

Professional Lives: Compiling the Biographical Dictionary of Civil Engineers

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Introduction

Benjamin Disraeli, novelist and politician, wrote "*Read no history, nothing but biography for that is life without theory.*" For those interested in civil engineering, the biographical approach has been rather neglected, but that omission is about to be remedied. The first volume of a two-part *Biographical Dictionary of Civil Engineers* (BDCE) is now with the publisher. This is the story of how it came about.

Related professions such as architects and surveyors have been well served in this respect for some time. The *Dictionary of National Biography* (DNB), reflecting the interests of the era when it was compiled, has many more entries on architects than on engineers. Of the 80 entries in BDCE which appear also in DNB, only about 15 could be called civil engineers as the term is understood today. It was partly a request for nominations for entries to a revised DNB, now in preparation, that prompted the Institution of Civil Engineers' Archives Panel to consider filling the gap. In 1995 it began to consider '*a basic work of reference on the lives and works of individuals engaged in the practice of civil engineering in the British Isles before the middle of the nineteenth century*', including Britons who worked abroad as well as foreigners who worked here. It was to be written with the needs of the informed general reader in mind as well as those of the specialist.

In March 1996, with the support of the Council of the Institution, an editorial board was appointed to oversee the project. The chairman was Professor Sir Alec Skempton, and the other members Ron Cox, Peter Cross-Rudkin, Bob Rennison and Ted Ruddock. Mike Chrimes, Head Librarian of the Institution, was secretary. The board members were based in London, Dublin, Coventry, Newcastle and Edinburgh and had a wide spread of interest in the various aspects of historical civil engineering.

An initial list was drawn up from various sources, including the *Dictionary of National Biography*, *Colvin's Biographical Dictionary of British Architects*, *Bendall's Dictionary of Land Surveyors* and Skempton's *British Civil Engineering Literature 1640-1840* as well as the Frank Smith and the John James collections and other information in the Institution archives. This list contained over 2000 names, ranging from Ailnoth, the engineer of the Tower of London in 1157-90, to Louis Philip Nott, who died on 4th July 1916.

It was recognised from the outset that there would need to be two volumes to cover such a range. Even so, there would need to be limits on the chronological span, or entries only for the most famous, if the published work was not to be too unwieldy. This second option was discarded almost without discussion. The choice of a starting date has already been discussed by Mike Chrimes in his contribution to *Perceptions of Great Engineers II*, the proceedings of a conference at Merseyside Maritime Museum in 1997. At first it was thought that there was too little known about the people involved in the schemes of the Tudor period to be worth including. Research has shown otherwise and the date of 1600 selected initially was pushed back to 1500. Even that has receded slightly, as the first work mentioned in BDCE, a pier at Dover Harbour, was probably completed by 1495. For the master masons, craftsmen and designers earlier than that, readers are referred to John Harvey's magisterial *English Mediaeval Architects* (1954).

The question of an end date for the whole work remains to be settled. Originally a date for the division between the two volumes was set at 1850, but subsequent thoughts turned to somewhere

between 1820 and 1835. Thus the first volume would have seen the organisation of the profession progress from infancy to maturity. In this period the transition from canals to locomotive railways was well under way and the Institution of Civil Engineers was emerging as the leading professional body. The death of Thomas Telford in 1834 can be taken as marking a time of transition. There were still many changes to come, for instance in the education and training of civil engineers, the dissemination of engineering ideas and practice and the fragmentation of the profession. Preliminary work by the editorial board soon settled on 1830 as offering least overlap.

Whatever date had been chosen, there were bound to be some engineers who had undertaken significant work before the cut-off, but whose main career was later. Since an important part of the dictionary will be lists of works, these people will be given brief entries in the first volume, with a comprehensive list to 1830, and a brief summary after that date. Their whole career would be dealt with in Volume 2. Examples include Robert Stephenson and G.P. Bidder, though G.W. Buck, who worked for Stephenson on the London & Birmingham Railway after a career as a canal engineer, will appear in Volume 1 only.

