

Book Reviews

The Legacy of Light, A History of Irish Windows

NESSA ROCHE (with photography by Hugh MacConville), 1999

Bray, Co. Wicklow: Wordwell Ltd.

104pp. 66 illus. IR£19.95

ISBN 1-869857-31-3

This is an ambitious little book. According to the publisher's blurb it aims to be, 'not only a history book, telling the fascinating story of how windows gave Ireland its distinctive style of architecture, but also a campaigning manifesto, urging people to preserve what is unique and highlighting the environmental damage caused by PVC windows, and even a DIY guide for householders on how to maintain their authentic wooden windows'.

As the first publication of this kind for Ireland, and coming at a critical moment in the battle to conserve the country's architectural heritage from insensitive development, such a concentrated line of attack must have seemed the most effective approach. It presented the authors with a considerable challenge, namely to produce a short, attractive book that is simultaneously popular, polemical and authoritative, on a topic that is difficult to contain due to its multifarious and ambiguous nature. Needless to say, the end result is not without its flaws, but by and large Nessa Roche and Hugh MacConville, her photographer, have succeeded in giving us a book that is both a stimulating read, and visual treat. MacConville's task was the easier. The window is by far the most evocative part of any building and he is very good at capturing the required atmosphere, simply and without fuss. His crisp colour pictures - any time as good as those in Val Clery's more pretentious *Windows* (1978), but without the Freudian subtext - together with their informative annotations form an essential part of the narrative and help to hold together an otherwise rather loosely structured text. The juxtaposition of these with the descriptive illustrative material is not always successful, but that seems unavoidable within the crowded format adopted for the book.

Having just completed a doctorate on the subject of historic windows in Ireland, Nessa Roche's problem is not a shortage of factual information on historic window design; it is the opposite, how to give a balanced, informative but readable account of a complex sequence of events, mainly of a technical nature, to a lay audience. She writes very well, avoids professional jargon while drawing on her extensive knowledge base to enrich the dialogue with well-chosen illustrations and quotes from contemporary sources. As a result traditional fenestration practices and their products come over as an interesting and significant part of Irish cultural heritage - worth knowing about and, more importantly, worth conserving. It is no mean achievement and this book will certainly do the cause that Dr. Roche, and members of the various conservation bodies that supported the publication, espouse no harm. All the more reason why extra vigilance should have been maintained lest the standards of solid historical practice be compromised in the attempt to tell a good story.

Dr. Roche sometimes errs in this respect by being rather cavalier with her interpretation of the historical material. An example is the case she seeks to make (in a section, perhaps appropriately titled, 'Stretching the Rules') for the use of the fabled 'Golden Section' by Irish Georgian builders to control their façade compositions. The practical application of specific proportional systems like these in historic architecture is notoriously difficult to prove, and neither she nor her model, Cruickshank & Wyld's *London: The Art of Georgian Building* (1975), offers convincing corroborative evidence to support the claim of the Golden Section's widespread usage. It would have been wiser to refrain from conjecture of this kind in a popular book.

Likewise, Dr. Roche could have been a bit more circumspect in her phraseology. Terms like, 'Renaissance', are used far too loosely for comfort, and when Alberti is cited as having been a contemporary of both Serlio and Palladio (p7) one begins to wonder whether this is not indicative of a less than secure grasp on the basic chronology of major European art historical movements. On the face of it such broader concerns may seem of secondary importance in a study that focuses on detailed aspects of Irish architecture, but since the whole argument of the book rests on the assumption that an indivisible and mutually supportive relationship of the detail to the whole exists in architecture, one is entitled to expect this to be reflected in the way the material is presented as well.

A greater clarity might have emerged for the conceptual framework of the book had the British connection been brought more to the fore; throughout the work the Irish-English axis in particular seems fudged in order to emphasise the regional/national character of the subject matter. As a consequence the uninitiated reader is not sure how 'the history of Irish windows' fits in with the rest of Britain and/or Europe and, therefore, is unable to form an opinion on what is claimed (possibly quite legitimately) to be essentially Irish patterns of development.

HENTIE LOUW

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Naval Hospitals of Port Royal Jamaica

JEAN AND OLIVER COX, 1999

Kingston, Jamaica: Caribbean School of Architecture at the University of Technology

72pp. illus. No price

ISBN 976-8027-21-5

This is the first in a series of short monographs on the buildings of the Caribbean. Jean and Oliver Cox discuss two hospitals constructed by the British Navy on the same site nearly seventy years apart but with decidedly different design approaches and performance records. Their essay illustrates how early European architecture in tropical territories involved the interaction of advanced building technology with indigenous environments, traditions and skills. The focus here is on construction to withstand the destructive forces of earthquakes and hurricanes.

The first purpose-built naval hospital in Port Royal was constructed in 1740-1743 largely to the design of Admiral of the Fleet Vernon and with work supervised by the local storekeeper. Designed to meet British not Caribbean building conditions, the structure had conventional brick walls with a prefabricated timber roof. Materials were shipped from England. The structure was badly damaged by an earthquake (1771) and then by a hurricane (1787), after which it was abandoned.

