

◆ Cater Rand, an engineer in Georgian Sussex

By John H. Farrant

Cater Rand (1749–1825), a Lewes schoolmaster with some education and continuing interest in science, practised also as an engineer, on projects ranging from training in military fortification in Ireland to equipment for life-saving from the Sussex cliffs. He concentrated, though, on land drainage, river navigation, coastal defences and harbour works in Sussex. Within the old tradition of multi-occupation surveyors, Rand with some success made the transition from work which finished up in a map, to civil engineering. But on several occasions, he found himself at odds with the emerging cadre of ‘professional’ consulting engineers who operated nationally.

INTRODUCTION

When in 1837 building of the first steam railway in Sussex, between London and Brighton, began, the great majority of the county’s substantial engineering works dated from the previous 60 years. All the river navigations and canals (bar 16th-century improvements on the Arun) were built between 1785 (the Arun to Newbridge) and 1827 (the Adur to Baybridge), while improvements were made to the drainage of many of the levels, the low-lying lands bordering rivers or seashore liable to flooding. Major works were undertaken on Shoreham and Rye harbours, and alterations were made to piers built in the 1730s at the other two estuarine harbours in Sussex, Littlehampton and Newhaven. Brighton Chain Pier, to encourage the cross-Channel packet traffic, was built in 1822–3. Turnpike roads there were in some number by 1780, but the following decades saw a substantial increase in mileage and, after 1800, improvements in quality. The building and maintenance of bridges by the county justices advanced apace, while local Acts authorised the toll bridges near the mouths of the Adur (1781) and the Ouse (1784). Public gas works appeared in the second decade of the 19th century. And numerous other schemes never went beyond the drawing boards (or fertile minds) of engineers, amateur and professional.

These works, mostly in transport, furthered Sussex’s integration into regional and national economies, by improving marketing of agricultural produce, distribution of coal and access to the burgeoning seaside resorts. The men who planned

and directed them were therefore a significant group. Cater Rand, a Lewes schoolmaster, is frequently recorded between 1775 and 1825 as associated with engineering projects in eastern Sussex. Few were completed to his plans or under his direction, but he seems to have played a useful role in stimulating or advancing interest in such projects and (albeit not consistently) in support of the engineers who did direct the works. Furthermore, the projects with which he was involved provide a cross-section of the types of engineering work, with the exception of roads, contemplated or executed in Sussex around 1800.

THE ‘PROFESSIONAL’ CIVIL ENGINEERS

Before the 19th century, in a rural area such as Sussex, there were very few ‘engineers’ who had some degree of technical competence and scientific knowledge and who worked only in their home area. One before Rand’s time is known, Captain William Markwick of Battle and Catsfield (1666–1740). His father James had prospered as a clockmaker in London and bought land in Sussex.¹ Between at latest 1709 and 1733, William was employed by the Lords, Bailiffs and Jurats of Romney Marsh. He was responsible for a sluice to drain Pevensey Levels in 1694, piers at Folkestone in 1709 and groynes at Brighton in 1724. His advice to John Warburton on works for Newhaven harbour in 1724 was informed by the inspections he had made for the Duke of Newcastle, on how to protect Bishopstone marshes from encroachment. John Pursglove of Herstmonceux (d. 1718) was described

by the appraisers of his chattels as 'blacksmith and engineer', and in 1712 was the 'ingenious engineer' formerly employed in the mines 'in the northern counties' (probably Derbyshire), who 'with his instruments bored through the [Roman tessellated] pavement' found at Eastbourne. But he seems to have been a craftsman rather than a man of science, dying possessed of bellows, an anvil and 'other tools'.²

Before the Civil War, foreign engineers were occasionally engaged to advise on harbour works, Flemings at Rye in 1577 and a Dutchman, Hendrick Cranhalls, at Hastings in 1636.³ But thereafter English talent was used, in combined roles. The initial design of 1724 for the new harbour at Rye was by Captain John Perry, who was also engaged for three quarters of his time to supervise construction. His clerk, Edward Rubie, later contracted for part of the work. For the harbour works of the 1730s at Newhaven and Littlehampton, John Reynolds, who, as a carpenter from Poplar, was earlier a contractor at Rye, acted as both engineer and contractor. The piers of 1760 at Shoreham were probably based on a plan of 1753 for the Admiralty by J. P. Desmaretz, chief engineer at Portsmouth dockyard, but Reynolds's son took a similar role as contractor as had his father. Such arrangements were typical for their period, but there was a marked change of practice from the 1760s, under the lead of John Smeaton (1724–92). Smeaton 'acquired remarkably early a very clear conception of the professional role of the engineer as a consultant mediating between a client and a contractor', a role which left him free to undertake commissions as and when he wished. Each of the leading engineers to whom he provided inspiration and leadership was frequently retained simultaneously for several projects in different parts of the country. An important role for the consultants was to appear before select committees of the Houses of Parliament to testify on the Bills to authorise projects. By that means they became known to MPs and peers who might later be leading promoters of projects in the provinces.⁴

The first generation of self-consciously professional civil engineers, commanding a body of specialised knowledge, definitely distinct from the craftsmen, and active in the third quarter of the 18th century, made little appearance in Sussex, though Smeaton reported on Rye harbour in 1763–4 and on the lower Ouse in 1768. But several of the

great names of the second generation did work in the county. The one most involved was Smeaton's pupil William Jessop (1745–1814). Between 1783 and 1806 he was consultant engineer for the Upper Ouse, Lower Ouse and Western Rother (and possibly the Arun) Navigations and for works at Rye and Littlehampton harbours, and also drew up several plans which were not executed. Second to him was John Rennie (1761–1821), who produced a considerable volume of proposals relating to Sussex between 1797 and 1810, though only two were implemented, for the Portsmouth and Arundel Canal and the Royal Military Canal.⁵ Besides these famed engineers, there were also those of the second rank, but nevertheless competent (such as Daniel Alexander, surveyor to Trinity House and to the London Dock Company, who reported on Rye Harbour in 1813 and 1817), and the largely unsuccessful (such as Ralph Dodd of London (1756–1822) who proposed for Brighton a harbour, 1806, a water-supply scheme, 1810, and a pier, 1819).⁶ Some, through practical experience, acquired a certain degree of competence. William Clegam (1784–1863), master of a cross-Channel packet boat until 1816, was resident engineer for Shoreham harbour, 1816–21, and Brighton Chain Pier, 1822–3, and earned sufficient regard to be appointed in 1826 first superintendent of the Gloucester & Berkeley Canal, on Thomas Telford's recommendation.⁷

Smeaton defined a hierarchy of engineering supervision, beginning with himself as consultant and passing through resident engineers, who were employed by the company undertaking the project, and such assistant engineers as were necessary. This hierarchy became the norm for all major projects. If no resident engineer was appointed it fell to the contractor, as work proceeded, to take all the operational decisions or to act on the direct instructions of the corporate client, perhaps represented in person by one of the proprietors or trustees. The number of consultant, resident, assistant and pupil engineers, plus senior freelance engineers of equivalent professional calibre, in all branches in Britain in the second half of the 18th century is estimated at only about 260. As well as for the consultant, a national market developed for the resident engineer and for the contractor. In 1790, if the Upper Ouse Navigation was unable to find a contractor, Jessop suggested a man from Birmingham who could supervise

a direct labour force. The company engaged the Pinkertons, contractors who worked on a host of Midland navigations. After their default, Jessop warned of the shortage of resident engineers, a proprietor tapped his contacts in Bristol, but the Mr Hodgskinson appointed as superintendent seems not to have stayed for long. After the initial works were complete, the person responsible for maintenance might be a local man with no technical skill: the expeditor of the Upper Ouse in 1822–33 started ‘as a mere river-digger’ and ‘was not a man of science’.⁸