Despite splitting the work into two volumes, the number of entries in the first volume alone was envisaged at the start to be about 400. An estimate was made of the likely length of the articles of about 330 of these, about whom sufficient was already known to be judged suitable for inclusion. The other 70 or so would probably be at the shorter end of the scale. On this basis, the text was expected to be over 250,000 words long, with lists of works and of sources in addition. As it turned out, almost 800 entries have been included, running to well over 500,000 words.

It was intended from the first that, although the members of the editorial board would undertake the bulk of the work, entries would be sought from other authors where appropriate. Each article would be signed by its author. In the event 56 other people provided one or more articles. Thus there are contributions from experts who have researched particular fields of interest, others from those who have concentrated on particular individuals over many years. Susan Hots of the Institution's Library staff did extensive work on military engineers and Tess Canfield researched the lesser known early members of the Institution. Rob Thomas, also of the Library staff, assisted with archival research.

Previous biographies

The introduction to BDCE lists published biographies of civil engineers within the date range (omitting architects who were also bridge builders). The list is not long. The obituary notices published by *Gentleman's Magazine* of the select few are brief indeed. After Thomas Telford's own *Life*, published posthumously in 1838, and some memoirs published by John Weale, Samuel Smiles' famous *Lives of the Engineers* (from 1857) dealt with Sir Cornelius Vermuyden, Captain John Perry, Sir Hugh Myddleton, John Metcalf, William Edwards, James Brindley, John Smeaton, John Rennie, Telford and George and Robert Stephenson. In the rest of the nineteenth century three more biographies, of Sir Marc Isambard Brunel, Robert Stephenson and Robert Stevenson, and Sir John Rennie's autobiography were published, and then nothing until 1925. The 1950s and 60s saw some more full scale biographies and the 70s several articles in journals. The 80s and 90s produced a trickle of both.

Of subjects, from the seventeenth century there are Humphrey Bradley, Sir Jonas Moore, Myddleton and Vermuyden. For the next half century there are Perry, George Sorocold and Thomas Steers. To 1790 Brindley, John Grundy, Smeaton and Thomas Yeoman are added, and in the final 40 years to 1830 there are 19 more names. Of the really important people, none are missing, but many of the next rank await their biographers.

Selection of subjects

The term engineer was used originally for military engineers, but came increasingly to be used for civilians also. "Civil engineer" was first used in 1763, or possibly slightly earlier. As the

profession developed from the 1760s, many of its leaders came from backgrounds such as millwrights, mining engineers, surveyors or architects, and continued to ply their trades at the same time as undertaking work which would now be recognised as civil engineering. Military engineers also used techniques which could be transferred to the civil arena and helped to advance the expertise available. The famous definition of the profession of civil engineer, "*the art of directing the great sources of power in nature for the use and convenience of man*", includes aspects of engineering which are now the province of other institutions, from mechanical engineering to naval architecture. In deciding on names to be included in BDCE, an inclusive approach was adopted.

A rule of thumb was adopted that to be included, an engineer would have had to have been responsible for at least two significant jobs. It was recognised that resident engineers carried significant responsibility in those days of more difficult communications, and they would be recorded on the same basis. Contractors would be included if there was evidence of a career in contracting. Promoters, ironmasters and the like would be considered individually on the basis of their contribution to civil engineering.

From the original list of names, some were rejected as being too early, and may be found in *English Mediaeval Architects*. Some started before, but had not achieved much by 1830 and so will appear in Volume 2 only. Others, despite research, remained too obscure.

Format

It was recognised that there would be large variations in the information available. Nevertheless the aim has been to provide names and titles, dates and place of birth and/or baptism, marriage and death, physical appearance and character traits, religious affiliation, places of residence and cause of death. Facts about the family include father's name, dates and occupation, mother's dates and maiden name, number of siblings and details of them if in relevant occupations, and details of children if relevant to the subject's professional activities or of notable achievement themselves. Details of the subject include education and training, occupations, offices held, honours, geographical interests. The text of each article describes the major works which established the subject's reputation, or demonstrated innovation, in sufficient detail to place the work in context in the development of civil engineering. At the end are chronological lists of significant works and of printed reports by the subject, and a list of information sources. Despite the large number of authors, this has resulted in a certain homogeneity of style, which may make comparisons between articles easier, but perhaps also makes the work more monochrome than it might otherwise have been.