In marked contrast, the second hospital on the site proved to be a successful pioneering work in prefabricated iron, designed in England but fully responsive to Caribbean climatic conditions and seismic activity. It has survived six earthquakes and as many hurricanes. The building, measuring 380 by 56 feet, was constructed in two phases with the central section begun in 1817 and additions at either end six years later. Completed in 1824, it was used as a naval hospital until 1905, after which it served military and other purposes. A multi-professional design team tackled the project. It was headed by Edward Holl, an architect in charge of building design for the Admiralty in the naval dockyards since 1804. Holl had earlier employed cast iron as a constructional material in dockyard structures at Devonport, Plymouth, Chatham and Sheerness. John Sturges of the Bowling Ironworks in Bradford provided materials for the Port Royal hospital as well as important comments

on specifications. Although not mentioned by the Coxes, staff of the Admiralty works department likely contributed to the design process as well.

Holl's hospital features a prefabricated iron framework that ties together brick bearing walls. Its superstructure is anchored by wooden piles and massive brick foundation cores. Cast iron columns, ring beams and floor beams form galleries encircling the two storey structure. Ward beams span 22 feet and those in the galleries 15 feet; both lock into cast iron wall plates bolted through the brick. The seatings of the beams in wards are staggered to avoid weakening the brickwork. Central beams in each of the ward blocks are connected by metal straps to the beams spanning the galleries to increase stability across the structure. A hipped roof has cast iron trusses with principal members bolted together in sections and fitted with wrought iron tension rods.

The Coxes' monograph is a welcome work on an important subject. Written in English with Spanish and French translations, it is accessible to a general audience, well illustrated with colour plates, drawings and sketches, and contains useful appendices, including a condition and use survey (1995). Even so, the essay would have benefited greatly from some historical context on prefabricated iron construction. The authors fail to recognise that Holl's hospital may well be the earliest of its kind built for former European colonies in tropical territories. Moreover, no mention is made of the Royal Engineers' prefabricated iron framework system for military hospitals and barracks for the West Indies in the 1820s. These structures were also the product of teamwork and had design features similar to the Port Royal naval hospital as well as interesting differences in details. A comparison would be revealing.

In 1969 the Port Royal naval hospital was taken over by the Jamaica National Trust, repaired and rehabilitated as a centre for archaeology. Hurricane Gilbert (1988) badly damaged the roof and the museum had to be evacuated. It is appropriate that the monograph concludes with proposals to preserve and enhance the building for museum and Trust uses. UNESCO has been involved and the European Union financed the present publication. These are encouraging signs but the conservation of this internationally significant building should proceed without delay. Its loss would be tragic.

JOHN WEILER

The Diary of William Mackenzie: the First International Railway Contractor

DAVID BROOKE(Ed), 2000

London: Thomas Telford Publishing

610pp. 26 figs, 25cm, £29.95

ISBN 0 7277 2830 X

This is a big book about building railways in the 1840s. It is also a diary and, therefore, about its diarist, William Mackenzie (1794-1851), less well remembered than his junior partner, Thomas Brassey, though undoubtedly one of the great contractors of the first half of the 19th century. This is part of his rehabilitation. More than that, it focuses attention on the international dimension of Mackenzie's career. The diaries cover the years 1840 to 1850 when he led the way in the application

of British railway building experience to Continental Europe, in particular France. A portrait of Mackenzie in 1845 that serves as cover, frontispiece, and introductory figure has papers at the great man's feet inscribed 'Railways in FRANCE' - that by which he wished to be judged.

A foreword by Michael Chimes explains that the diaries came to the Institution of Civil Engineers in 1990, as part of an extensive Mackenzie archive. This acquisition led to an exhibition in 1994, and publication of the diaries is the next step in dissemination of the archive. The catalogue of the exhibition is the best source for Mackenzie's life up to 1840, to which Brooke gives only two pages.

The diaries start with Mackenzie occupied in Britain and Ireland. The action soon shifts to France, following an approach from Joseph Locke, and to the building of the Paris & Rouen Railway (opened 1843) by the newly formed partnership of Mackenzie & Brassey. This led to the building of the Rouen & Havre Railway, opened in 1847, and many other initiatives. Mackenzie & Brassey's success was passingly such as to give credibility to anything they touched. Mackenzie's *annus mirabilis* was 1845 when he was 'fairly beset' with contracts 'of all sorts', prompting 'a great dizziness in my head'. Things started to go wrong in 1846 - 'trouble has come on us on every side not expected'. Business problems were compounded by poor health and then by the revolutions of 1848. Worse health led to a withdrawal from affairs and a falling out with Brassey in 1850. The diaries fizzle out only months before Mackenzie's death.

The justification for publication of the diaries lies in their rarity as first-hand witness to the contractor's world in the heroic period of railway building. As the foreword points out, this has value not just for railway historians, but for economic and social historians as well. In evaluating a published diary it is best to start at the end. The index is crucial; like any diary this one contains a vast amount of thematically unstructured information. Unfortunately the index here is little more than a guide to names and places revolving around railway schemes. There are many interesting topics on which researchers might wish to interrogate the diaries - costs/estimates, iron/founders, steam-engines/power. These remain unindexed as such, and for many purposes irretrievable; few not imbued with enthusiasm for railway history will sift through the whole.