From well before the 18th century there were readily available men who could survey land and prepare estate maps. Prominent in eastern Sussex in the 1720s was Richard Budgen (1695–1731) who published a map of the whole county and whose son and grandsons were also surveyors.⁹ Thomas Marchant was the leading surveyor later in the century. Such men might be employed to prepare the survey which informed the consultant engineer’s proposals for the line of a canal or navigation. In respect of the (earlier) turnpike roads they played a more significant role because the engineering knowledge required was slight, for few trusts improved the alignment of their roads.¹⁰ When methods of constructing the carriageway were revolutionised, a body of specialist engineers followed. In 1817, a federation of nine East Sussex turnpike trusts adopted McAdam’s system and he recommended a trained surveyor for appointment, J. W. Campbell, who had worked under him in Bristol.¹¹ The main road bridges were the responsibility of the justices in quarter sessions who probably looked, for their design and repair, to the same people as they would for buildings, namely masons and, for the more prestigious projects, what were later called architects. Thus Lewes bridge (1727) was designed by Captain Nicholas Dubois, concurrently responsible also for Stanmer House, while the New Gaol at Horsham (1775–9) was to the designs of William Ride, who supervised works for the Duke of Richmond and other noblemen.¹² John Johnson from Camden Town was, on the strength of his Shire Hall in Chelmsford, commissioned in 1801 to design County Hall, Lewes.¹³ John Cowper, a local architect and builder, was appointed clerk of works, the keeper of the completed building, and finally, in 1815, the first ‘Surveyor of County Buildings and Bridges’ for East Sussex.¹⁴

It is against this background of the embryo engineering profession that the interest of Cater Rand’s career lies. He was a local man of some scientific knowledge who was involved in a variety of engineering works, several of which presented problems of some complexity, but during the period when, for sizeable projects, it was becoming customary to retain a consultant engineer of national reputation. No collection of his own papers is known to survive: only one document used here is likely to have been in his possession at his death, a notebook started in 1817, but possibly one in a series extending back to at least 1772. Our knowledge of his life and work depends on references in records maintained by those other people and organisations with whom he had contact, in personal, official and professional contexts. The range and diversity of the records in which he is found mentioned give some confidence, though, that the resulting account is reasonably representative of his ‘engineering’ work.

THE SCHOOL IN LEWES

Cater Rand’s grandfather bore the same distinctive forename, being his mother’s maiden name, and was born in 1684 in Colchester, Essex, where at his death he still owned property. He was appointed to the Excise service in 1707 and had postings in Sussex at Wadhurst, Cuckfield and Horsham before coming to Lewes in 1715, living first in Southover and then in St Michael’s.¹⁵ The Excise was at this period the most efficient branch of the civil administration, and, though needing political influence to gain appointment, its officers were required to be competent in bookkeeping and complex arithmetic to calculate quantities and the taxes due. Fairly frequently they retired to school teaching with a commercial bias. Rand was one of them, being discharged from the Excise in July 1731 because he refused to be transferred to Chichester.¹⁶ By November 1732 he was running a school in Lewes: Thomas Pelham of Stanmer paid him for schooling a boy, and his kinsman the Duke of Newcastle did likewise in 1734. In that year the poll book described him as a schoolmaster, and Rand duly voted for two Pelhams. The school was to continue through three generations of the Rand family until 1809, with Pelham patronage for at least 60 years.

That patronage had since 1711 supported a Grey Coat charity school in Lewes, doubtless with the free places being deployed to support the family's political interest. In the run-up to the April 1734 election, John Head, the master from at least 1721, was induced by promise of support for his school to switch his allegiance to the Pelhams' Tory opponents. The Revd Anthony Springett, Rector of Westmeston, thereupon proposed to endow Rand's school with a £50 annuity running to 1805, and instructed Rand to admit 20 boys without charge from March 1734. A year later Rand sent his bill to Springett — who responded that he could afford only £5 and looked to Pelham and his friends to make up the difference in his lifetime. Indignant at the suggestion that he should vest the annuity in trustees immediately, in April 1735 he wrote his will to bequeath the annuity for the benefit of five other local schools. William Hay of Glyndebourne urged the Duke to act, and it may have been from then (and certainly from 1737) that dated the Duke's donation to Rand's school. It was £20 a year in the 1730s and £12 a year in 1765 (for 'educating 18 boys at the writing school at Lewes'), and was continued until at least 1795 by his heir in Sussex, Thomas Pelham (1728–1805). In 1784 Pelham's steward specified that boys should be admitted, with a letter from him, between the ages of eight and twelve, and that he should receive quarterly reports on their attendance.¹⁷

Cater Rand the elder died in 1748 and the school was continued first by his second son Charles (1719–63) who had been assisting his father as early as 1735, then by Charles's widow, Lucy (1721/2–81, daughter of Richard Verrall, master of the White Hart). From at least 1744 Cater had run the school, as the Pelhams' tenant, at 159–160 High Street, immediately east of St Michael's church. In 1761 Charles reminded Newcastle that almost ten years previous he had promised to have a school built at his house and to settle accounts; 'as my family is large a remittance... will be very acceptable.' A schoolroom was built to the rear of no. 159, which since 1858 has been part of the photographic studio of Edward Reeves and his descendents (Fig. 1). Like his father before him since about 1742, Charles was also writing master at the town's grammar school, teaching on his own premises, as well as taking fee-paying pupils.¹⁸

Cater Rand, born on 9 December 1749, was the eldest child to survive infancy. In 1775 he

married Mary, the 20-year-old daughter of Thomas Scrace, also master of the White Hart; she died in 1783. They had six children, two sons and four daughters. Both sons entered the service of the East India Company and predeceased their father; three daughters married Army officers, one of them in Calcutta where the fourth also married. Cater did not remarry, but he did get a Laughton girl, Elizabeth Dedley, pregnant in 1803; perhaps she had been a servant in his household. He died on 21 December 1825, aged 76, and was buried at St Michael's.¹⁹

Shortly before he died, Charles had amended his will to bequeath to Cater, if he chose 'the business of schoolmaster, all my mathematical books and instruments', thereby indicating the bias of the school's curriculum and of Cater's early education. Presumably he gained more advanced instruction outside the town, before he is found in Lewes in January 1771 as a ratepayer. In October 1773 he published a ready reckoner for the value of gold according to the quantity and price per ounce, as the Government had recalled light-weight gold coin that summer; the title page describes him as 'writing-master and accomptant'.²⁰ In that year he also took over from his mother the Newcastle tenancy, and in early September advertised that

AT LEWES, in SUSSEX, YOUTH are commodiously Boarded, Educated, and Qualified for all Manner of Business,

augmenting this in December with:

Mr RAND, with an ardent Desire of opening the narrow confined Ideas of Youth, (which is too much neglected) intends going through a COURSE of LECTURES in EXPERIMENTAL PHILOSOPHY, Three Evenings a Week with the first Principles of Religion, Taste, and Learning, and [to] elevate their Minds, as they advance in Years, above the low Pursuits of sensual and tasteless Amusements.²¹

An advertisement a year later emphasised the use of the latest experimental equipment, his pupils being:

taught the various Branches of the Mathematics, with the Use and Construction of the latest improved Instruments, &c. to facilitate and expedite the Theory and Practice of the Mathematical Arts, which immediately concern us, and are indispensably necessary in the common Affairs of Life, by ocular Demonstration, in a Series of Lectures, and



Fig. 1. St Michael's church, Lewes, by Henry Petrie (1772–1842), ?1803, with Cater Rand's schoolroom to the left, at the rear of 159 High Street (Sussex Archaeological Society, Sharpe Collection 207).

the Learners' own Practice on the Globes, Orrery, Conic Sections, Hadley's Quadrant, Theodolite, Sector, Scale, Sliding-Rule, Charts, Maps, Diagrams, &c. &c. and on a large Philosophical Apparatus, consisting of Electric Machines, Air Pump, the Mechanical Powers, Microscopes, Telescopes, Hydrostatic Balance, and many other Contrivances, to render the Mathematical Arts easily attainable.