Some statistics

In the early planning of the project, five periods were identified in which there were subtle but real changes in the nature of civil engineering and engineers in Britain. At first thought to end in 1599, 1699, 1749, 1799 and 1830 respectively, analysis of the articles as they came in suggested that the three middle dates could more sensibly be 1689, 1759 and 1789. A chronological list of 329 of the most important works and the engineers responsible has been prepared and will be included in BDCE. From it the following figures have been obtained, which show how both the work available and the number of people involved increased in each of the periods:

| Period | Works started | | Engineers named |
|-----------|---------------|------------|-----------------|
| | total | per decade | |
| 1500-1599 | 11 | 1 | 11 |
| 1600-1689 | 25 | 3 | 22 |
| 1690-1759 | 55 | 9 | 50 |
| 1760-1789 | 86 | 28 | 68 |
| 1790-1830 | 152 | 38 | 86 |

From this it may be found that just under one third of the articles in BDCE deal with engineers who had charge of major works.

The next table compares the numbers of entries proposed in mid-1996 (the left hand column) and shortly before completion (right hand).

| | 1500-1599 | | 1600-1689 | | 1690-1759 | | 1760-1789 | | 1790-1830 | |
|---------------------|-----------|----|-----------|----|-----------|----|-----------|----|-----------|-----|
| architect | | | 2 | 2 | 1 | 2 | 14 | 13 | 11 | 41 |
| contractor | | 3 | | 9 | | 8 | 7 | 19 | 29 | 51 |
| engineer | 3 | 13 | 17 | 24 | 20 | 25 | 56 | 66 | 95 | 188 |
| mechanical | | 7 | 3 | 4 | 3 | 9 | 8 | 11 | 21 | 38 |
| surveyor | | 5 | 1 | 5 | 1 | 4 | 8 | 10 | 9 | 31 |
| writer or scientist | | 3 | | 5 | 3 | 4 | 7 | 4 | 11 | 22 |
| other | | 4 | | 11 | | 8 | | 15 | | 113 |

The most obvious change is the inclusion of almost 15 percent of the articles about people who were not primarily engineers, even under the wider usage of the term adopted by BDCE. These include textile mill owners, marine engineers, gas engineers, gardeners, a lawyer and a Garter King of Arms, who are shown to have contributed to the development of civil engineering. There are also promoters, from the early landowners who pioneered fen drainage, through General Wade and his military roads to William Madocks who reclaimed land in North Wales; manufacturers from Ralph Greatorex, a seventeenth century mathematical instrument maker to the iron masters of the nineteenth; educators such as John Muller, described as the scholastic father of all the great engineers employed in this country for forty years; mining engineers, from whom developed the tunnellers of later years; and inventors.

The numbers of entries in almost all of the other categories have increased during the project, but the largest gain is in engineers in the period 1790-1830. This reflects as much the work which has been done on the leaders of the profession, which has thrown up repeated references to the supporting cast of assistants and resident engineers who made possible the careers of the heroes portrayed by Samuel Smiles and Tom Rolt. In BDCE, the lists of works of Smeaton, Jessop, Rennie and Telford include the names of the resident engineers. For Smeaton there are 20 names, of whom 15 have entries of their own. Jessop is one of these, and in turn his list contains 26 names, of whom 17 appear in their own right. For Rennie the numbers are 39 and 26, for Telford 41 and 31. Many of these people remained with one employer throughout their known career, others changed as employment opportunities came and went. Collaboration amongst authors, particularly the editorial board, has enabled connections to be made and fuller *curricula vitae* to be established.