David Brooke provides three short introductory essays that are valuable supplements to the diaries, though they do not grow out of them, most of the background coming from other sources. These essays are good on the nature of railway work organisation, but are not conceived as introductions to the subject as a whole. Much information appears in Brooke's notes, but its value is again compromised for not being indexed. There is a 'Directory of People Mentioned in the Diary', a handy mini-biographical dictionary. This is inevitably eccentric, but more so because of Brooke's apparent reluctance to look to the world beyond railway building. Marc Brunel, William Fairbairn, J. M. Rendel, and Sir John Rennie are all mentioned in the diaries, but not in the Directory, and the last two not even in the index.

Mackenzie does record that he spoke to Brunel, but not about what. Sadly, this is typical. The diaries are disappointingly laconic. Brooke regrets Mackenzie's lack of comment on George Stephenson when the latter died in 1848 - but this is entirely in keeping with a general absence of peroration. Mackenzie writes of, but not much about, his career. The momentous decision to go to France is opaque: Locke mentions the Rouen railway, Mackenzie writes to Locke, and Mackenzie goes to France, and that is all we learn. The spectacular collapse of the Barentin viaduct in 1846 is recorded simply as a matter of fact. There are, however, some passages that do convey something of the meat and potatoes of contracting and railway engineering. These hint at the attention to detail and depth of practical experience that underpinned Mackenzie's success, and a sense of the dense banality of Herculean achievement does emerge. There is a hint of the conflicts that arose when contractors moved into promoting, as Mackenzie did in 1844, but the diaries are characteristically reticent, and these murky waters remain unexplored by Brooke. An aspect of contracting that does

figure is the risk of taking control of processes and materials - the Pontaudemer ironworks became a disastrous liability in 1846.

Brooke draws attention to what is perhaps the most striking insight gained from the wholeness of this record of a contractor's life - the astonishing amount of time spent travelling. In itself this helps to bring back a sense of just what a dramatic impact the railways had on people's lives. Thanks to Mackenzie and others the time it took to travel between London and Paris was drastically reduced between 1840 and 1850 - and with no loss of safety to judge from the number of serious accidents with horses and carriages that Mackenzie experienced or witnessed.

Brooke makes it clear that the transformation wrought by British involvement in railway building in France was more financial than technical, providing investment capital to kick-start a centrally controlled network. How this has been reversed, as we stumble endlessly towards a high-speed Channel Tunnel rail link, and look enviously across to the TGV! Against assumptions that centralisation was a negative factor Brooke quotes Locke in explaining that from 1842 onwards railway development in France as against Britain was a contrast 'between method and confusion'. In 1844 the Belgian government 'determined to take advantage of the prevailing disposition amongst English Capitalists to invest in railways, foreign and domestic.' Certainly Mackenzie & Brassey were trail blazing in showing the French and others how to build railway lines quickly and efficiently, but Brooke concludes that their prime achievement was not in the realm of engineering or construction, but in opening up the Continent to British finance.

However important Mackenzie was as a contractor the publication of this book means that he has also to be judged as a diarist and as a man of his times. The diaries start the day after Mackenzie's second marriage, perhaps representing something of a personal fresh start at the age of 45. The prose style is frank, but rarely interestingly so - more Pooter than Pepys. There are good reasons why Mackenzie's diaries are a rare surviving insight into the day-to-day world of the early railway builders. These were busy, practical businessmen, not much given to reflection. In so much as Mackenzie emerges as a person, he confirms one's worst suspicions about 19th-century railway contractors, whose reputation 'rested on their ability to get the job done on time or with the minimum of delay'. Mackenzie was harsh of judgement, with little good to say about people other than those (women and children) who could be patronised. An Irishman 'who had his hands and Eyes destroyed' on Mackenzie & Brassey's works is dismissed as 'very insolent'. A week later Mackenzie went to the Opéra with one too few tickets for his party. Rather than pay for another ticket he returned home with poor Mrs M. Mackenzie & Brassey made profits of £343,120 in France by 1850. Such profitability flowed in part from insistence that pay of 1s/2d a day was 'ample' for labourers, and from being vexed to find some of these labourers burning 'our coals' in their 'cots'. Brooke identifies with his subject, presenting the revolutions of 1848 as a 'resolute defence' against 'bands of arsonists and looters', without reflecting that Mackenzie was among those whose activities prompted arson and looting.

Qualities that made for success as a contractor appear to have been offset in Mackenzie by an unappealing preoccupation with his health. Frequent moans about 'face ache' and the like, even in the good years, raise the suspicion that the decline in his health in the late 1840s and his relatively early death might have been related to the professional setbacks of 1846 and a loss of motivation. The diaries become perfunctory as Mackenzie seems to lose heart - 'I lay long in Bed very uncomfortable and troubled about affairs which lie heavy on my mind and the prospects looking forward are very gloomy'.

Mackenzie's diaries present a fascinating glimpse of a man of stature arriving at and declining from his highest point. But they are not a good read. Much might have been edited out. Do we really need to know when Mackenzie rose, breakfasted, and retired each day, or that on many days 'nothing occurred'? However, it is as a reference rather than as a narrative that the diaries are

principally important. They probably are, as is claimed, a unique record, of enormous value to railway studies. Wider potential would be better served through online publication where the limitations of the index and the bulk of the material would not matter.