In June 1775 a laboratory was added, and in December he had purchased the house adjoining (no. 161) and fitted it up for the reception of boarders. A large private playing yard was walled round. Religion, morality, chronology and history were now offered, as well as private instruction in mathematics every evening between 7 and 9, except when the lectures were given. The following autumn, a native of France was teaching French.²²

Genteel pursuits like dancing found no place in the curriculum, and indeed Rand styled his school in 1779 the 'Lewes Commercial and Mathematical School', 'the plan of which is to form the man of business', clearly differentiating

it from the grammar school where Latin and Greek were taught. The attention to mathematics and its practical applications was progressive but not innovative. In Sussex higher mathematics was routinely being offered in boys' schools from the early 1770s, with 37 schools down to 1800 so doing. Only four predated Rand's, in the Cliffe at Lewes in 1769–71, in Seaford in 1771 (and maybe later), Edward Allfree's at Herstmonceux from at latest 1771 and, premier amongst them, Benjamin Martin's in Chichester in 1734–41 whose teaching was reflected in his much reprinted and translated *Philosophical grammar* (1735) and *The young trigonometrer's compleat guide* (1736).²³

The course of Rand's lectures had from the outset been repeated for the public, with 20 seats available at one shilling per lecture. In early 1774 the courses comprised three on pneumatics, four on electricity and three on astronomy. In the winter of 1775–6, the lectures numbered 14 and encompassed, in addition, geography, mechanics, optics and hydrostatics, plus, for the pupils only, religion, morality, chronology and history, and in 1776–7 were increased to 20 with magnetism,

hydraulics and chemistry added. Hitherto science teaching had been offered to the gentlefolk of Lewes only by itinerant lecturers, such as Mr Silk who visited the town in 1761, and Mr Pitt who, in 1776, asserted that 'no travelling philosopher, with such an extensive set of instruments, hath been in these parts these twenty or thirty years.' As Rand did not offer his lectures after 1777, there may not have been much demand for his or Mr Pitt's.²⁴

Following his wife's death in 1783 and his own bankruptcy in 1784 (see next section), Rand ceased to take boarders, the school occupied only the room at the rear of 159 High Street, the tenancy of the rest of 159 and of 160 being surrendered, and Rand gave more of his time to other employments. The school continued until 1807 or 1808, and in 1809, his sixtieth year, Rand moved to a recently-built terraced cottage which he had purchased at 2 North Street.²⁵

The synopsis of Rand's first series of lectures reveals no originality, and the level of his knowledge and reading is indicated by the scientific books which he presented, along with a collection of globes, to the Lewes Library Society on his (belated) election in 1802, as they were among the most popular of the late 18th century: James Ferguson's *Lectures on select subjects* (first published in 1760), Richard Kirwan's *Elements of mineralogy* (1784) and William Herschel's *catalogue of ... stars* (1786). He had been a subscriber to Mendes Da Costa's *British conchology* (1778) and Whitehurst's *Inquiry into the original state and formation of the earth* (1778). From its foundation in 1785 the library actually provided a better range of scientific reading than these titles suggest, while Rand became an assiduous reader of periodicals such as the *Philosophical Magazine* and, on the basis of reviews, proposed books for purchase. Within two years of election he was its Treasurer and credited with improving the Society. Rand had already garnered a reputation as a man of science: his one appearance in Dunvan's history of the town (1795) is as 'a man of extensive science and accurate observation, [who in 1794 while supervising clearance of the river] discovered the remains of a bridge and causeway which led from Old Mallings across the brooks to Lamport.'²⁶ His public dispute about coal at Bexhill with John Farey in 1807 (see below) exposed, however, limits to his scientific knowledge.

BANKRUPT AND MAPMAKER

Two misfortunes befell Rand in 1783 and 1784. The first was his wife's death in March 1783, leaving him with six children, the eldest just seven years old. The second was his being declared bankrupt in July 1784. At the end of 1776 Rand borrowed £450 against the reversion, on his mother's death, of 20 acres of land in Cranleigh, Surrey, perhaps in relation to 161 High Street, which he had rented a year earlier and purchased in October 1779. That was the security for borrowing £420 in February 1781. In March 1782 he borrowed, on the security of the Cranleigh property but from a different lender, a further £250 to kit out his brother Charles to join the East India Company's army.

In June 1783 Rand accepted a bill of exchange from Joseph Bowen, his sister Lucy's husband, for £500. The bill was drawn on one James Sydenham, a haberdasher in Cornhill, London, to whom, Bowen said, he had given hard cash. Two months later, when Bowen was on his way to Brighton, Rand wrote two bills on the Lewes Bank, so that Bowen could draw the £500 in cash. Bowen was a London bookseller, to whom Rand had lent 'considerable sums' of money and for whom he had endorsed and negotiated promissory notes. Believing that the original bill arose from trade, as Bowen sent books to India on the recommendation of the Sydenham family, Rand presented it for payment. But Sydenham refused to honour it. Around the turn of the year the Lewes Bank obtained an order for Rand's arrest. Because of his good reputation, the Sheriff's Officer did not execute it, and Rand's father-in-law, Thomas Scrace, stepped in and paid off the bank with £398. Sydenham claimed in the Chancery case he initiated that in April 1783 he was gambling with Bowen and two other friends at the Swan, Lambeth, had lost £3000 to Bowen and had made out three promissory notes. As the note presented by Rand arose from gambling, it was by law null and void, and he sought the court's declaration to that effect. In February 1784, Rand borrowed £175 from William Attree, a Brighton attorney, who with Scrace petitioned for letters of bankruptcy which were granted in July. To make things worse, John Tourle, who had not been told of the prior charge on the Cranleigh land when he lent the £250, started another action in Chancery to secure entry to the land. So Rand faced legal costs as well as debts of £1700 plus unpaid interest.

And James Sydenham was declared bankrupt in August 1784.²⁷

The bankruptcy commission stated that he had traded for five years as a bookseller, stationer, dealer and chapman. But that was a fiction to give him, as a trader, the protection of the Bankruptcy Acts, rather than to risk indefinite imprisonment as an insolvent debtor. Aside from being the New Fire Office's agent in 1784 and 1786, there is no other evidence of his engaging in a trade in which Lewes was already well provided by William Lee, Araunah Verrall (Rand's cousin) and James Lambert, which would have entailed advertisements in the local newspaper and to which none of his debts clearly related.²⁸

Rand's possessions in Lewes were itemised in his insurance policy of 1782:

	£
now dwelling house, timber and tiled	520
household goods	400
wearing apparel	75
plate	15
china and glass	10
printed books	150
mathematical instruments	350
brewhouse, near, timber and tiled	50
utensils therein	15
stable and cowhouse adjoining each other, distant from above, stone and tiled except very small part boarded	85
utensils and stock therein	30
[total insured]	1700

The household goods were auctioned, a few days before the formal commission was issued: sundry suites of mahogany chairs, double and single chests of drawers, dining, card and tea tables, scone and other looking glasses, large quantity of household linen, some very curious prints, fine goose and other feather beds with suitable hangings and bedsteads, bath stoves, brewing utensils, kitchen furniture of all kinds, including a remarkable handsome and strong coal range. Perhaps the household goods were bought by Scrace, to protect his grandchildren's welfare, but increasing Rand's debt to him by another £400 or so. His 'very valuable mathematical, philosophical and electrical instruments' (much as described in the advertisement of 1774) and books, along

with coins and medals, were auctioned in London in September. In 1798, it was said that Rand 'is furnished ... with instruments very expensive and accurate as well as with an excellent collection of books fit for a teacher in his line', suggesting that some items at least were returned by well-wishers. The house, which had cost £500, was brought in at auction on 24 December 1784 and sold privately for £735 to Lord Pelham, of whom Rand then became tenant. The tenancy of nos 159–60, except for the school room, was relinquished in 1786. That, if his wife's death had not already done so, must have ended boarding of pupils. Ten people were in residence at no. 161 in 1790, presumably Rand, his six children and three servants or assistants for the school.²⁹ It seems that friends and patrons rallied round to keep the family afloat, recognising that Rand was the victim of others' dishonesty. The property at Cranleigh seems to have been sold.

He was still an undischarged bankrupt in 1808, which may explain his small part in public affairs. His most significant contribution to town business was to sit on the committee to raise subscriptions for the new market house, and, even then, although he had been appointed a commissioner under the enabling Act of 1791, he did not attend a meeting before 1806 but then fairly frequently until 1816.³⁰

At least 30 Sussex schoolmasters of the 18th century, produced, or offered to produce, land surveys, these masters being often at schools educating boys for 'business' or offering higher mathematics; in each decade from the 1730s to the 1790s between five and seven of them were practising.³¹ For Rand, surveying in a much wider sense became his dominant employment, and from 1790 he tended to give that as his occupation.³² Only two conventional land surveys by him have been traced, both in Lewes, of a Pelham tenement (1792) and of glebe land in St John-sub-Castro with advice on valuations (1799–1800). A one-off was his abortive proposal in 1796 to publish by subscription 'A topographical survey and plan of the Town of Lewes, the Cliff, and Southover'.³³ Mapmaking was not the focus of his practice, as it probably was for most schoolmaster-surveyors. Rather he was active where surveying overlapped with engineering, and where the simpler methods of surveying were insufficient. His specialisation in drainage and navigation works called for angle-measuring instruments, which were more accurate

but required more skill than the plane table, chain and wheel on which the land surveyor relied.³⁴