Inevitably there have been problems in finding information. Sometimes facts which ought to have been straightforward to establish have proved elusive. William Crosley junior, a canal engineer who became one of Robert Stephenson's assistants on the London and Birmingham Railway, was alive in 1838 and dead by 1850. He ought therefore to be covered by the official registers of deaths, but none of the 12 people of that name whose deaths are recorded in that period fits his description. People with more common names also cause problems. There is a William Wright of Barford, Warwickshire who was appointed Under Clerk of Works (or deputy resident engineer) on the Birmingham Canal in 1768 and supervised lock construction. He applied for the job of Engineer to the Stroudwater Canal in 1776 and was probably lucky not to be appointed. A William Wright was appointed Resident Engineer to the Basingstoke Canal in 1788 and the name appears in the Quarter Sessions orders in Cheshire in 1803, supervising construction of bridges. Had it been possible to establish that this was one person it might have been worth an entry, but a link was not proved or disproved and so William Wright does not appear. Nor does Charles Roberts, who is believed to have supervised the Caldon Canal (whose minute books are no longer available); his name also appears on the Staffordshire & Worcestershire Canal, the Birmingham Canal in 1771, the Dudley Canal in 1793 and the Newcastle Junction Canal in 1797.

At the planning stage, estimates were made of the likely lengths of articles. It is true to say that these have proved consistently under the mark. There were thought to be eight 'four star' people - Vermuyden, Grundy, Smeaton, Brindley, Jessop, Chapman, Rennie and Telford - who would have the longest entries, and it proved difficult in a couple of cases to work within the limits set. Robert Mylne and George Sorocold joined this select band. Below this level, some articles have been subject to a measure of editing to bring them into line with the importance of the subject, but some are perhaps not as long as might have been warranted, due simply to lack of information.

There are a few entries put in partly to dispel possible confusion. There was a John Smeaton who was born in 1806, 14 years after his eminent namesake died. The younger man became Engineer to the London Docks Company before dying young in 1842. There are also two families of Easton, originating in Scotland and Somerset respectively. The latter had a predilection for the initial 'J' when christening their male offspring and it has not always been easy to separate them. In other places people who would not warrant an article of their own are mentioned under entries of more famous namesakes. As an extreme example, there are two John Phillips included, and in the second of these a further four are mentioned, with brief details.

1500-1599

Inevitably our knowledge of people from the sixteenth century is heavily dependent on the survival of records from that age. In practice this means that we know most about those involved with works financed by the church or state, and the research which has gone into the *History of the King's Works* is invaluable. Harbours at Dover, Leith, Portsmouth and Yarmouth, bridges at Aberdeen, Dunkeld and Doune, and fortifications from Berwick and Carlisle to Pendennis and Camber occur. The Exeter Canal and water supply to London and Plymouth and Nonsuch Palace are also here. The articles for this and the next period dwell longer on the nature of the work being undertaken, as background reading is less readily available.

1600-1689

In this period of political instability and unsteady but significant economic advance, we find entrepreneurs such as Sir Hugh Myddleton, who financed the New River on behalf of the City of London, Arnold Spencer, William Sandys and Sir Richard Weston who respectively made the Great Ouse, Warwickshire Avon and Wey rivers navigable. A public/private partnership was the draining of Hatfield Chase, for which Sir Cornelius Vermuyden was brought over from the Netherlands. Later he undertook two campaigns in the Bedford Level of the Fens. The minute books survive and give us information not only about Vermuyden but also many of those associated with him. From this period too date the first printed reports and Sir William Dugdale's *History of Imbanking and Draying*.

The Union of the Crowns saw a pledge to rebuild Berwick Bridge in stone, a task which occupied 13 years under James Burrell. Indigenous engineers start to appear in greater numbers. Despite King Charles II's complaint that there were no engineers of ability to be had in all of England, Huntingdon Beaumont had already begun to build waggonways in Northumberland and that same county saw the appointment of the first salaried county surveyor, 150 years after the Act of Parliament which authorised it. Survey instruments were improved, which were to prove indispensable in the works of the next age.

