

Book reviews

Structure in Architecture: History, Design and Innovation

ROWLAND J. MAINSTONE, 1999

Aldershot and Brookfield, Vermont, Ashgate Publishing

423+xi pp. 312 illust. £80.00

ISBN 0-86078-763-X

This is one of many Variorum volumes that Ashgate Publishing is producing on the history of art, architecture, and civil and structural engineering. The last of its 12-volume series *Studies in the History of Civil Engineering* has recently appeared, sadly preceded by the death of its editor, Frank Newby, while a volume of collected writings by the late Professor Sir Alec Skempton must now serve also as a memorial work.

The format of each volume is similar, whether it be compiled by an editor or dedicated to the published work of an individual. The contents comprise papers selected, in this case, by their author. Generally these are facsimile reproductions from the original publication, although here are included two essays noted as appearing in print for the first time.

Rowland Mainstone has for long been studying and theorising on the genesis and evolution of structures. He was for many years active in structural and architectural research at the Building Research Establishment. The first edition of his major study *Developments in Structural Form* appeared in 1975 while he was still at the BRE. (Its second edition was reviewed in *Construction History*, Vol. 15, in 1999.)

In this collection Mainstone both focuses on the general issues of how structural forms were conceived and evolved, and develops the approach in studies of particular buildings and their structures. He is concerned mainly with the period before 'engineering' as such was acknowledged to be a discipline within building design, although one paper does provide a succinct review of the development of structural engineering design in Britain. In this he points out that, with analytical tools and modern materials and techniques, almost anything that the architect can conceive can now be provided with a structure both safe and economical.

Mainstone's detailed studies concentrate on major masonry structures built in medieval and earlier times, which even now challenge engineers to produce anything comparable using today's technology. These are the large-span roofs - the Pantheon in Rome, Hagia Sophia in Istanbul (on which he has written a book, in addition to the several papers reproduced here), St Mark's Venice, Brunelleschi's dome of Florence cathedral, and the dome of St Peter's in Rome.

With nothing or little by way of original documentation to hand, the building becomes the primary evidence of its own design and construction. This requires the painstaking process of observation of the structure in order to inform theories as to how it was conceived and built, and how its observed movements and distortions can be related to the forces and other effects such as ground movements acting within and on the structure. This, necessarily, is an iterative process.

Some argue that this explanation can be aided and informed by the use of modern analytical techniques, which usually involve making mathematical 'models' for computer analysis of the structure. Mainstone is not a devotee of this approach, which he rightly argues will serve no purpose if the model does not closely simulate the actual structure, and will in any case not help understanding of how the original design was created. Furthermore, the primary results from the computer model will be the calculated forces in structures whose individual components are generally proportioned to be of more than adequate strength.

What is more critical is the *geometry* of the structure, which must ensure stability and contain the line of action of the compressive forces within the masonry. Today, with the benefit of ideas on the 'stone skeleton' by Jacques Heyman, this can be assessed retrospectively by hand-drawn diagrams. This approach has the advantage of being quick, simple, and easily understood.

Analytical skill developed slowly. The study of the crack patterns in the dome of St Peter's in 1742 was notable for the prediction of what would today be called the collapse mechanism of the roof, with the crown sinking and the dome splitting into vertical segments as it also hinged outwards at about mid-height. The solution - chains applied at the correct level to resist the outward movement - was then evident.

But before then, how were structures conceived? In the early general papers, Mainstone explores this daunting question, and argues convincingly that 'intuition' offers an answer, deriving from experience, insight, and understanding. He identifies several types of intuition.

'Spatial' intuition is the ability to visualise and distinguish stable and unstable arrangements of structure. This draws on observation, for example of a natural rock arch, complemented by an appreciation based, one could say, on common sense - a beam, for example, supported on a post at only one end will simply fall to the ground. 'Muscular' intuition relies on awareness of and comparison with bodily actions - a heavy weight carried in the arms will put them into tension while compressing the legs - but lacks a quantitative aspect. This is developed into an intuition of 'structural adequacy' by experience and precedent, so that suitable materials and member sizes are used.