PETER GUILLERY
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The Fireproof Building: Technology and Public Safety in the Nineteenth Century American City

SARA E. WERMIEL, 2000

Baltimore & London: The John Hopkins University Press

viii + 301 pp. illus. £31.00

ISBN 0-8018-6311-2

The reader of this book has two for the price of one - in addition to the story of development of fireproof construction in America, Sara Wermiel also covers the introduction of the rolled iron and steel joist, in which America was a late starter, but rapidly overtook England and the Continent.

The story is all about conflagration, defined as a fire involving groups of buildings that destroyed property valued at the time at \$1 million or more. In the nineteenth century, this meant whole towns and cities, a problem from which we in Britain were spared, having had our conflagrations in London in the eleventh and twelfth centuries as well as in 1666 and elsewhere up to the eighteenth century. These events resulted in legislation to prevent the spread of fire, principally with masonry party walls, which was not carried across the Atlantic, where rapidly expanding and new towns and cities were generally of timber construction.

The first chapter describes the extent of the problem and sets the scene for the first fireproof buildings, up to 1840, when brick or stone vaults spanned on to masonry walls. This form of construction was used for prisons and other federal buildings, and also for banks. The use of structural iron crossed the Atlantic in the 1840's, with the introduction of iron and brick floors, as they are generally termed, mostly for federal buildings. The American iron and brick floors usually took the form of fairly short span half brick arches on tertiary iron beams at close centres. In England, brick arch floors were generally restricted to mill type buildings mostly in the north, with a few notable exceptions such as Barry's Palace of Westminster, whereas the Americans used them for all types of buildings, particularly custom houses and other federal buildings, and hence needed the shallower construction obtained with arches on beams at about 4ft centres.

The significant event in the furtherance of the application of the iron to buildings occurred in 1853 when the US Treasury Secretary centralised the development process and set up an Office of Construction to purchase and manage the huge quantity of federal construction then needed. This Office was staffed by Army engineers, including Captains Meigs and Alexander, with Captain Bowman as the engineer-in-charge. Designs were the responsibility of Ammi B. Young, who had experience of vaulted masonry buildings. This was the department that motivated and encouraged the growing iron industry to produce rolled (wrought) iron beams, initially channels, and in 1856 Trenton succeeded in rolling 9" deep joists. Within a year Phoenix also succeeded in rolling iron joists. The Office of Construction arranged for and paid for testing to prove and refine the sections, and disseminated the results to promote the use of iron and brick flooring. The third chapter describes this development in detail with contemporary references.

In the 1860s a number of other flooring systems emerged to compete with brick arches, including a corrugated iron arch former to a concrete floor, patented in 1867, as used by Moreland and others in England, but the hollow clay arch blocks introduced in the 1870's soon replaced all the other

forms of floor. Interspersed with the story of the development of flooring systems are the descriptions of the configurations that were still occurring to test fireproof construction, and the search by architects and builders for lessons to be learnt from the fires and remedies to be developed. Tile and block manufacturers soon extended their range to include tile protection to beam flanges and to columns, and also to extruded blocks for building partitions and forming ceilings.

The fourth chapter looks at the parallel development of slow burning construction for mill buildings using large timber sections, in conjunction with good management of combustible material, fire alarms, extinguishing measures and improved means of escape. This alternative was developed and refined by the factory mutual insurers, who found that the strict controls enable them to quote very low insurance rates for potentially the most hazardous kinds of factories. This influence of mutual insurers, and their success in reducing the extent and cost of fire damage, was extended to the use of slow burning construction in other types of buildings and also influenced the provisions included in building regulations.

Chapter Five entitled 'The Fireproof Skyscraper' extends the story to the introduction of steel for structural use and the skeleton frame. Tile arch floors and other tile components were already available for the construction but they soon had to compete with the emerging reinforced concrete, by pioneers such as Hyatt and Ransom. Chapter Six describes the slow development of means of escape, an aspect of the problem which followed behind fireproof construction methods, and generally required official regulation to force it to be addressed seriously. On both sides of the Atlantic, deaths in fires, particularly in theatres and similar buildings, attracted a great deal of public attention. This attention and the control of the extent of conflagrations caused fires to be studied in more detail and lead to the development of the craft of surveying and to the study of the problem of fire in the widest sense, by organisations such as the British Fire Prevention Committee.

The quotation which heads the final chapter - entitled "The Invisible Infrastructure of Safety" - is an eternal truth taken from a 1915 study: 'Suffering through fire is to a large extent, one of the preventable ills of humanity'. As Sara Wermiel says, "Most building fires are preventable. Those that cannot be prevented can be controlled". This final chapter discusses how long we all took to recognise these truths and how the skeleton frame, the skyscraper and indeed most modern construction would not have been possible without the developments of fireproof construction in the nineteenth century.

References are all grouped together at the end of the text, but with helpful headings stating the page numbers to which the references on that page apply. This makes reference to the notes almost as simple as if they were at the foot of each page. The references themselves show that Sara Wermiel has in most cases gone back to original material, which is after all the only acceptable way to proceed. Second hand references rely on others' selection and interpretation and are always liable to suffer from the ills of Chinese whispers. The bibliographical essay, which precedes the index, discusses the sources consulted and is so much more useful than a list because it enables the reader to identify and select which to pursue for further information.