ENGINEER: FORTS, RAILWAYS, BRIDGES AND MINERALS

In the 1790 poll book Cater Rand appeared as 'Surveyor of the Forts, on the Coast of Sussex'; in the family bible he described himself as 'Surveyor of the Ordnance and Civil Engineer'. In 1812, he had completed his 'many years of public employment (in the Civil Department of the Ordnance, as Surveyor)', and in 1820 recalled that Mr Green of Lewes had preceded him in 'the surveying and directing of works for the several batteries, under the Board of Ordnance.' There was no such post on the Board's civilian establishment as authorised in 1783. William Green (1734/5–1820) was not a civilian, but rather an officer of the Corps of Engineers, and had indeed supervised construction of the Sussex batteries of 1759–60. But, having married well, he saw little active service thereafter and settled to a gentleman's life, being superannuated as a captain in 1776. The seven batteries manned down to 1795 did not amount to a large estate, and the master gunners seem to have reported maintenance requirements direct to the Board of Ordnance. Rand may have been involved in the (ill-documented) construction of the two larger batteries at Langney Point in 1795, but the temporary fieldworks of 1803 around Eastbourne and the Martello towers of 1804–7 were designed and constructed under the direct supervision of Royal Engineers. Rand may have been engaged on a casual basis and claimed a grander title than was his due.³⁵

Even so, he gained some reputation in military science, at least with Thomas Pelham of Stanmer (1756–1826). In 1799 he was granted a patent for 'an improved military and naval telescope', which he had originally designed for Pelham's private use but which received favourable comment from the Duke of York and was offered for sale by Watkin's, 70 St James's Street, London. The telescope incorporated a micrometer, which developed the stadiometer, rediscovered and published in 1778, as moveable hairs in the focus enabled the distance of an object of known size to be determined or, if two observations of a known distance apart were made, an object of unknown size. Rand emphasised the measurement of ranges for artillery fire, but

intended to adapt the micrometer for surveying, by adding a table of allowances for use when the object viewed was not perpendicular to the axis of the telescope, and by fitting it to a theodolite (Fig. 2).³⁶

Indeed, there was a moment when Rand might have trained military engineers. In 1798 he visited Ireland, at Pelham's behest, as Chief Secretary to the Lord Lieutenant of Ireland from 1795 to 1798. Fortifications were then being built against possible French invasion, but his mission was to meet the Revd Dr Robert Burrowes, Master of the Royal School in Enniskillen. Burrowes wrote to Pelham:

Mr Rand appears to me a person remarkably well qualified in the mathematical branches as applied to practical purposes, and particularly in that branch in which we are so much deficient here, military engineering. On looking at the situation and on enquiry as to the circumstances of the place he seems more ready to engage in a plan of education in Ireland than could almost be expected from a person of his attainments and long residence in England. He is furnished I understand with instruments very expensive and accurate as well as with an excellent collection of books fit for a teacher in his line. Such a man it could not but be an object of national importance to have engaged in a department of military education.

Burrowes suggested that, as at Woolwich, the Government should award six commissions a year to the pupils who performed best in examinations conducted by Army officers.³⁷

Burrowes intended Rand to take the letter with him back to Sussex, probably by the same route as he had come, the 100 miles of mail-coach road to Dublin for a boat to England. It is dated 24 May but makes no reference to the news which must have arrived that day, that the long-feared rising had started and that a force of the United Irishmen was massed by the road from Enniskillen, some 30 miles outside Dublin. Rand left the following morning, perhaps in some haste, as he did not collect the letter. On the evening of the following day he witnessed, by his reckoning, 700 Fencibles and yeomanry rout 5000 rebels at Tara Hill. He noted down the size and positions of the opposing forces and the numbers of casualties, and sketched one of the rebels' pikes. Nothing came of the military academy; Pelham on account of illness



Fig. 2. Patent military and naval telescope, invented by Cater Rand, 1799, and made by William Watkins, London (Collection of M. E. Rudd). (A) The telescope, length extended, about 1040mm. (B) The micrometer built into the eyepiece. (C) The table to calculate the distance of a target of known height from readings by the micrometer.

was already back home, and the Lord Lieutenant was replaced at his own request within a month. 'Had my Lord Camden's administration continued in the country', Burrowes wrote to Pelham a year later, 'I should have had [the school] now more flourishing. I applied to the present Government for that species of encouragement which would have brought it forward but did not succeed.'³⁸

In referring to 'many years of public employment' with the Board of Ordnance, Rand implied that it had occupied much of his time, by distinguishing 'my professional engagements' and use of 'my leisure in works of civil engineering'.

'Since leaving my situation in the Ordnance, and engaging myself more at large in civil engineering', he continued, 'I have been much engaged in works of drainage.' So we come to Rand's activity as a civil engineer, which, as he said, was mainly with water control, but also included various other schemes.

Two concerned railways. With improved navigation of the River Ouse, George Shiffner wanted to connect his chalk pit at Offham to lime kilns and a wharf on the river. In 1807 he approached William Jessop who had been the consulting engineer for the Upper Ouse and now recommended an incline plane railway on

1 in 3 gradient, with ironwork by the Butterley Iron Company of Derbyshire, in which he was an original partner. Not for the first or last time, Rand put forward an alternative, recruiting to help Samuel Bill (c. 1773–1847) who was supervising the coal explorations at Bexhill (see below). Their proposal was for a vertical shaft from the quarry to a 1 in 12 gradient tramway tunnelled through the cliff and across the flood plain to the river. William Jessop junior retorted to Shiffner:

It was not without due consideration that the plan recommended for your incline plane was constructed and the experience of my Father and myself inclined us to adopt this mode as liable to the fewest objections. But if you be induced to prefer the mode printed out by Mr. Rand, I can only say that I think I may venture to predict that you will be disappointed in your expectations; and I must beg to decline the furnishing any plans that may involve us in the discredit which I think will attach to it.

Shiffner adopted the Jessops' scheme which was completed in March 1809.³⁹

Rand was connected with at least one other railway project. When the plans for the new entrance to Shoreham harbour were published in 1815, Rand immediately proposed that either canals or railways should connect the harbour with Brighton and Worthing, its main markets. But only after the entrance was opened in 1819 and much of the benefit was being lost through the inadequate road to Brighton, did pressure for improvement build up. Early in 1821 public meetings agreed on the need for a new road and for an iron railway; though the latter proposal was soon dropped, notice of application for a turnpike Act was given in the autumn. A competing scheme was then advanced by the Hon. John Lindsay for a 'double granite road of kerb stone' as far as the eastern end of Shoreham harbour, and for a granite harbour at Hove. The railway, he claimed, would cost £3000 as against £7200 for the road, and would be similar to that from Plymouth to Dartmoor, presumably meaning the seven-mile Haytor granite tramway near Bovey Tracey which was opened in September 1820 and comprised parallel runs of curbs, 15 inches wide by 12 high, with a flange on the inner faces. Lindsay was seeking markets for the granite from the Channel Island of Herm, of which he had purchased the lease in 1815; it was probably Rand

who had suggested the Shoreham scheme. On the island, Lindsay had built a double line railway, from observation of which Rand calculated the 'Comparative value of horse and mechanical power of steam for rail or tram roads of iron or granite'; as his calculation was in favour of steam, they no doubt wanted steam engines on the Shoreham line. In 1859, it was recalled that Rand kept specimen rails outside his house and envisaged a railway between London and Newhaven. 'Sages shook their heads and smiled at his chimera, but ... our good friend Cater Rand was no visionary after all.'⁴⁰

Bridges also engaged Rand's attention. In 1808 he produced plans for widening Lewes bridge, by dismantling both parapets and building overhanging pavements (Fig. 3). But when the justices found that the tenders were nearly double the amount which Rand had led them to expect, they carried out a more modest scheme by Amon Wilds which they had previously rejected. Rand submitted one of the tenders for his own scheme. Fourteen years later, in 1822, he gave evidence to a Commons committee in support of a Bill for a bridge over the Arun at Littlehampton. He also prepared for Lord Gage a rough field plan for a new road from the gates of Firlie Park to the turnpike.⁴¹

Rand's activity even extended to mineral engineering. Several discoveries of fibrous lignite in the Weald from 1800 onwards were declared to be of coal. In Sussex, at Bexhill, two shafts were sunk in 1806, with at least one steam engine for draining, and gave rise to extravagant hopes.