1690-1759

Greater political stability following the revolution of 1688, growing trade and wealth and technological advance opened up greater demand for infrastructure and better means of achieving

it. Drainage, water supply, navigation and ports, both military and civil were still the main sources of work. It was now possible for several men to make full careers in civil engineering, and to work in different fields. Charles Labelye, a naturalised Swiss, built Westminster Bridge, by far the most costly work of the period, but was also consulted about fen drainage and a new harbour at Sandwich. Thomas Steers was engineer of the first dock at Liverpool, a harbour in Ireland and the Newry Canal (1737-41), and other navigations. This period was also notable in that John Grundy senior had sufficient confidence in the scope for a career to train his son as a civil engineer, probably the first such instance in Britain.

1760-1789

The nature of civil engineering progressed significantly in these years. A further increase in the work available, coupled with a limited number of practising engineers, led to a division of responsibilities which can still be recognised today. Consulting engineers, based away from the scene of the work, involved in several projects at any one time and employing or directing resident staff become more common. This was the start of the canal age and engineers found themselves opposing each other in Parliament on canal Bills. In order to avoid professional arguments degenerating into personal antagonism, the Society of Civil Engineers was formed in 1771. John Smeaton was a founding member, though not its president, and he is regarded as the father of the profession. The Society took on some of the characteristics of a professional body, but as it catered for the leaders of the profession only, it failed to transform itself fully and it was left to the Institution of Civil Engineers later to take on that role.

Thomas Yeoman, John Grundy junior, Robert Mylne, Joseph Nickalls, John Golborne, Langley Edwards, John Gott and William Jessop were all early members of the Society. James Brindley's principal assistants, Robert Whitworth and Hugh Henshall, had been elected within a month of its first meeting but Brindley himself died the following year without becoming a member. Most of these men were based outside London, but met there when Parliament was sitting.

Design-and-build contractors were still to be found, but people prepared to work to the designs and specifications of others and with funds to finance at least part of the work in progress were now in evidence. They tended to be family associations, such as the Dysons and the Pinkertons.

British engineers began to work abroad in greater numbers, some settling permanently; others, mainly military engineers, created the infrastructure of the expanding Empire. Foreign visitors were shown round the burgeoning industries in Britain and report their observations for the benefit of professionals at home.

1790 on

By 1790 canals were seen as a profitable investment and there ensued a canal mania when over 50 new lines gained Acts. These included important through routes such as the Grand Junction and the Kennet & Avon, but also many of less obvious economic importance. William Jessop bore the brunt of the consultancy work, though he often left the construction entirely to others. John Rennie and Robert Whitworth were also active in this sphere, and several other engineers were involved in the promotion of three or four canals. Public railways made their appearance, a large programme of dock and harbour construction was undertaken and the large sums of money spent annually on turnpike roads led to a more scientific approach to road construction. Jessop first, then Rennie and Thomas Telford dominated this period, but there were several other important players such as William Chapman, Robert Stevenson, Francis Giles and Alexander Nimmo. Sir Marc Isambard Brunel, William Tierney Clarke, Sir William Cubitt, George Leather junior, Sir John Macneill, James Rendel, Sir John Rennie, James Simpson, George Stephenson and James Walker (second

President of the Institution of Civil Engineers after Telford) all had significant achievements to their names before 1830. They, with 24 others, appear in Volume 1 but will be dealt with more fully in Volume 2.

This period also saw the rise of contracting on an enlarged scale. Jolliffe & Banks, Hugh McIntosh and Henry, Mullins & MacMahon undertook works valued in hundreds of thousands of pounds, and with contracts in several places at once, they relied on agents to carry out the work at site. It is also noticeable that engineers such as Rennie and Telford had their own preferred contractors, before the famed Joseph Locke/Thomas Brassey relationship of the next age.

Training

As has been mentioned, civil engineers came from a variety of backgrounds, though the training they received is not always known. It is noticeable that, even when civil engineering became an occupation with a large number of practitioners, a significant number of entrants came directly from outside, bringing new skills. It is also remarkable how early some of them achieved positions of responsibility, which can only partly be explained by the scarcity of trained people.