This book is particularly welcome as an authoritative and comprehensive treatise on a hitherto somewhat neglected topic. Its reasonable price means that a space will be found for it on the shelves of anyone interested in nineteenth century building construction, if only because of the transfer of ideas and techniques across the Atlantic and their influence on practice here. It is a matter of regret that so much less original source material is available in this country to enable similar research to be undertaken for England.

LAWRANCE HURST

Six Bridges: the Legacy of Othmar H Ammann

DARL RASTORFER, 2000

New Haven, Connecticut and London, England: Yale University Press

188 pp. 176 illus. £26.00

ISBN 0-300-080547-6

Many considerations of the career of Othmar Ammann (1879-1965) begin and end with the George Washington Bridge, for as the reader learns in Darl Rastorfer's *Six Bridges*, Ammann's first independent design was a singularly stunning achievement of engineering and politics. As the longest bridge in the world it spanned nearly twice as far as any previous bridge; and it was completed during the Great Depression after more than three decades of proposals to span the Hudson River. Had Ammann designed no other bridges he might be still be justly remembered as one of the greatest bridge designers of the twentieth century. Fortunately, Rastorfer goes well beyond the George Washington Bridge, tracing the career of Ammann and the development of his engineering style through his six major works.

Six Bridges was published in conjunction with an exhibition at the Cooper Hewitt Museum in New York City and without a doubt its exquisite photographs are the book's greatest attraction for the historian, engineer or general reader alike. The over 150 photographs, many from archival collections, are a mix of contemporary and modern views with many striking perspectives. Also among the illustrations are drawings and architectural renderings, primarily of proposed designs for elements of the George Washington Bridge. Particularly interesting are numerous views of the bridges under construction which reveal the enormity of effort required – the towers and cables of the Verrazano-Narrows Bridge bristling with workmen dwarfed by their scale, or the as-yet unencumbered towers of the George Washington Bridge rising high above the landscape. Rastorfer also addresses the complications of constructing such large public works in urban areas. Aerial photographs show a swath of Bay Ridge, Brooklyn demolished for the approach ramps to the Verrazano-Narrows Bridge or the Triborough Bridge viaduct elevated above Wards and Randall's Islands ignoring the land below. Perhaps the only shortcoming of the graphical content is the lack of a map of the New York metropolitan area to show the relationships of the bridges to one another and to the network of roadways and traffic patterns to which Rastorfer often refers. The reader unfamiliar with New York area roads will do well to have a map nearby.

The well-written and informative text of *Six Bridges* is a valuable contribution to the existing body of literature on Ammann. The book begins with a biographical section covering Ammann's career from his arrival in America in 1904 until his death in 1965. Rastorfer's access to a newly discovered body of personal correspondence allows the reader a glimpse of Ammann's previously well-hidden personal character. Ammann's award-winning technical writings are well-known in the profession for their clarity, but he left behind few personal writings. The initial chapter also includes a brief summary of the historical development of suspension bridges in order to place Ammann's bridges in context. This section is generally accurate, although Rastorfer confuses the engineering properties of weight and deck stiffness – the George Washington Bridge can have so little of the latter precisely because it has so much of the former.

The body of the book consists of a chapter devoted to each of the six bridges: the George Washington Bridge (opened in 1931), the Bayonne Bridge (1931), the Triborough Bridge (1936), the Bronx-Whitestone Bridge (1939), the Throgs Neck Bridge (1961), the Verrazano-Narrows Bridge (1964). Each chapter includes the obligatory factual information surrounding design and construction, but the richness of Rastorfer's text arises from the discussion of features unique to each bridge, such as alternative designs, aesthetic considerations, later retrofits, or societal impact. The chapter on the George Washington Bridge discusses, for example, the never-built stonework of

the towers but also examines aesthetic choices for other components of the bridge, including anchorages, interchanges, toll plaza and approach spans. In discussing the Bayonne Bridge arch (the longest arch bridge in the world until 1977) Rastorfer reveals that both the piers of the approach spans and the abutments were designed to appear more massive than required by structural considerations. As was the case with the George Washington Bridge towers, the masonry cladding of the abutments was never added. Rastorfer's examination of the Triborough Bridge – actually a network of a steel lift bridge, an elevated viaduct and a suspension bridge – discusses how Ammann had to contend with existing tower foundations and anchorages from a never-completed suspension bridge begun in 1932. The brief chapter on the Throgs Neck Bridge lacks some of the richness of historical circumstance presented in other chapters. Rastorfer uses the Verrazano-Narrows Bridge, which again captured the title of world's longest span for Ammann, to discuss the risks and sacrifices of the laborers who built the bridges and the role of the neighbourhood preservation movement which opposed the bridge.

The book includes a catalog of Ammann's works, especially useful for the inclusion of several minor spans and unbuilt proposals. The glossary of engineering terms will be helpful to the non-technical reader.