These ideas are developed in greater detail and applied in the papers on specific structures and forms. Mainstone includes essays on several, not yet mentioned here. That on squinches and pendentives has an appealing set of diagrams showing how the forces pass through these slightly obscure but essential components of domed and vaulted construction. A short paper considers the genesis of some ribbed vaults by Guarini and Leonardo. Mainstone's contribution to the discussion of a 1967 paper on the roof of Westminster Hall by Jacques Heyman highlights the importance of getting the structural model right. Debate continues on 'how' this great medieval timber roof actually works (but it does!).

The last two papers come a little closer to the present, on the concept and the realisation of late 17th century reinforced flat stone arches at the Louvre in Paris, and its near-contemporary, Smeaton's Eddystone lighthouse off Plymouth. The former with their iron reinforcement in tension and stone in compression anticipate the reinforced concrete beam, while the lighthouse, with its dovetailed interlocking blocks, is an elegant way of enhancing the shear resistance of stone masonry to resist pressure from the waves.

The facsimile reproductions of papers are crisp, the photographs in particular being rendered as clearly as one could hope. The text of paper VI, taken from a larger-format journal, may be small enough to try the eyes of some readers.

Given that the papers have been written over nearly four decades for many different learned journals, there is inevitably occasional repetition of illustrations and discussion between papers. This matters little as a price for having these papers in one volume. Together with Mainstone's books on the development of structural form and on Hagia Sophia, they provide a body of work on the evolution of structural design that will be of enduring interest to historians of building design and construction. They should also be required reading for structural engineers, at whatever stage of their career.

Michael Bussell

Creating Paradise: The Building of the English Country House 1660-1880

RICHARD WILSON and ALAN MACKLEY, 2001

Hambledon and London: London and New York

xviii + 428 pp, 134 illus., 5 figures, 21 tables. £25.00

ISBN 1 85285 252 6

In his autobiography *The Passing Years* (1924), Lord Willoughby de Broke, leader of the doomed 'last ditch' opponents of the 1911 Parliament Act, quoted a fellow aristocrat who boasted: 'I always live up to my income even if I have to borrow money to do it'. That is a sentiment which would have been echoed by many of the builders whose undertakings are chronicled in this painstaking and revealing book. Country houses were hugely expensive items of conspicuous consumption whose construction, in the period of 1770 to 1800 alone, absorbed at least £3.8m worth of the resources of the landed elite: a sum which far outstripped that invested in the construction of spinning mills in the pioneering years of the Industrial Revolution. The houses which resulted from this massive investment have been itemised, analysed and eulogised over many generations. What is less well known is how they were financed and how they were built, and these are the questions which the authors, both of them economic historians, address in this book.

Wilson and Mackley followed in the footsteps of a number of scholars who have examined the process of country-house building or have sought to set it in its socio-economic context, and some of the material, especially in the earlier chapter, will be familiar to aficionados of the subject. Rather than making aesthetic value judgements of embarking on stylistic analysis, they attempt to qualify the incidence and cost of country-house building through a close study of building patterns in six well-documented countries and through a minute examination of building accounts and estate records. One valuable result is the highlighting of little known houses, such as John Carr's Denton Hall, Yorkshire (c. 1770-5) and Edward Blore's Haveringland Hall, Norfolk (1839-43), which are perhaps more representative than the larger, more accessible or simply more picturesque examples of celebrated in most of the literature. There are some tables, but not too many to deter the lay person, and the authors do not parade their technical expertise. The book is very well illustrated in black-and-white, and, though some parts of the country are conspicuously under-represented in the survey, notably the south-east and to a lesser extent the south-west, the authors have spread their net wide enough and have delved deep enough into the available records to inspire confidence in their conclusions.

For historians of construction the main interest in the book will lie in the section dealing with costs, materials and financing. Several instances are provided of the vexations associated with country-house building before, and even after, the rise of the quantity surveyor and the fixed-sum contract in the nineteenth century; John Walker, for example, the owner of *The Times*, decided to employ day labour and spent twice the sum originally estimated (£120,000) on the mammoth Bearwood in Berkshire in 1866-74. The authors could have made more of the use and relative cost of structural iron in nineteenth century houses such as Bearwood, not only for conservatories but also for girders ('ironmongery' appears in the index but not 'iron'). But they rightly stress the importance of changes of transport, a particularly revealing map shows materials for Henham Hall, a James Wyatt house of 1792-8 near Southwold in Suffolk, being brought by sea from as far away as the Baltic (timber), Newcastle (glass), Dorset (Portland stone) and London (stoves, chimney pieces, furniture and mahogany), and by road from Norwich and London. Yet even when transport costs are taken into account, Wilson and Mackley show that the bulk of the expenditure on country houses went on labour: a point which has not been sufficiently emphasised in the past.