[T]he fine iron of the county may probably be again wrought with great advantage to the public, as well as to individuals; divers manufactories may be successfully established, and the agricultural interests of the county by the increased facility and reduced expense in burning lime, may be materially assisted.⁴²

Rand pronounced favourably on several of these finds, from the first at Newick in 1800 onwards; was recommending the Library Society to buy books on minerals and mining; and brought himself, again, into conflict with an acknowledged expert. One find was on John Fuller's land on the boundary of Heathfield and Waldron parishes. Having had Rand's opinion, in 1807 Fuller sent samples to John Farey. Farey, an early adherent of the new science of stratigraphy being developed particularly by William Smith, had in

his motives for wishing to avoid the discussion of a question of SCIENCE in a Newspaper will be seen and approved, by all who are capable of understanding the subject.⁴⁵ Farey emphasised that the distinction was that fossil coal was found in seams, each with the same thickness over a large area, while bituminated wood was found only in casual and detached masses, surrounded by pipe-clay or other earth. Although much wood coal had been found at Bovey Tracey, it had not been found economical to mine in competition with Newcastle and South Wales. One element in the argument was Rand's accusation that Farey misquoted Ephraim Chamber's *Dictionary*, edited by Abraham Rees (1779–86), when Farey was in fact quoting his own articles which appeared anonymously in August 1807 (the same month as his comments on Fuller's samples) 'in *Dr. Rees's new cyclopaedia*... [where] the most ample reasons and quotations are adduced to shew, that all real or fossil coal not only may be, but actually is of vegetable origin, and yet not bituminated wood.' He requested Rand or anyone else connected with the Bexhill works to send him or John Marten Cripps of Lewes, if they could, examples of real vegetable impressions. The Bexhill works were abandoned, probably late in 1809, having cost over £30,000 for no return.⁴⁶ It can have been little comfort to Rand that it was his observations which Gideon Mantell published in 1822.

ENGINEER: WATERWAYS AND HARBOURS

Around 1800, the tidal reaches of the Sussex rivers served three main purposes: to drain fresh water off the land, to provide a means of communication by barge, and to offer facilities for shipping in the estuarine harbours. In trying to cater for one or more of these purposes, engineers had generally abandoned the practice of excluding the tide from the river by a sluice, which acted as a mud trap for the river above, to the ultimate destruction of the drainage. They held that the free run of the tide benefited land drainage, as well as harbours and navigation, and was to be achieved by straightening, widening and deepening the river's course, with properly heightened banks. But the apparent compatibility of the various objectives did not always preclude conflicts between the various groups of users.⁴⁷

In 1768 Rand may have been away from Lewes, learning surveying, but he was doubtless aware of the proposals which John Smeaton then made for improving the drainage of the Lewes Laughton Levels, and of the much smaller improvements which were under way by 1771 when he was definitely in Lewes. So, as he had learnt how to use surveying instruments, it was natural that he should apply them to the current concern to manage the river which flowed through his home town. In 1773–4, he claimed many years later, he had produced a plan for reorientating the piers at Newhaven (which Smeaton had recommended), to take account, despite the prevailing eastwards run, of the strong recoiling current rounding Beachy Head and running hard west about an hour before high tide. Only in 1791–3 were the piers rebuilt, and then to the plan of William Green, but they were 'laid down' by Rand, presumably meaning that he marked out the lines to which they should be built.⁴⁸

Simultaneously, he was 'Surveyor of works' under the Act of 1791 for improving the navigation and drainage of the river below Lewes, to plans by William Jessop. Here the Trustees of the Ouse Lower Navigation let the contract to the Pinkertons, and the river-cutters started work in mid-June 1792. At the same time the trustees appointed a surveyor, presumably Rand, with the role of overseeing the conduct of the contract. Advertisements in February 1793 seeking 200 or 300 workmen invited them to apply to Pinkerton, but in September (signed by the trustees' Clerk) directed them to the Surveyor, taking their own tools. This indicates that the Pinkertons had abandoned the contract and that Rand had taken on direct management. Scarcity of labour, inflation and resulting financial difficulties impeded progress and, if the receipt of funds from lenders is indicative, work slowed down after 1795 until halting in 1799. By then the two major cuts at Southerham and Southease and smaller cuts at Cliffe and Asham had been completed, and the whole length from Lewes to just north of Newhaven had been embanked. Rand was paid one half per cent of the value of work supervised, giving him £34 by Michaelmas 1799. Work probably resumed, to remove some remaining shoals, in 1803–5. In the former year Rand tried to form the workmen into a Corps of Pioneers, presumably as part of the Lewes Rape (South) Volunteers, having been appointed to the

committee to raise a Corps of Volunteers for Lewes Borough.⁴⁹

Rand had comparatively little employment with the commissioners for Lewes and Laughton Levels. In 1796 he surveyed, and in June 1815 reported on, the drains and sewers at the Cliffe, Lewes, for which he charged respectively £5 12s. 6d. and £6 12s. 9d.⁵⁰ The explanation is probably that in 1782 the commissioners had redefined the office of expeditor and transferred to it the operational responsibilities of the water bailiff who was one of the (gentry) commissioners. As expeditor was appointed the young John Ellman of Glynde (1753–1832), later famed for his Southdown sheep, who was well able both to assess the work required and to supervise its execution.⁵¹

In 1797, Rand reported on a dock scheme in Sleepers Hole, on the west side of Newhaven harbour. Neither this nor the plan of 1773–4 is known to have been requested by the harbour commission, but in 1802 a plan of the shoal inside the piers and an estimate for its removal (which was not started until 25 years later) were certainly commissioned. In 1810 he was directed to assist John Rennie in inspecting the harbour and this led to Rand revising and extending the Admiralty survey of Seaford Bay by John Murray (1805), and he produced a rather crude plan of the bay for the printed sailing directions published by the harbour master in 1814. No doubt he was employed for similar work on other occasions, but from 1819 the commissioners employed a consultant engineer on a regular basis, and the first report by Josias Jessop (another son of William) occasioned Rand's publication of a polemic pamphlet, for two reasons. Firstly, Rand 'could but fully agree with Mr Jessop, as to the pier work recommended, it being precisely my own idea', and secondly the commissioners had failed to keep an undertaking not to implement the report until he had seen Jessop about the proposed pilework.⁵²

If Newhaven harbour was not improved so that vessels could reach its safety in all weathers, then at least the distress of shipwreck beneath the cliffs could be alleviated. A public meeting in Lewes in December 1786 raised a subscription for machines with which mariners and goods might be winched to the cliff top. Rand was among those thanked for their plans and models, though that of Mr Thunder, carpenter of Brighton, was selected.⁵³

In 1787, William Jessop also estimated for

improving Glynde Reach, a tributary joining the Ouse on the east, below Lewes. No sooner had the Act for the lower Ouse been obtained than notice was given of application for an Act to improve the Reach and extend it by a canal through to the Cuckmere valley and north to Horsebridge Mill, near Hailsham. When the notice was renewed in the following year, 1792, a branch canal from Edley to the Lewes–Eastbourne road near Selmeston was added. Rand took levels and prepared plans, probably on Thomas Pelham's instructions, as the proposed canals ran close to much Pelham property. The application was not pursued. The commissioners of sewers, though, did follow through a small scheme of improvement to the Reach between 1796 and 1803.⁵⁴

Plans for making the Cuckmere navigable beyond the tideway up to Horsebridge were revived in 1813, perhaps on account of the recently authorised enclosure of the Dicker. Again Rand was the surveyor, producing the plan for deposit and an estimate of cost, but again no further progress was made, and in December 1815 he was threatening legal action if his expenses were not paid.⁵⁵

In 1792 Rand prepared a plan and an estimate for cutting through the oxbow immediately below Excete Bridge on the Cuckmere River and for embanking both sides to the sea (Fig. 4). The Commissioners of Sewers for the Cuckmere Levels were not the clients, but they did retain him in 1802 to recommend drainage improvements. His proposals, however, were expected to benefit only 180 acres at a cost of £13 an acre and, with Rand's advice, more modest works costing around £210 were ordered, though in 1806 he was complaining that they had not been carried out as intended. His fee was £25.⁵⁶

Whereas the engineer concerned with the Cuckmere Levels did not have to consider the requirements of a harbour at the mouth nor, to any large extent, navigation of the river, he found in the Adur valley a situation comparable to that in the Ouse. In 1800, Rand was making, evidently in his own time, a detailed survey of the River Adur up to Mock Bridge. The engineering problem at Shoreham Harbour was considerably more complex than at Newhaven, where the piers of 1731–3 had at least stabilised the Ouse's outfall. The Adur still flowed eastwards behind a shingle spit; two miles along the spit a cut, protected by piers in 1760, had soon been overrun by shingle,