Six Bridges allows one to trace two thematic threads through Ammann's bridges that are particularly relevant in current engineering practice – the role of aesthetics and public good in bridge design and construction. The design of the George Washington Bridge relied on the close involvement of the architect Cass Gilbert. Ammann's later bridges included collaboration with an architect, but with less involvement as the bridges relied on the structural components themselves for aesthetic definition. For the 1964 Verrazano-Narrows Bridge, no architect is listed among the parties responsible. From the 1930s through the 1950s, expansion of the roadway systems and the ascendancy of the automobile was viewed per se as a public good, and Ammann's six bridges increased access in the New York metropolitan area making possible its great commercial development with seemingly little attention paid to urban and social effects. Not until the Verrazano-Narrows Bridge do we see a public group actively involved in questioning the necessity of such construction and its wider effects. Today's civil engineer must not only consider technical requirements but also respond to issues of aesthetics and public benefit. Ammann's bridges provide an interesting case study of the shifting prominence of these issues in the twentieth century.

Darl Rastorfer's *Six Bridges* is a superbly illustrated book certainly worthwhile to anyone interested in bridge design, but also to a wider audience interested in the interaction between major public works and urban development. All of Ammann's built works are located in the New York area and *Six Bridges* demonstrates the significance of this great engineer to both long-span bridge design and the history of the metropolis.

STEPHEN G. BUONOPANE

Home Builders. Mactaggart and Mickel and the Scottish Housebuilding Industry

MILES GLENDENNING and DIANE WATTERS (eds.), 1999

Edinburgh: RCAHMS

320pp. 307 illus. £15

ISBN 1-902419-08-1

Home Builders is the outcome of the first stage of a Royal Commission on the Ancient and Historical Monuments of Scotland research project. Initiated and funded by the Glasgow-based

building firm of Mactaggart and Mickel, it charts the history of the company from the 1880s to the present day, while at the same time tracing developments in the Scottish building industry as a whole. At first the potential pitfalls of such a project seem more apparent than the likely benefits. The task of marrying the two distinct strands of the book must have presented the editors with problems of chronology, compatibility and coherence. Given the difficulty of the task it is all the more admirable that the result is a cohesive and comprehensive volume.

The book takes us through the history of housebuilding in Scotland from the early nineteenth century to the present day. It is clear from the outset that Mactaggart and Mickel were no minor players in this story, securing as they did some of the most important inter-war housebuilding contracts in the west of Scotland, including the 1500-house Glasgow Corporation development at Mossbank. The scrutiny of the company's history in fact allows many of the key developments in Scottish housebuilding to be examined from the perspective of the builders themselves. They embraced the transition from city centre tenement dwellings to cottage-style, garden suburbs which transformed Scottish housebuilding in the early twentieth century. They built speculatively, principally for owner occupation, and continued to do so after the First World War when local authorities increasingly began to take the initiative for housing-building projects. Giving evidence to the Ballantyne Commission on Scottish working-class housing in 1913, Andrew Mickel held firm to these principles and in doing so he was, according to Diane Watters, more representative of early twentieth-century thinking on housing than the 1917 Ballantyne Report with its whole-hearted endorsement of state intervention.

The first half of the book is devoted to the Mactaggart and Mickel story and this section is written in its entirety by Watters. To her credit she is measured in her assessment of her subjects and produces a balanced historical analysis rather than a company-sponsored hagiography. Even though their favoured path of private building for owner-occupation looked increasingly legitimate from the 1970s when the tide began to turn against state housing provision, she avoids the suggestion that theirs was the right approach all along. The 'tortoise' of private speculative building and the 'hare' of mass public housing both had their place in the complex history of twentieth-century Scottish housebuilding.

Essentially this volume works because the two components of the story are so closely entwined. A conveniently sub-divided text and a thoughtful and effective introductory chapter help the reader to navigate the way between the case history of Mactaggart and Mickel and the Scottish-wide picture with minimal difficulty. The volume is lavishly illustrated throughout with a range of material from architects' plans to contemporary cartoons, advertisements and aerial photographs, all of which combine to give a valuable visual dimension to the text. A series of appendices is also provided, containing useful housing statistics and information on the Mactaggart and Mickel archive along with a set of transcripts of interviews with members of the firm, mainly from the 1980s and 1990s.

The opening chapter states that this volume is intended as 'an introductory source book'. With the generous provision of archive material, illustrations and the comprehensive bibliography it clearly achieves this objective. In fact it provides a good deal more. In its treatment of housebuilding from the early nineteenth to the late twentieth century it tackles a wide range of issues of key importance in the social, political, architectural and urban history of Scotland. Its potential readership is correspondingly wide. It has much to offer the historian, town planner, geographer and contemporary observer of Scotland's recent and current urban growth.

LOUISE MISKELL
University of Swansea

The Making of the Modern Architect and Engineer

ULRICH PFAMMATTER, 2000

Birkhäuser: Basel

312pp illust. DM 58.00

ISBN 3-7643-6217-0 and 0-8176-6217-0

This is a useful but unimaginative book in a shaky translation. Its subtitle, 'The origins and development of a scientific and industrially oriented education', encapsulates Pfammatter's subject-matter, timescale and standpoint. That is to lay out the framework whereby the ideas of the Enlightenment and, in particular, the to-ing and fro-ing between scientific thought and its practical application - between theory and 'praxis', as the academics love to say - became institutionalised in the polytechnical teaching of architecture and engineering in the nineteenth century.