The figures for those whose training is known are:

| | 1500-1599 | 1600-1688 | 1689-1759 | 1760-1789 | 1790 on | |
|----------------|-----------|-----------|-----------|-----------|---------|-----|
| engineer | | 1 | 1 | 3 | 10 | 15 |
| civil engineer | | 2 | 3 | 6 | 31 | 42 |
| military | 7 | 3 | 17 | 5 | 24 | 56 |
| mining | 1 | 1 | 1 | 11 | 17 | 31 |
| mechanical | | | | | 3 | 3 |
| naval | 2 | 2 | 2 | 5 | 4 | 15 |
| university | 2 | 3 | 4 | 4 | 16 | 29 |
| cleric | 3 | 1 | | 1 | 1 | 6 |
| lawyer | 1 | 2 | 2 | 1 | 2 | 8 |
| mason | 3 | 1 | 17 | 26 | 10 | 57 |
| carpenter | 1 | | 13 | 14 | 4 | 32 |
| millwright | | | 4 | 7 | 10 | 21 |
| iron/smith | | 4 | 12 | 11 | 19 | 46 |
| contractor | | | 1 | 1 | 10 | 12 |
| builder | | | 2 | 5 | 5 | 12 |
| gardener | | | 2 | | 2 | 4 |
| surveyor | | 2 | 10 | 18 | 22 | 52 |
| architect | | | 2 | 3 | 19 | 24 |
| self | 3 | 2 | 3 | 3 | 12 | 23 |
| other | | 3 | 1 | 6 | 5 | 15 |
| | 23 | 27 | 97 | 130 | 226 | 503 |

It is evident that training as a civil engineer only started to increase after 1790. It was still by no means common when the Institution of Civil Engineers was founded in 1818, and indeed was one of the reasons given for its inception.

New names

The references quoted at the end of each article bring together primary and secondary sources. With the exception of a very few of the early members of the Institution of Civil Engineers, who

are known only from the membership records, there are no entries whose name has not appeared at least once in print. Some are like the canal contractor James Houghton, who is mentioned in two canal histories, each time without explanation, but who with his son worked on at least eight separate jobs from Shropshire to Somerset. Others are like John Hall, of whom there were three, but who have now been distinguished from each other.

It is hard to select examples of people whose significance has been known, but who are dealt with here at appropriate length for the first time. Such a list might include John Adair, who made the first competent survey for a Forth to Clyde canal about 1703; colliery viewers such as John Buddle and Nicholas Wood; Lemuel Cox, builder of piled timber bridges in unprecedentedly deep waters; Hiram Craven, stonemason, contractor and mill owner, who with his family and relatives by marriage founded a company that continued well into the railway age; John Green, pioneer of laminated timber bridges as well as designer of the suspension bridge at Whorlton which has been claimed to be the earliest remaining unaltered example of its type; Charles Hutton, Professor of Mathematics whose wide ranging publications included works on the theory of bridges; George Leather junior, who made the transition from canal to railway engineer and planned a company town before ever a railway was intended to pass through Swindon; John Reynolds, a design-and-build contractor of the early eighteenth century, the excellence of whose work was praised by Grundy; John Smith, one of the earliest constructors of suspension bridges, who also built economical bridges of rubble masonry of larger spans than previously attempted; and Alexander Stevens, designer and builder of numerous fine masonry bridges. George Sorocold, principally a waterworks engineer but recognised by his contemporaries in the early eighteenth century as the 'great English engineer' and John Grundy junior, the early consulting engineer have both been the subject of biographical articles previously, but their importance has not always been recognised.

There are also a few rogues, such as John Mills, who failed to hand to his employer the tolls he had received on their behalf, and whose behaviour came back to haunt him throughout his career. John Upton employed ghost workers on the Holyhead Road but managed to continue working while on bail, before absconding to Russia. Others ran into problems because of the difficulties of the times yet survived. James Hollinsworth was one of several canal contractors overpaid for their work, due to cost inflation and the primitive methods of making interim payments. He was arrested when he was unable to repay the excess, but became a respected resident engineer on some of the largest works in the land. Simon Hamer, who absconded from the Leeds & Liverpool Canal owing money but returned to work on other canals and railways, will be dealt with in Volume 2.