The authors throw revealing light on the sources of country house funding. Only £2700 was spent by Thomas Edge Webb in modernising and classicising Strelley Hall (Nottinghamshire) in 1789-90, but he was clearly unusual for financing the rebuilding of his house out of estate income alone. It was far more common, even when rents were rising, as they were in the late eighteenth century, to

resort to sales of outlying estates, profits from investments in government stocks, mortgaging land, and one's wife's marriage portion; factors which all contributed to the rebuilding of Sledmere (Yorkshire) in 1787-92 by Sir Francis Sykes, whose famous portrait by Romney, attended by his well-connected wife, adorns the book's back cover. And for the largest late-seventeenth and eighteenth century houses, sinecure offices from political cronies played an important part: some at least for the funding for Holkham Hall (Norfolk) came from the profits of Dungeness lighthouse and for Sir John Griffin, who rebuilt the derelict Jacobean Audley End (Essex), starting in 1762, drew the income from no fewer than five lighthouses. 'Great houses', as the authors tersely put it, 'were built from non-landed wealth'.

What did it all amount to? The authors wisely steer clear of facile moralising about excessive expenditure or the diversion of wealth in to non-productive channels. For them the builders of country houses were doing what their social role demanded: to house themselves magnificently if they were very rich, and in a suitably dignified way if, like the vast majority of the landed class, they came from squirearchy. Their investment, they argue, boosted England's rural economy and contributed to a 'craft culture' which was one of the nation's strengths in the age of rapid economic advance covered in the book. This is a conclusion which invites further discussion. Meanwhile, Wilson and Mackley's deft analysis of the available facts have supplied an essential basis for future understanding not only for the history of the country house in its most glamorous era, but also of the role of the building in the English economy as a whole.

*Geoffrey Tyack,
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Making Houses: Crafting Capitalism; Builders in Philadelphia, 1790-1850

Donna J. Rilling, 2001

Philadelphia: University of Pennsylvania Press

208 pp. 24 illust. £31.50

ISBN 0-8122-35800

Between 1790 and 1850 the population of Philadelphia, its 'city and suburbs', increased from 44,000 to 309,000. This was a period of prosperity and decline but the underlying trend was expansionist. As early as 1792 Susanna Dillwyn noted that 'the town increases surprisingly' a phrase reminiscent of David Defoe's astonishment at 'such a prodigy of building' in Westminster over seventy years before.

With the burgeoning population the building trades in Philadelphia prospered and evolved to meet the consequent demand for housing. The ways in which builders, builders merchants, individual tradesmen, real estate brokers, and others responded to this opportunity is the subject of this book. By means of the judicious use of records in the City Archives, the Pennsylvania Historical Society and other primary sources, Donna Rilling has assembled a compelling account of the *Crafting of Capitalism* in the building trades. She has rather less to say about the *Making of Houses*. Accordingly this is a very different study to such works as Cecil D. Elliot's *Technics and Architecture* (1994) or *Building Early America* (1976) edited by Charles E. Petersen.

Crafting Capitalism provides a business history, or rather a series of such chronicles. As such it should be of value to economic historians. Not the least of its concerns is the importance of barter to the building trades at this time with craftsmen 'agreeing to work on each other's dwellings according to expertise' (1841). This is close to Isaac Ware's reference to a builder '... doing his share of business in another's house, according to their several subordinate professions' (1756). Between 1811 and 1816 'bank currency' came into greater use and these exchanges of labour (and goods) gradually became less significant.

In focussing so exclusively on Philadelphia there is some loss of historical perspective. For example, the speculative builders in the early nineteenth century 'Quaker City' financed their ventures in the interval of time between the generous, but temporary, terms offered by the ground landlords and the eventual sale of a particular property. No reference is made to the origins of this financial device in England and ultimately in France. We are, though, given important details on the 'First Purchasers' of William Penn's vast land holdings. It was their descendants who often feature as the ground landlords in the transactions described here. This fundamentally feudal device was, amongst American cities, peculiar to Philadelphia and was to come to an end when ground rents were abolished there in 1854.