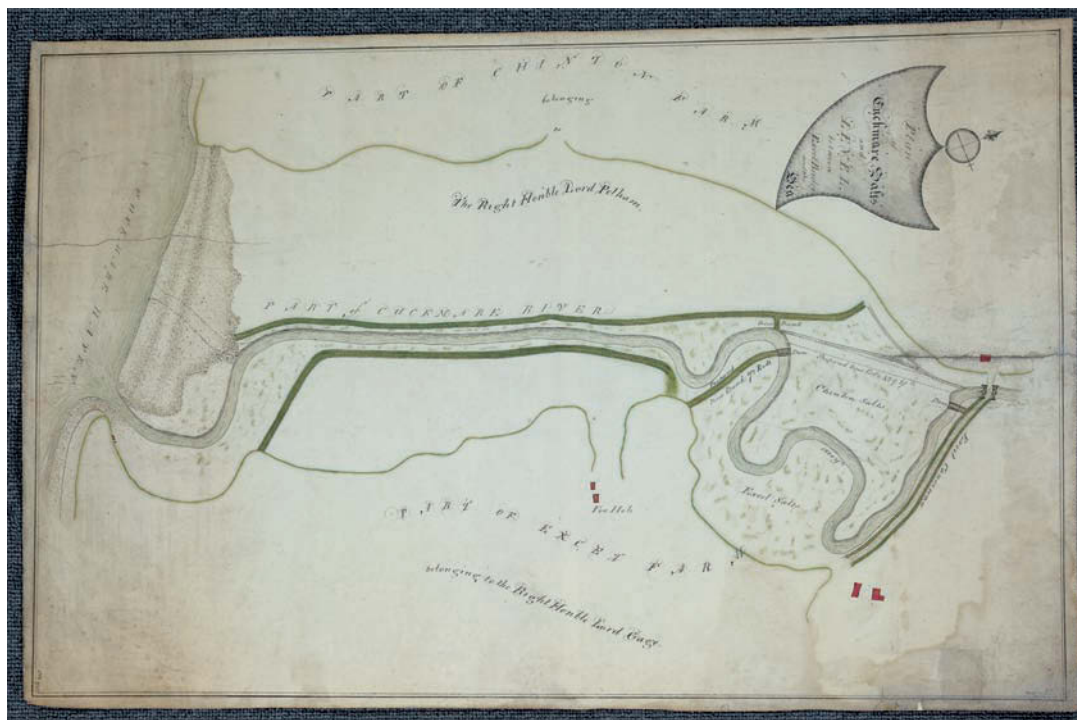


Fig. 4. 'Plan of Cuckmare Salts and Level between Excet Bridge and the Sea', by Cater Rand (1749–1825), 1792 (East Sussex Record Office, ACC 5179/15).

and by 1800 the river's outlet was a further mile to the east and continually shifting. So inadequate for its trade had the harbour become, and so slow were the harbour commissioners to act, that in May 1800 a meeting of local inhabitants and traders invited William Jessop to report on it. Jessop considered that the river should continue moving eastwards until it reached its 'natural' mouth four miles from New Shoreham, and be kept open by continual dredging.⁵⁷

Some promoters found the report 'much too vague and general' and feared that 'if the harbour is allowed to travel to the eastward, the Brighton people will swallow up all the trade.' So Rand was encouraged to produce a rival report, which a further meeting, in September, thought thoroughly calculated to benefit the town and the county's trade. He proposed to reopen the 1760 cut, with the eastern arm blocked by a dam (surmounted by a tide mill), and, with a precision markedly lacking in Jessop's report, estimated the cost at £20,890 16s. 8d. He argued, though without direct reference, that Jessop's plan would lead to

silting and that anyway 'the present and probably increasing commerce of the country, will warrant a bold expenditure, in execution of substantial works.'⁵⁸ Jessop responded, in a private letter to Lord Egremont, with the legitimate statement that he thought he was asked to produce a cheap scheme, and the mocking remark: 'As his [Rand's] Philosophy soars far above my knowledge or comprehension, so may his mechanical ability.' Yet it was substantially Rand's plan which was put forward by William Clegam in 1815 and generally approved by William Chapman, even if he amended it (in a way which was largely unsuccessful) before implementation. In 1815 Rand again produced an alternative plan, though no details are known.⁵⁹

If he found no employment with the harbour commission, Rand was more successful with regard to the river. In 1806 a Bill to improve the drainage and navigation below Bines Bridge was read a first time; the associated plan was surveyed by James Creasey. For the following session a new plan was deposited, this time surveyed, reported

and estimated by Rand, and the Bill passed into law. As Creasey died early in 1807, Rand's appointment as surveyor may have been a matter of persistence bringing its reward. Rand probably also had the direct supervision of the works which began in April 1808 (and soon ran into financial difficulties). The Adur Navigation may be the most important engineering work for which Rand was fully responsible.⁶⁰

In later years the Commissioners of Sewers for the Rape of Bramber engaged him for surveys and reports, but most importantly as one of 'two skilful persons, one to be chosen by the Commissioners of the harbour, and the other by the Commissioners of Sewers ... such two persons being skilled in river embankments', under the Shoreham Harbour Act of 1816. The harbour commission was required to secure the river banks against damage from the 'more speedy and extensive flow of the tide' following the opening of the new mouth, and the two engineers (Rand and Richard Buck) were to issue three certificates, one before the work began on the height to which the banks should be raised, the second one month before the new mouth was opened that the banks had been duly heightened, and the final certificate two years after the opening, declaring the banks to be satisfactory and so discharging the harbour commissioners from further liability. His field notebook shows Rand conscientiously carrying out his duties. The greatest difficulty arose when Rand would not sign the final certificate in October 1821, as there had been flooding in 1819 and 1820, and an arbitrator was called in.⁶¹

Rye Harbour, more than any other in Sussex, was damaged by the erection of sluices on the three rivers draining through it, and there was a long history of hostility between the harbour commission and the Corporation of Rye on the one hand, and the various commissions of sewers on the other. Only in the 1830s were reasonable working relations established, but that was not before two influential commissioners of the upper levels had considered the possibility of dispensing with the most important sluice, Scot's Float, and allowing the tide free run, which would also facilitate navigation. One or both of them employed Rand early in 1812 to report on the possibility of doing so, and he found in favour of an open channel, though the works would cost £27,000. Then in March the sluice 'blew up' in an

exceptionally high tide; 600 acres were flooded and, though the harbour was greatly improved, the commissioners decided as a body on re-erecting the sluice. In the ensuing controversy, Rand printed a pamphlet stating the advantages of an open channel and in 1817 gave evidence to that effect in an action brought by the sewer commission against some of the harbour commissioners. In 1816 or '17 he was employed by the harbour commissioners in making surveys of the salt marshes adjacent to the harbour, probably in connection with plans (not effected until the 1830s) for their enclosure.⁶² In 1813 he valued the land at Cliff End in Pett Level which the Government wanted to purchase from the Medley estate for extension of the Military Canal, and during its excavation in 1815 he specified and supervised works to ensure that salt water did not seep into the level. Concurrently with the latter task Rand took a general view of the Pett and Icklesham Levels for the sewer commission.⁶³

In 1812 Rand was retained to advise the Commissioners for Pevensey Levels on how to replace the Little Hutch at Pevensey Haven. He proposed 'iron pipes or tubes', and the commissioners were on the point of borrowing £1000 when they decided that the hutch was serviceable for a few more years. But they spent £300 on works higher up. Rand charged the considerable sum of some £125, exclusive of expenses.⁶⁴ These works may have been similar to ones which he had supervised for Lord Sheffield in 1798, when Thomas Pelham reported that the 'borers' were progressing satisfactorily at Falmer, presumably in sinking a well, and that Rand would give notice when they were at leisure to work at Newhaven, there being no difficulty in their working horizontally. The demesne land of Sheffield's manor of Meeching included low-lying land bordering the river.⁶⁵

Age and exertion were taking their toll by May 1813, when he ventured out for the first time after four months with very severe rheumatic indisposition, and the fatigue and exposure on the levels at Steyning threw him back. His proven recipe for waterproofing boots, which he had first noted in 1772, was, alas, insufficient protection. Nevertheless, he was still active into his seventies, on Shoreham Harbour (1820) and Littlehampton Bridge (1822). He was recognised as the leading (or maybe only) local engineer. As Lord Sheffield heard from his Lewes solicitor when planning to

drain land at Newhaven in 1811, 'if your Lordship wants a workman, there is a man in Piddinghoe ... but if you want an engineer I believe there is none in the neighbourhood but Mr Rand.'⁶⁶

CONCLUSION

The total of works completed through Rand's agency was small. But if the majority of schemes with which he was associated came to nothing, he was a fertile source of ideas and generally advanced the application of engineering to useful purposes in Sussex. The Offham incline plane was probably, like the granite tramway, the application to a local need of an invention of which he had learnt through the growing scientific press. His schemes were usually realistic in scale as regards the likely costs and benefits, in contrast to the monumental proposals of, say, John Rennie for Newhaven and Hastings harbours. He worked with a knowledge of local circumstance which was denied to eminent outsiders, whether of emerging needs (as at Shoreham) or of physical characteristics (such as the significance of the westward set of the tide one hour before high water on parts of the Sussex coast). But therein lay a source of conflict between him and his like, and engineers of greater standing. Of Josias Jessop's appointment at Newhaven, Rand wrote: 'where the professional abilities of an engineer *may* be found necessary to be called in, ... call in a man ... well informed ... with all the *localities* of the *situation* that fall under his eye.' William Stevens, harbour master at Newhaven from 1827 to 1864, expressed similar sentiments, having in mind the engineers who had reported in the two decades before he took up office.