The lower boundary

The editorial board would be disappointed if it were found that anyone of major importance had been omitted. Nevertheless, as information has been assembled about people whose worth has not hitherto been recognised, it was felt that others might also make the grade when more research is done. There are therefore a few entries in anticipation of such research. This though has meant that the dividing line between inclusion or not has become a little fuzzy in one or two places. County surveyors, bridge builders and canal contractors are cases in point. John Gethin in Herefordshire and the Couchmans in Warwickshire are in, Thomas Sykes in Derbyshire and Benjamin James in Monmouthshire (who also worked in Breconshire) are not. The Muschamps and John Law were regional bridge builders in Lancashire and Yorkshire, the Nixsons in Cumbria and are all included, but the Gowlings in Westmorland are not. James Houghton, already mentioned above, is in, but the Beswicks of Birmingham, Dennis Edson, the Hollands of Gloucester and Worcester, and the Pearcees of Frampton-on-Severn all worked on canals over a significant length of time and some distance from home. William Tredwell, who worked on the Worcester & Birmingham, Gloucester & Berkeley and Macclesfield Canals and whose family flourished throughout the railway age will

be found in Volume 2; they were not unique in making the transition from canal to railway contracting, but unusual in doing so with some success.

Sometimes information has been found too late to be incorporated, but decisions like those above have been made not only on the information available now but on intuition about what might be turned up. The possibility of an addendum to catch latecomers is under consideration.

Additional information

Mention has been made already of the chronological table of major works, which is one of two appendices to BDCE. The other is a table of wages, costs, and salaries, which gives information in values of the time and also converts these figures to present day values. Here we find consulting engineers charging up to £840 per day and resident engineers earning £52,000 a year.

There is also an introductory essay by Sir Alec Skempton on the practice of civil engineering from 1500 to 1830, written from a biographical standpoint but also summarising the progress of the profession in Britain over that time. The result of much redrafting, it is an elegant example of completeness with conciseness and well worth reading on its own account.

Achievement

The principal achievement of BDCE is to bring into one place information from an extensive range of sources, many of them primary, some readily available but others not. There is a wealth of raw data which, for the first time, provides an authoritative source of information on the development of civil engineering in Britain and Ireland. The emphasis is on the factual but where appropriate, assessments are made of the significance of people, works or events. Others may develop this further.

It is possible, when viewing an interesting building, to turn to Sir Howard Colvin's *Biographical Dictionary of British Architects* and find the name of the architect and a list of other works by the same person. From this, some part of the relative historical importance of the building may be gauged. No such facility has existed until now for civil engineering works, but here is a handy source of information about technical innovation, rarity of the works, and importance of the people involved which may help towards more rational decisions on conservation, at least for works to 1830.

What next?

The Institution's Archives panel intends to continue to Volume 2, but no timetable has yet been set. The nature of the sources in these later years is rather different, with the publication of obituaries in the Proceedings of the Institution providing a starting point for many of the subjects.

The preparation of Volume 1 has raised some questions which have not been fully answered. It will be seen that rather more is known about early contractors than had previously been thought, but more work needs to be done. There are more names to be found, and too little is known about their organisation and financial strength, or their involvement in work outside civil engineering, such as landscape gardening. The table about training earlier in this paper gives data for only two-thirds of the entries, and the acquisition of skills which enabled individuals to make the transfer from mechanic to engineer is not always clear.

The major schemes of land drainage are well covered, but there is a great need for more research into more local works. Bridge builders, many of whom in the eighteenth century seem to have obtained repeat contracts from Quarter Sessions, often became contractors for canals. Although canal minute books are mostly in national archives, many other documents have been deposited locally. Information from county record offices is probably the least well represented of any source

in BDCE and offers considerable scope for worthwhile research. The information contained in BDCE provides a context for this work.

It is recognised that a project like this cannot have an end. It is hoped that it will be a stimulus to further research. Thought is being given to the best means of receiving and disseminating the results of future work. In the meantime, Mike Chrimes will act as a focus for this and he can be contacted at the Institution of Civil Engineers, and by email at mike.chrimes@ice.org.uk

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