Many aspects of life for builders in early nineteenth century America would have been familiar to artisans on this side of the Atlantic. The working day in summer was fifteen hours of which two were taken up by meal breaks. In winter it was nine hours, or eight hours net working time. The climate in Pennsylvania is subject to far greater extremes of temperature than is typical of Britain, a circumstance which may well have encouraged the development of more sophisticated off-site production methods. There is some suggestion that, as in England, houses were sold as 'a shell'. This would have enabled builders to cash-in on their investment sooner, whilst purchasers could have their houses finished internally to meet their own needs and tastes.

Despite the similarities there are some issues which will be alien to a British readership. An example of this is the way in which the Colonies regressed to the use of timber for 'America's Wooden Age'. As late as 1810 some 65% of the housing stock in Philadelphia was of timber frame construction. For America 'the Great Rebuilding' did not begin in earnest until the late eighteenth century and even then was an exclusively urban phenomenon.

The timber used for building was grown in the State, felled in autumn, hauled over winter snow to be processed in mechanised saw mills and finally floated down the Delaware River to the city. To

some extent this timber had been water seasoned in transit. The abundance of timber in the New World may account for dominance of the Carpenters' Company in Colonial and early Federal Philadelphia, although only about a quarter of these tradesmen there were members of the Company. Its *Rule Book* of 1786 lists prices for both carpentry and joinery. Any possible demarcations between these two trades is not discussed although some suggestion is made that joinery was a winter activity and carpentry a summer occupation. We are given a fascinating insight into the ever greater specialisation within the joinery trades, including the off-site manufacture of sash windows and the construction of staircases. Indeed it was the bifurcation of certain trades that offered an important step towards ever greater use of mechanisation.

The various industrial machines that came into use at this time were, at first, water powered. Water powered sawmills had been in operation in North America as early as c.1633. To maximise efficiency trees were selected from neighbouring forests which permitted their regeneration. Steam powered mills were three times as fast and their voracious appetite could only be fed by clear felling. As a result the woodland did not re-establish itself as quickly so that these mills were compelled to relocate about every eight years. In practice, the introduction of steam power in Pennsylvania in the second quarter of the nineteenth century was probably inhibited by the building slump of 1830 to c.1848.

It was in 1830 that four of Philadelphia's artisan entrepreneurs invested in some New England quarries which offered better quality marble than that which was available in their home State. Curiously enough we are told that quarrymen in Pennsylvania continued to use wooden wedges rather than plugs and feathers to wrest stone from the mother rock.

By examining individual business histories a real picture is created as to how builders contended with this period of great economic, technological and aesthetic change. These were decades potent with opportunities and littered with pit-falls. Building slumps could spell disaster for developers and unscrupulous developers could cause distress for sub-contractors. One developer, Warnet Myers, duplicitously entered into an agreement with one of his money lenders in the State Supreme Court, rather than using a lower court as was customary, so that this agreement 'might not be seen by so many' of his other creditors. Rilling also notes that for some building supplies 'collusion may have accounted for the somewhat consonant pricing' of commodities like bricks. In circumstances such as these building tradesmen accounted for a quarter of all insolvencies whilst representing only a fifth of all artisans in the 'City of Brotherly Love'. For some Penn's 'holy experiment' had matured to a point at which a Quaker master-builder like Moses Lancaster gained much from this pre-existing network, this Society of Friends, in which obligations were met and bills paid promptly. As the author observes in one of her few flourishes of Americanese 'ethnocultural connections' were important and were presumably true for others like the Welsh and the German communities in the Quaker State.

The historic core of eighteenth and early nineteenth century Philadelphia survives remarkably intact. Red brick and off-white marble details are the predominant materials. Like London, Philadelphia was built out of the brick earth on which it stands. In these circumstances it is disconcerting to read that kilns, rather than the more ephemeral and therefore mobile clamps, were used to burn bricks. These kilns were fired by native timber but, at a later date, the State's anthracite was also used although it demanded more skilful brickmasters. Anthracite was also used for lime burning but bricklayers always preferred the wood burnt product for their mortar.