... small tidal harbours and the small amount of money that could be devoted to their improvement were insignificant to large Engineers, who wanted more means

and greater extension of plans to conform to their tastes. Newhaven harbour was too insignificant to engage sufficient of their attention to ensure laying down of proper plans. They hastily viewed the harbour for a tide or two, and then as hastily drew their conclusions, and upon them based alterations which were not sufficiently matured to ensure success.⁶⁷

Such tensions, though, were not eased by Rand's style. His public response to Farey and his pamphlet of 1820 on Newhaven harbour indicate how he may have irritated the professionals and their clients. His wife's early death and his children leaving Lewes must have impoverished his family life and may have contributed to his nursing unwarranted grievances.

Within the old tradition of multi-occupation surveyors, Rand with some success made the transition from work which finished up in a map, to civil engineering. But the days of such men were numbered, as the function of the consulting engineer was established and the scale of activity required full-time clerks of works. And as a proponent of science education, Rand had the misfortune to be overshadowed by the rising generation in Lewes which included the geologist Gideon Mantell, the mathematician J. W. Woolgar and the other founders, in the month before Rand's death, of the Lewes Mechanics Institution.

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 - ²⁴ SWA, 10 Jan., 7, 21 Feb. 1774, 11 Sep., 25 Dec. 1775, 16 Sep. 1776, 5 Oct. 1761, 5 Aug. 1776.
 - ²⁵ ESRO, LT, St Michael's, Lewes, 1780–1809, All Saints', 1809–25; SAS/A 753. *First report ... charities in England, for the education of the poor* (House of Commons, 1819), 235, refers to his being writing master of Lewes Grammar School, possibly paid £17 15s. a year around 1812–16, but not teaching; this may have been a continuation of Pelham patronage.
 - ²⁶ C. Rand, *Analysis of a course of six lectures on the subjects of pneumatics, electricity, and astronomy* (Lewes: author, 1774), dated by SWA, 26 Dec. 1774. ESRO, R/L11/1 and 2. J. V. Button, *The Lewes Library Society ... A poem* (London: W. Button, 1804), 7. The first account book, for 1811–19 (ESRO, R/L 11/5/1) is not in Rand's hand. D. Waley and J. Goring, 'Lewes Library Society. The early years, 1785–1831', *SAC* **138** (2000), 153–64. [P. Dunvan], *Ancient and modern history of Lewes and Brighthelmston* (Lewes: William Lee, 1795), 300.
 - ²⁷ TNA, B 1/75, p. 175; C 12/594/14; /605/42; /2139/28; /2434/21; B 4/22, ref. S246. ESRO, SAS/FB 49–51; SAS/LEW 31–34; PBT 1/1/62, pp. 239–43. *London Gazette*, 6 Jul., 11 Sep. 1784, 25 Aug. 1789, 14 Jun. 1791, 9 Apr. 1808.
 - ²⁸ At least until 1782 Rand insured his own property with the Sun Insurance Company. *Bailey's British directory* **3** (London: W. Bailey, 1784); he retained the fire agency until late 1786: SWA, 11 Sep. 1786. C. Brent, *Georgian Lewes 1714–1830. The heyday of a county town* (Lewes: Colin Brent Books, 1993), 123–5. Lucas, 'Verrall', 96.
 - ²⁹ SWA, 21 June, 13 Dec. 1784. Guildhall Library, MS. 11936/291, no. 442306. *Morning Post and Daily Advertiser*, 9 Sep. 1784. BL, Add. MS. 33339, ff. 142–3, 206–7. ESRO,

