY, who, in the year 1696, was furnished by the *Trinity House* with the necessary powers. In 1700 it was finished; but in the great storm of November, 1703, it was destroyed, and the projector perished in the ruins. In 1709 another, upon a different construction, was erected by a Mr. RUDYERD, which, in 1755, was unfortunately consumed by fire.

The next building was under the direction of Mr. SMEATON, who, having considered the errors of the former constructions, has judiciously guarded against them, and erected a building, the demolition of which seems little to be dreaded, unless the rock on which it is erected should perish with it. Of his works, in constructing bridges, harbours, mills, engines, &c. &c. it were endless to speak.

Of his inventions and improvements of philosophical instruments, as of the air-pump, the pyrometer, hygrometer, &c. &c. some idea may be formed from the list of his writings inserted below.

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In his person, Mr. SMEATON was of a middle stature, but broad and strong made, and possessed of an excellent constitution. He had great simplicity and plainness in his manners: he had a warmth of expression that might appear, to those who did not know him well, to border on harshness; but, such as were more closely acquainted with him, knew it arose from the intense application of his mind, which was always in the pursuit of truth, or engaged in the investigation of difficult subjects. He would sometimes break out hastily, when any thing was said that was contrary to his ideas of the subject; and he would not give up any thing he argued for, till his mind was convinced, by the deducement of facts, before unknown to him, and by sound reasoning. In all the social duties of life, Mr. SMEATON was exemplary; he was a most affectionate husband, a good father, a warm, zealous, and sincere friend, always ready to assist those he respected, and often before it was pointed out to him in what way he could serve them. He was a lover and an encourager of merit wherever he found it; and many persons now living are in a great measure indebted for their present situation to his assistance and advice. As a companion, he was always entertaining and instructive, and none could spend their time in his company without improvement.

As to the list of his writings; besides the large work above-mentioned, being the History of the *Edystone Lighthouse*, and numbers of Reports and Memorials, many of which were printed, his communications to the Royal Society, and inserted in their Transactions, are as follow:

1. An Account of Dr. KNIGHT'S Improvements of the Mariner's Com-
pafs. An. 1750, pa. 513.
2. Some Improvements in the Air-Pump. An. 1752, pa. 413.
3. An Engine for raising Water by Fire; being an Improvement on
SAVARY'S Construction, to render it capable of working itself; invented
by M. DE MOURA, of Portugal. Ib. pa. 436.
4. Description of a new Tackle, or Combination of Pulleys. Ib. pa. 494.
5. Experiments on a Machine for measuring the Way of a Ship at Sea.
An. 1754, pa. 532.

6. Description

6. Description of a new Pyrometer. Ib. pa. 598.
7. Effects of Lightning on the Steeple and Church of *Lestwithial* in *Cornwall*. An. 1757, pa. 198.
8. Remarks on the different Temperature of the Air at *Edystone Lighthouse* and at *Plymouth*. An. 1758, pa. 488.
9. Experimental Enquiry concerning the natural Powers of Water and Wind to turn Mills, and other Machines depending on a circular Motion. An. 1759, pa. 100.
10. On the Menstrual Parallax arising from the mutual Gravitation of the Earth and Moon, it's Influence on the Observation of the Sun and Planets, with a Method of observing it. An. 1768, pa. 156.
11. Description of a new Method of observing the Heavenly Bodies out of the Meridian. An. 1768, pa. 170.
12. Observations on a Solar Eclipse. An. 1769, pa. 286.
13. Description of a new Hygrometer. An. 1771, pa. 198.
14. An Experimental Examination of the Quantity and Proportion of Mechanical Power necessary to be employed in giving different Degrees of Velocity to heavy Bodies from a State of Rest. An. 1776, pa. 450.