The place of women in the building trades is examined with regard to their roles as investors and employers but not as labourers. As in Britain, female employers were almost always 'bridging the gaps in male succession'.

Donna Rilling's *Crafting Capitalism* in Philadelphia is a valuable companion volume for Linda Clarke's *Building Capitalism* (1992) in London. Both books are essential reading for anyone interested in early nineteenth century urban development.

James Ayres

Survey of London Volume XLV: Knightsbridge

John Greenacombe (ed.) 2000

London: The Attilone Press

245pp. Illus. £75.00

This latest volume of the Survey of London is essentially a tidying-up operation. Over the years 1973-86 the Survey team produced four magnificent volumes on Kensington, which as well as dealing specifically with that part of London presented an admirable analysis of the nineteenth century development process. One of those volumes described the history of the Brompton area, including the Old Brompton Road and the Harrods store. That left Knightsbridge to be dealt with, which is in fact in Westminster but mostly feels as if it belongs to Kensington: that is especially true of the squares to the east of Exhibition Road such as Princes Gardens and Ennismore Gardens.

It is right to have rounded off the story of this part of London in this way, and the quality of research and writing in the new volume is as high as ever. But there is no concealing that it is a slightly awkward production, partly because some of the best bits of Knightsbridge have already been dealt with in the Brompton volume but also because the area has always had an ill-defined identity. Although its name is ancient, derived from the King's Bridge over the Westbourne river, the road called Knightsbridge was not so named until 1903 and the Underground station (which is how most people know what to call the areas of London) didn't open until 1906. And to add to its nebulous character, it has never been an administrative entity. So although the word Knightsbridge has clear connotations for everyone of department stores, hotels and supposedly sophisticated wealth it is difficult, on closer inspection, to know what focus to give its history.

The way the survey team have chosen to handle this problem is simply to start at the east near Hyde Park Corner and work westward. First of all they deal with the east end of the street which ultimately was named Knightsbridge, above all its relationship to Hyde Park. The key episode here was Thomas Cubitt's development of Albert Gate in 1841-7, not just because of the two Italianate mansions that he chose to construct (one of them leased to the fraudulent railway magnate George Hudson), but also because of the infrastructure he provided for arching over the Westbourne river and creating a dignified gateway to the park. He at least thought about the relationship between the street and the park, with better results than anything that followed. The key problem with subsequent developments on the north side of Knightsbridge, from the Hyde Park Hotel in the 1880's to the rebuilding of the Knightsbridge Barracks in 1967-79, has been the intrusion of high buildings on the park. The survey authors give good accounts of why the campaigns to prevent such buildings failed, without voicing their own wrath about the damage which such developments have inflicted.

On the opposite side of the street, the history of the east end of Knightsbridge has more to do with retail, especially the role of two department stores: Woollands, which closed in 1967, and Harvey Nichols which is still going strong on the site at the corner with Sloane Street where it was founded in 1831. Here there is an obvious weakness in this volume because Harrods has already been dealt with elsewhere. There is no attempt to summarise why this clustering of department stores took place, and how neighbouring properties have been affected.

But one historic characteristic of the area which certainly is highlighted is the overlapping of extreme wealth and poverty, especially at Knightsbridge Green where Knightsbridge meets the Brompton Road. In part this was undoubtedly because of the barracks, providing good custom for a string of pubs which in the 1850s and 1860s spawned concert rooms in their rear premises (George Leybourne first performed his hit 'Champagne Charlie' at the Sun Music Hall on the south side of Knightsbridge in 1867). And from 1865 there was also the presence of Tattersalls, the horse auctioneers, which just like the racecourse threw together the blue-blooded aristocracy with riff-raff of the horse world. Thus that part of Knightsbridge became "quite as unseemly as the Haymarket" and remained so until after the Second World War. Except that mixed in with the unseemly there was also improving

entertainment. Just along the road there had been the Great Exhibition of 1851 and much in that tradition Humphrey's Hall, an ex-roller skating rink, because a centre for exhibitions, notably a recreation of a Japanese native village, which attracted huge crowds in the years 1885-7.