Almost throughout, Pfammatter takes it for granted that this movement was single, sequential, progressive, and a Good Thing. Given such a programme, the core of the book is inevitably about France. Its defining figure is J. N. L. Durand who, Pfammatter alleges in his last line, 'brought about a "Copernican revolution" in the history of architectural and engineering education'. But the best sections of the book are about Switzerland and, specifically, the ETH at Zurich, Pfammatter's *alma mater*, which keeps the old flame of an enlightened and progressive connection between architecture and engineering burning more brightly, perhaps, than any other institution. To that extent this is a manifesto from the ETH, old-fashioned in its optimistic, technical rationalism.

In Pfammatter's view, the central figures of the French Enlightenment, Diderot, D'Alembert and Condorcet, and to an extent Descartes before them, excogitated a secularised model of progress which was directly reflected in the educational institutions of the first French Republic and Empire. For architecture and engineering, this means the Ecole Polytechnique, where Durand institutes his famous preliminary course for young architect-engineers. 'Fearless and decisive' young polytechnician-officers help throw over the reactionary regime in 1830. Thereafter the Polytechnique flourishes, foreign students about, principles of unity between theory and practice spread, and similar institutions staffed by passionate technical educators spring up abroad on almost a colonial basis, notably in German-speaking countries and America. Meanwhile in Paris, pioneering polytechnicians in 1829 set up the Ecole Centrale des Artes et Manufactures to forge the link between design and private industry which the Polytechnique, with its stress on government service and 'representative' buildings, lacks. Hence a second flood of flawless professionals and industrialists, from railway engineers to the innovators of skyscraper technology.

This story is well enough known in outline. But Pfammatter fills it out by systematically setting out the institutions, teachers and graduates belonging to the polytechnical family tree and expounding the development of their curricula. The long section on the Ecole Centrale, not so much written up as the Polytechnique, is valuable. It introduces, for instance, the unfamiliar name of Charles-Louis Mary, whose architecture course there took a more 'structural', less 'elemental' approach than that of Durand and influenced among others William Le Baron Jenney, a Centralien in the 1850s.

The Swiss branch of the tree, dear to Pfammatter's heart, is an instructive one. It begins with Guillaume-Henri Dufour, an early graduate from the Polytechnique who returns to Switzerland to found a military school, teach descriptive geometry (crucial to polytechnical methodology) and mix engineering, soldiering and liberal politics. The Zurich ETH (originally the Eidgenössische Polytechnikum) belongs to the next phase, after the Swiss acquire a liberalising constitution in 1848 and industrialise. It follows the model of Karlsruhe rather than Paris in offering separate, specialised technical schools but adds a unique layer of instruction in the humanities available to all, taught by intellectuals of distinction like Jakob Burckhardt and F. T. Vischer. Semper initially

heads the architectural school, Culmann that of the civil engineers. But even Pfammatter with his zeal for unity between architects and engineers cannot deny that a gulf divides them.

Mostly, Pfammatter is content to reel off the names of institutions, teachers and curricula in the kind of haze of technical-progressive enthusiasm familiar sixty years ago from the work of Sigfried Giedion. The trouble with the book is that it offers a single model of development, without nuance. When it comes to the English-speaking cultures he is at sea. His account of the United States relies on out-of-date sources, assumes a simple progression from 'shop culture to school culture' and omits to mention the chronic shortages of skilled labour without which American innovation and modernisation cannot be understood. Britain, with its early industrial primacy but slow take-up of technical education, just baffles Pfammatter. It earns a lame little chapter at the end in which Semper acquires an importance he never had.

In conclusion, three sceptical questions may perhaps be permitted. Firstly, to what extent do institutions of technical education reflect rather than set trends? For instance, did the success of the Zurich ETH influence the exceptional standards of Swiss construction, or conversely, was it perhaps influenced by them? Such issues hardly occur to Pfammatter. Earlier, the founding of the Polytechnique can legitimately be interpreted as an attempt to rescue from revolutionary confusion schools which had already been set up under the Ancien Regime to supply government needs for trained personnel. Durand's 'Vorkurs' hardly originated as a rational ideal, but rather as an attempt to offer a safe, simple and comprehensible minimum in a short period for architect-engineers soon to be dispatched to the services or provinces. The freedom of thought and action for the teachers whom Pfammatter heroizes was seldom as absolute as he implies.

Next, was the link between polytechnical theory and practice generally as strong as Pfammatter implies? It is about the same old success stories that he tells us: about Eiffel, Contamin, Jenney and so on. But there is evidence the other way. Balzac made a spirited attack on the impracticality of Polytechnique graduates in his *Le Cure de Village*; while in 1899 the director of the Ecole Centrale said that mathematics made his students too abstract in tendency and that when they were given a course on bridges, roads, railroads and architecture 'they say "that is meant for masons and workers"', and we have to propagandize them for months in order to make them understand that they cannot make a living on algebra'.¹

Finally, an architect and engineer can be spatchcocked together and even co-exist in the same person, but can their fundamental aims really ever be identical? One strand in architectural education is almost wilfully missing throughout this book, but surfaces here and there. That is the view of architecture as an art rather than as a technical-progressive service. It is always in the background in France in the shape of the Ecole des Beaux Arts; and it is this ideal which Semper tried to champion at the ETH, not without discomfort and muddle. Struggling to understand the popularity of Beaux-Arts architecture in the materialist-progressivist America of the 1890s, Pfammatter makes the passing suggestion that American 'shop culture' was transmuted into a studio culture. It's an interesting idea. But what is missing is recognition of the fundamentally irrational and imaginative nature of the studio concept, and with it one irreducible aspect of architecture. Architecture is not a uni-directional subject, and the kind of progressive model of its development presented here will always break down.