- ACC 4600/102, f. 45. Sussex Archaeological Society Library, T. Woollgar, 'Spicilegia ... Lewensis', **1**. In 1799 the painter James Lambert bequeathed to Rand his pantagraf: ESRO, AMS 6326/45.
- ³⁰ ESRO, SAS/LEW 34. V. Smith, ed., *The town book of Lewes, 1702–1837*, Sussex Record Society **69** (Lewes, 1973), 79, 83, 84. ESRO, R/L 25/3.
- ³¹ Caffyn, *Schools* 15, and references in index at 508.
- ³² ESRO, R/L 12/4, 5, 6, Lewes poll books, 1790, 1796, 1802.
- ³³ ESRO, ACC 3412/3/82, 124. SWA, 15 Aug. 1796.
- ³⁴ S. Bendall, *Dictionary of land surveyors and local map-makers of Great Britain and Ireland 1530–1850*, 2 vols (London: British Library, 1997), **1**: 8.
- ³⁵ ESRO, R/L 12/4; KRA 1/4/1, 'Report of Cater Rand on a viewed Survey of... part of the river Rother and Levels...' (Lewes: 1812); SAS/LM 189, C. Rand, 'Newhaven harbour. Report and observations thereon' (1820, printed). TNA, WO 54/219, for the Board's civilian establishment, with staff in post c. 1797, updated to 1805. R. J. Goulden and A. Kemp, *Newhaven and Seaford coastal fortifications* ([London]: [R. J. Goulden], 1974), 3, 5. Rand is not named in the papers of the local solicitor who handled the purchase of sites for Martello towers: ESRO, RAF box 26. J. E. Goodwin, *Fortification of the South Coast. The Pevensey, Eastbourne and Newhaven defences 1750–1945* (Worthing: author, 1994), 3–4, 16. Neither John Goodwin nor Frank Kitchen have found Rand's name in their research in the Ordnance records. On Green (who proposed or supervised works on Rye harbour in 1764–74 and on Newhaven harbour in 1786–90), see J. H. Farrant, 'The making of Francis Grose's Antiquities: evidence from Sussex', *SAC* **131** (1993), 154.
- ³⁶ M. E. Rudd, 'Cater Rand's patent military & naval telescope of 1799', *Journal of the Antique Telescope Society* **10** (1996), 6–9, for the only known example of the micrometer. The Science Museum, London, has a telescope by Jesse Ramsden (acc. 1911–252), carrying the table of allowances. C. Rand, *Description and use of the patent military and naval telescope for measuring distances and the extension of objects at sight* (London: author, 1799). C. Rand, 'Specification of the Patent granted to Mr Cater Rand ... [Patent Spec. No. 2289]', *Repertory of Arts & Manufactures* **12** (1800), 45. A. W. Richeson, *English land measuring to 1800*, Society for the History of Technology, Monograph Series **2** (Cambridge, MA: MIT Press, 1966), 159–60.
- ³⁷ BL, Add. MS. 33105, ff. 361–3.
- ³⁸ P. M. Kerrigan, 'A 1798 pike and notes on the battle of Tara Hill', *Irish Sword* **21** (85) (1999), 273–6, for a printed map of Ireland autographed, 'C. Rand on the spot' against notes of the events at Tara Hill, and marking the road between Dublin and Enniskillen. T. Pakenham, *The year of liberty. The story of the great Irish rebellion of 1798*, rev. edn (London: Weidenfeld & Nicolson, 1997), 113–15, 159–60, giving the size of the forces as 350 and 8000. BL, Add. MS. 33106, f. 306.
- ³⁹ ESRO, SHR 1961–1973 (1967 quoted) which I interpret differently from earlier writers. M. Robbins, 'The first Sussex railway', *Railway Magazine* **117** (1971), 355–7. R. G. Martin, 'The Offham Chalkpit tramway and incline — a survey and description', *Sussex Industrial History* **15** (1985/86), 11–15. T. Evans, 'George Shiffner and the Offham chalkpit tramway', *Sussex Industrial History* **15** (1985/86), 15–18. H. S. Torrens, 'Coal hunting at Bexhill 1805–1811: how the new science of stratigraphy was ignored', *SAC* **136** (1998), 181–2. SWA, 6 Mar. 1809. This was not Sussex's first railway, as it was predated by that in the Earl of Ashburnham's limestone mine at Glazier's Forge, Burwash: A. Young, junior, 'A tour through Sussex 1793', *Annals of Agriculture* **22** (1794), 266–8.
- ⁴⁰ SWA, 17 April 1815. *Brighton Gazette*, 22 Feb., 8 March 1821. SWA, 3, 10 Sep. 1821. J. Uttley, *The story of the Channel Islands* (London: Faber & Faber, 1966), 186–7. West Sussex Record Office (hereafter WSRO), Add. MS. 1000, f. 42, a notebook of Rand's, 1817–21. M. C. Ewans, *The Haytor granite tramway and Stover canal*, 2nd edn (Newton Abbot: David & Charles, 1966), 20–23. ESRO, R/L11/7/6, Burwood Godlee, 'History of the Lewes Library Society' (1859), 24.
- ⁴¹ ESRO, QDP/15; QO/EW38, 17 July 1807, 23 June 1808; QAB3/1, pp. 164–8. WSRO, IN/Arun/L3/1. ESRO, ACC 2553/8 (undated).
- ⁴² Torrens, 'Coal hunting', 177–91, for much in this and the next two paragraphs. SWA, 2 June 1806.
- ⁴³ ESRO, R/L 11/1/4. G. A. Mantell, *The fossils of the South Downs; or, Illustrations of the geology of Sussex* (London: Lupton Relfe, 1822), 34–6. *Brighton Gazette*, 30 June 1830. J. Farey, 'On the means of ascertaining the nature of soils, &c. and on the finding of coal', *Agricultural Magazine* (Dickson's) **3rd ser.**, **1** (Aug. 1807), 116–17. ODNB, 'Farey, John (1766–1826)'.
- ⁴⁴ 'Editorial', *Agricultural Magazine* (Dickson's) **3rd ser.**, **1** (Sep. 1807). SWA, 5, 12 Oct. 1807.
- ⁴⁵ J. Farey, 'On the finding of coal in the south-eastern counties of England', *Agricultural Magazine* (Dickson's) **3rd ser.**, **2** (Jan. 1808). SWA, 18 Jan. 1808.
- ⁴⁶ For Cripps (1780–1853), see ODNB.
- ⁴⁷ For background to this and the following two paragraphs, see J. H. Farrant, 'The evolution of Newhaven Harbour and the Lower Ouse before 1800', *SAC* **110** (1972), 44–5, 50, 58–9.
- ⁴⁸ ESRO, SWA 12/2/1, *Mr Smeaton's report on Lewes Laughton Level* (Lewes: W. Lee, 1768), 10. ESRO, LH 189, Rand, 'Newhaven' (1820), 3–4, 10; SAS/LM 174, sketch of Newhaven piers, ? July 1810. Marchant's 1771 survey of the harbour, ESRO, SRA 6/13/5, has such a reorientation sketched in, but it may be a later addition. SWA, 13 Dec. 1790.
- ⁴⁹ J. H. Farrant, 'The Lower Ouse Navigation, pt I', *Sussex Industrial Archaeological Society Newsletter* **3** (1974), 4–5. SWA, 11 June 1792, 11 Feb., 9 Sep. 1793. T. W. Horsfield, *The history and antiquities of Lewes and its vicinity*, 2 vols (Lewes: J. Baxter, 1824–7), **1**: 217. ESRO, KRA 1/4/1. Barclays Bank Archives, ledger of Old Bank, Lewes, seen while on loan to ESRO in 1984. *Hampshire Telegraph*, 29 Aug. 1803. Ann Hudson has found no official record of Rand's Pioneers: A. Hudson, 'Volunteer soldiers in Sussex during the Revolutionary and Napoleonic Wars, 1793–1815', *SAC* **122** (1984) and pers. comm. The Hastings Rape Volunteers included a Corps of Pioneers: War Office, *A list of the officers of the gentlemen and yeomanry cavalry and volunteer infantry of the United Kingdom* (London, 1804), 661–2. Smith, ed., *Town Book*, 131, 134.
- ⁵⁰ ESRO, SRA 6/5/3 and 5; SRA 8/1/1.
- ⁵¹ F. P. Walesby, 'Memoir of Mr Ellman', in *Baxter's library of*

practical agriculture, 2 (Lewes: Baxter & Son, 1846), xxxi–xxxiii.

- ⁵² ESRO, LH 189, 'Newhaven', passim; LH 39. W. Stevens, *Newhaven harbour from 1827 to 1859* (Lewes, 1861), 10. ESRO, LAN 41, Rand to W. B. Langridge, 7 June 1810. Brighton History Centre (hereafter BHC), S040 Su8, 1814 sailing directions.
- ⁵³ SWA, 15 Jan., 19 Feb. 1787. Hastings Museum & Art Gallery, 950.57, drawing of a similar machine kept on Mr [Nicholas] Willard's farm at Birling, East Dean.
- ⁵⁴ ESRO, SAS/A 750. SWA, 12 Sep. 1791, 27 Aug., 10 Sep. 1792. ESRO, SRA 6/2/3, NRA 7/1/2 and AMS 5708. The canals appeared on one version of Gardner, Yeakell and Gream's map of Sussex (1795): D. Kingsley, *Printed maps of Sussex 1575–1900*, Sussex Record Society 72 (Lewes, 1982), 110.
- ⁵⁵ ESRO, QDP/49; SRA 7/17/3; ACC 5120/168/1; RAF box 92/30, Rand to Thomas Barton, 2 Dec. 1815). SWA, 6 Sep. 1813.
- ⁵⁶ ESRO, ACC 5179/15; RAF box 9/6, 17 June 1802, 18 July 1803, and 1804 accounts; RAF box 92/30, 'Report', 16 July 1803, and 'Memorandum', 29 May 1806.
- ⁵⁷ For background, H. C. Brookfield, 'A critical period in the history of Shoreham harbour 1760–1816', SAC 88 (1949), 42–50. WSRO, PHA, OF 10/22/7 and 4 (copy also in ESRO, SAS/A 746). SWA, 5 May, 14 July 1800.
- ⁵⁸ WSRO, PHA, OF 10/22/8 (copy also in ESRO, SAS/A 746). SWA, 1 Sep. 1800.
- ⁵⁹ WSRO, PHA, OF 10/22/10. W. Chapman, *Report on the harbour of New Shoreham* (Brighton: W. Fleet, 1815) (copy in BHC). SWA, 17 Apr. 1815.
- ⁶⁰ 47 Geo. III, c. cxvii. WSRO, QDP/W5, 6, 7. *Journals of the House of Commons* 61 (for 1806), 98, 170, 180. Gibbs and Farrant, 'Upper Ouse', 29. SWA, 4 Apr., 25 July 1808.
- ⁶¹ 56 Geo. III, c. lxxxi. WSRO, LD.iii/SM/1, 29 July 1813, 19 Aug. 1816, 6 June 1817; SH5/1/1, 30 Oct., 8 Dec. 1820; Add. MS. 1000, f. 41.
- ⁶² J. Meryon, 'An account of the origin and formation of the harbour of ... Rye', *Weale's Quarterly Reports on Engineering* 4 (1845), 32–70, espec. 55–6. ESRO, KRA 1/4/1; NRA 9/2/4; KRA 1/1/3, 24 Mar. 1829.
- ⁶³ ESRO, SAS/ME 25. This work, which involved purchase of 33 acres, finds no mention in P. A. L. Vine, *The Royal Military Canal* (Newton Abbot: David & Charles, 1972). ESRO, RAF box 92/30, Rand to T. Barton, 11 June 1816.
- ⁶⁴ ESRO, RAF, Pevensey Sewer Commission minutes, 1738–1835; SRA 7/5/1; GIL 4/280. SWA, 22 Nov. 1813. Two iron pipes through the shingle bank to the sea were installed at some date, as they are marked on OS maps surveyed in 1875.
- ⁶⁵ ESRO, AMS 5440/226, Thomas Pelham to Lord Sheffield, dated to June–Nov. 1798 by the references to Irish affairs and by Rand being in Ireland until the end of May.
- ⁶⁶ WSRO, IN/Adur/A1/2, 10 May 1813, Rand to C. Marshall; Add. MS. 1000, f. 40. ESRO, SAS/LM 187/128.
- ⁶⁷ ESRO, LH 189, 'Newhaven', 9; LH 39, Stevens, *Newhaven*, 9.