Finally this volume deals with the development of the area south of Hyde Park, from Kensington Green to Exhibition Road. The analysis of estate development is the real metier of the Survey team, and there are no great surprises here: indeed the sadness is that there are few architectural highlights, except the Lombardie All Saints, Ennismore Gardens (now the Russian Orthodox Cathedral) and the creation – and later dismantling- of Whistler's Peacock Room at 49, Princes Gate. Where this sector of London's development differed from other, comparable areas was that interspersed with Italianate terraces were custom-built villas, many of them commissioned by art collectors or people involved in the arts. Virtually none of these survive, having fallen victim to the developers of second – rat' mansion blocks.

Not many subscribers to this journal will be tempted to read this volume of the Survey from cover to cover, but if they did so they would absorb the meticulous methodology of the research involved in its production, as well as countless fascinating points about London's building history. Where they will be disappointed, with this volume as much as its predecessors, is that comparatively little space is devoted to the analysis of building construction; in particular that almost none of the line drawings show details of construction. Often the text cries out for such illustrations, for instance when it is pointed out the 58, Knightsbridge may have been the first non-industrial building in London built using the Hennebique technique, or when Woollands store, rebuilt in 1896 – 1901, is referred to as being steel frame faced in Portland Stone. If the information is known to exist, these are instances where the Survey should be providing much more practical detail.

The main reason for pointing out this gap concerns the readership and use of the Survey. The people for whom the Survey is most invaluable are those responsible, in whatever way, for the care of London's historic fabric: indeed that is the readership that C.R. Ashbee and his colleagues originally envisaged when they published the first volumes. What conservationists need to know is not just the detailed historical development of an area but the construction techniques used in individual buildings, especially where they are innovative or unusual. It is, after all, a knowledge of those techniques that is crucial to the repair and maintenance of such buildings. Given that the survey has achieved so much it may sound ungrateful to ask for more, but this is an aspect of its coverage which needs to be tackled in order to retain the loyalty of its most important readership.

Robert Thorne

A History of Building Control in England & Wales 1840-1990

A. J. Ley, 2000

Coventry: RICS Books

XVIII + 222, 7 figs. + 11 pl.

ISBN 0 5406 672 1

Before the Building Regulations people working in London, where building construction was controlled by the London Building Acts and by-laws under the authority of the District Surveyors, did not really know or appreciate what happened elsewhere in England and Wales. There were the Model Bye-Laws and some local authorities had their own by-laws with their particular foibles, and with building inspectors of varying diligence and experience. This urge to control building construction started in Parliament in 1840. It was prompted by concern about cholera and unsanitary conditions generally which it was suggested were the cause of disease.

These concerns applied primarily to speculative housing for the working classes which is why building control has always been biased towards residential construction, almost exclusively everywhere until the end of the nineteenth century and outside the conurbations until the second world war.

The other concern which building control addresses is fire. This was the reason for the first regulations for building in London in 1189 and indeed was the primary purpose for all building control legislation in London until the middle of the nineteenth century, for the eighteenth and nineteenth century Building Acts for Bristol and Liverpool and for some provisions in the Model Bye-Laws.

Mr. Ley expands on this story and traces the stages in the crusade in Westminster for national building control, which regularly failed to reach a conclusion because of opposition from speculators and residential developers and of the reluctance of local authorities to take it seriously or even to address it at all.

It is a fascinating but somewhat frustrating story because it confirms that there is no uniformity of the aspects of building control that could help one date buildings or know what details ought to be incorporated at any given date. A typical example is the party wall parapet, where it is now clear that there is no date at which they were no longer required and the roof could continue unbroken across the boundary, without even continuing the party wall up through the roof space.

Mr. Ley takes us through the influences which affected the development of proposals for building control, such as the philanthropic housing of the late nineteenth century, the post first war housing problem and garden cities, and the official bodies formed to investigate aspects of construction and if they should or could be controlled or regulated – the Department of Scientific and Industrial Research, the British Standards Institution and the Building Research Station.

It is a surprise to discover that Model Bye-Laws were first prepared by Local Government Departments as long ago as 1877 and that the first edition of Knight's Annotated version was in 1883, but local authorities were not required to adopt them.

Consequently there was a wide variation in legal requirements throughout England and Wales, which were further complicated by the different rules for their adoption between urban and rural authorities.