It must be added that there are frequent barbarisms in this English version, and various misconceptions which one hopes are due to mistranslation. 'Steel' is sometimes used where 'iron' is meant, and Pfammatter cannot really suppose that Camille Polonceau invented prestressing.

¹ Quoted in Robert R. Locke, *The End of the Practical Man: Entrepreneurship and Higher Education in Germany, France and Great Britain, 1880-1940*, 1984, p45.

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Structural and Civil Engineering Design

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This book, the twelfth in the series studies of the History of Civil Engineering will fascinate anyone who is interested in civil engineering design - the thinking process which gives people the confidence to embark on large scale construction. Most books on the history of civil engineering tend to look back at types of structure, materials, construction methods, science and analytical procedures, and, of course, biographies of famous engineers and their achievements. This book is different because it examines how engineers have devised workable solutions to design ideas, using rules, models and theoretical justification to increase confidence before starting construction. It brings together 20 previously published articles which explain how, throughout history, knowledge and experience of success and failure in construction have been gathered together to form a guide to the activity we now call engineering design.

The rationale for the inclusion of the selected articles is explained in the introduction by the editor William Addis. Throughout his distinguished career as writer and lecturer Bill Addis has played a major part in raising awareness of engineering design, a process which relies on precedent and theory. His earlier book (*The Art of the Structural Engineer*, Artemis, 1994) richly illustrates some of the best examples of recent structural achievements; the present work collects together the thinking behind this creativity.

The first part of the book comprises six chapters on the subject of design rules and methods. Five of these cover construction types, spanning a broad spectrum of topics from beams to bridges, from stone skeleton to suspension chains. The opening chapter "The mechanisation of design in the 16th century: the structural formulae of Rodrigo Gil de Hontanon" by Sergio Luis Sanabria, is of unique interest. It presents a competent history of the geometric and arithmetic rules governing the proportions of medieval masonry building. The following four chapters deal with rules for sizing wooden roofs and floors, retaining walls and the emerging science of soil mechanics, skyscraper foundations and geology, and the use of models as an aid for the design of suspension bridges. The chapter by R.F.D. Porter Goff, "Brunel and the design of the Clifton Suspension Bridge", is different because it focuses on one specific project, and one engineer's capacity to develop his design taking account of emerging knowledge.

The second part contains seven chapters under the heading 'Theoretical Justification in Design'. Three of these consider how numbers and geometry were used in the design of some of the great European cathedrals, but the other four chapters concentrate on the evolution of formulae for predicting the strength and stiffness of structural timber and iron.

In the chapter entitled "Stability concepts from the Renaissance to today" R.J. Mainstone describes the gradual change in ideas used to justify the survival of structures, beginning with intuition and stability, then using forces which must be in equilibrium, and finally comparing internal stress with the strength of materials. Diagrams explain this thinking for the cathedrals at Milan, Florence, Rome and London and churches in Paris and Istanbul. In chapter nine Stanley B. Hamilton explains how "Sir Christopher Wren's sound structural sense did not allow him to be seriously misled by his own inadequate theory" - what an important lesson for any engineer who might over-zealously believe in a flawed calculation! The evolution of beam design involved an understanding of stress (often referred to as strain in the nineteenth century writings), and it was Thomas Tredgold who in the 1820s was the first engineer and author to publish rules for the strength of iron and timber beams. Tredgold's rules and a discussion of their derivation, reliability and shortcomings, are discussed in the chapters by L.G. Booth and R.J.M. Sutherland.

The third part under the heading "Progress of Engineering Design" comprises seven chapters which deal with the origins, history and growth of engineering knowledge from the Egyptian pyramids to the present day. The chapter entitled "The Genesis of Engineering: theory and practice" by A. Rupert Hall gives a scholarly overview of the literature of mechanics. It includes discussion of the proportions of many things, some influenced by aesthetics such as the columns of a Roman temple, some by kinetics such as catapults and water wheels, and some by dynamics such as the hull of a ship. Rupert Hall concludes that modern engineering procedures were born out of a necessity to use non-traditional materials. A.J.S. Pippard deals with masonry dams and the search for theory to explain the stress under them, quoting many authors including Karl Pearson who disliked "to slumber in the middle third". D.I. Blockley and J.R. Henderson make the case for learning from failures and they rightly contrast the role of the engineer who must try to avoid failure, with that of the scientist who actively looks for failure in order to supplant new theory in place of old. With reference to our long history of design revolutions - Greek, Gothic, Rankine and Plastic - William Addis writes the concluding chapter to explain what modern engineers now do in their design offices, deciding what shall be built and the instructions for doing it.

The contents of this work provide a valuable collection of writing on a subject which is now very prominent in engineering education. As such, it will interest students and academics alike. Inevitably there are some gaps - such as methods of analysis, and forms of trusses - and some duplication - such as rules for sizing timber and iron beams. However there is an excellent index, and the extensive list of notes and references identify further sources of information. This book will surely become a most useful volume in the series on the history of civil engineering.

PHILIP COOPER