This useful book traces this complicated history with admirable clarity and concludes with nineteen appendices providing résumés of the requirements in Acts from the Bristol Act of 1788 to editions of the Model Bye-Laws, up to the 1985 Building Regulations and chronological list of the legislative growth of building bye-law powers. There is also a complete bibliography of sources consulted including very many parliamentary papers, and a useful index.

Building Surveyors and anyone concerned with or interested in the history of constructional legislation will need this book on their shelves because there is no other readily available source of this information.

Lawrance Hurst

Wilhelm von Traitteur. Ein badischer Baumeister als Neuerer in der russischen Architektur 1814 - 1832 [A Master Builder from Baden as Innovator of Russian Architecture.]

Sergej G. Fedorov, 2000

Berlin: Ernst und Sohn

pp. 331. 231 illust. £50

ISBN 3-433-01255-5

"A thorough inspection of the exam papers reveals (...) that the examination candidate is lacking an in-depth knowledge throughout, and it can be said that his knowledge in most mathematical sciences is barely rudimentary; differential and integral calculus are no more than words to him; most evidently he does not understand geometry and, moreover, he has no knowledge of triangulation, nor of road construction or hydraulic engineering". This assessment issued in the spring of 1811 by the Examining Board of the Baden Engineering Department for Wilhelm von Traitteur's attempt to pass its examination could not have been more devastating for the 23 year old, who had been hoping to be accepted as an engineer into the civil service. But his fervent wish was granted in late 1813, under different circumstances. Following a skilfully prepared audience with the Russian Tsar Alexander I., who visited Mannheim on the verge of the Napoleonic Wars, Traitteur was invited to enter into Russia's service. In February 1814 he took up his post in St. Petersburg, in the office of Lieutenant General Bétancourt. In 1816 he entered the Corps of the Engineers for Public Highways in the rank of a Major.

The fact that, in the wake of his pathetic failure in Baden, Traitteur then dedicated himself to the construction of suspension bridges, one of the high technology ventures of his time, cannot fail to raise a few eyebrows. This was, after all, an area in which only the first, tentative steps were being taken in Europe around 1820. The Union Chain Bridge (120m, Samuel Brown) was completed in Scotland in 1819, the Menai Bridge in Wales (180m, Thomas Telford), also a bridge with suspension chains, in 1826, and the first European wire rope bridge, Pont Saint-Antoine in Geneva (2 x 40m, Seguin and Dufour), was opened in 1822. Berlin was to join in with the humble Löwenbrücke (17m, Hesse) only in 1838. Amazingly, over the short time span of 1823-26 Traitteur managed to construct no less than five chain bridges in St. Petersburg, and he was the first to introduce this method of construction into Russia. Apart from three pedestrian bridges, he built two large road bridges over the Fontanka, of which the Egyptian Bridge (1825-26) had the widest span, at almost 55m.

Based on research carried out over many years, Fedorov has created an opulent monograph. With a sharp eye for detail he introduces the reader to the life and work of this *ingénieur-artiste* between France, Germany and Russia, against the background of the society and engineering history of an exciting era. The book focuses - and how could it do otherwise with a master builder as its subject? - on Traitteur's comprehensive body of work, his buildings and projects, which started with an efficient trunk road from St. Petersburg to Moscow. Above all, Fedorov follows the 'progress' of the five suspension bridges from their planning and architecture via the design and dimensioning stages, extensive preliminary testing, the construction and attempts at quality control, to the detection of inherent weaknesses, repairs and losses through collapse or replacement. In many cases the refining process for pig iron by the town's largest (English run) foundry that supplied the chains, was unbelievably poor. The fact that personalities like Lamé and Clapeyron, Traitteur's colleagues in the Corps for Highway Engineers and distinguished names in engineering history, were responsible for the design was of little use under those circumstances. It must have been a fascinating international community at work in the Corps - extremely well informed and in lively communication with colleagues all over the world. It is rather humbling to consider this international community, as today we tend to think of international contacts being a product of our own age. Many great names were among the group, Scots, Frenchmen, Germans, Spaniards... - Russian was hardly spoken at all. Farsighted and cosmopolitan Alexander I had recruited them from all over Europe to promote the industrial

revolution in Russia and to expand St. Petersburg, just one century after its foundation, to become its representative metropolis. This scientific community, assembled with such speed, was to disperse just as quickly with the emergence of the absolutist system introduced by the new Tsar Nicholas after Alexander's death. This, too, gives food for thought.

Sergej Fedorov is a godsend as the historian of Traitteur. Like him a traveller between Russia and Germany and familiar with both languages and cultures, he is able to utilize the baroque abundance of fantastic materials still to be found in Russian archives. There are, apart from files and letters, also newspapers, prints, contemporary models and photographs. The book does justice to this wealth of material with a wide variety of illustrations and also provides a number of useful tables. If anything at all were to be criticized, it would be the sometimes indistinct terminology of the structural analysis, possibly a slightly excessive benevolence towards the occasional over-emphasis of form and pleasing appearance in Traitteur's constructions and, last but not least, the peculiar distance the author keeps from his "hero", despite his obvious intense engagement with the topic: behind all the activity and creation, the man Traitteur has hardly been deciphered.

But these are minor quibbles. Impressively, Fedorov's work allows us to witness the rise and retreat of a colourful engineering personality, who was able to compensate for his lack of theoretical basic knowledge by means of practical, intuitive engineering, outstanding draughtsmanship, a flair for organisation, abundant curiosity and skillful self-portrayal as his own author and lithographer, and whose very individuality and significance was founded on his "determinedly construction-orientated approach towards suspension bridges as novel subjects of architecture at the time of the industrial revolution" (Fedorov). It would appear that it was not only the fascination of novel, ingenious construction methods but also a considerable measure of craving for admiration that led Traitteur towards suspension bridges. Obviously, lightweight construction has always held the promise of a heady aura of celebrity.

The book is highly recommended. Regrettably, so far, only a German language version has been published.

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Freyssinet, Prestressing and Europe, 1930-1945

Jupp Grote and Bernard Marrey

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The idea of prestressing concrete came early in the twentieth century with the observation that the cracking of concrete might be prevented by applying an initial compressive force. But how to do it? The pretensioning of wires round which the concrete might be cast was an early idea frustrated because high tensile steels were not available and the shrinkage of concrete was not fully understood. By the 1920s Freyssinet, who had used temporary prestressing for a bridge test early in his career, solved this problem. So apparently did the Austrian Hoyer with a method that may or may not have infringed Freyssinet's patent. But the idea had also interested German engineers to the extent that there were some objections to Freyssinet's German patent application. Eventually the advantages of Freyssinet's system were recognised by the German company Wayss and Freytag who used it under licence, first for their design of the Oelde Bridge.

Here is the first problem with this short book; the exact content of Freyssinet's patent is not made clear. This seems an obvious omission. Given that the idea of prestressing had been in the air for some time, and that others were interested in it, success would clearly go to the engineer who could first develop the practical means of achieving the theoretical goal. Without some technical information it is impossible to understand how Freyssinet succeeded where others did not, nor how Hoyer's system either differed from or was similar to Freyssinet's. And yet, while denied such technical information, we are provided with a detailed account of the difficulties that Karl Mautner, Wayss and Freytag's non-Aryan engineer, had with the Nazi authorities, with a potted history of the politics leading to the second world war and with brief biographical information on other engineers in the story. The authors seem more interested in displaying all that they know rather than in helping the reader to build up a clear picture of the developing state of the new technology.

In 1939 Freyssinet developed his concrete anchorage cone and used it for a small bridge at Elbeuf. This, in the words of the authors, 'changed prestressing radically' and yet the speed and extent of the transition from pretensioning to post-tensioning with internal wires is not made clear. Post-tensioning was not new because Freyssinet used it for the harbour works at Le Havre but with external prestressing wires, and external prestressing wires had also been used by Wayss and Freytag. The innovation was for wires to be within the concrete but not bonded to it, allowing them to be curved to accommodate the changing bending moments.

The relatively new technology of prestressed concrete was then boosted by the war. Otherwise wanted for armaments, the savings in steel offered by prestressed concrete gave it a clear advantage over other construction methods. However the picture is complicated by the relationship between French construction companies and the occupying power, by the legal status of Freyssinet's patents and the royalties that they commanded during the occupation. In Belgium Magnel had to devise his own method of post-tensioning. Wayss and Freytag's licensing agreement left them free to use Freyssinet's patent but they independently developed the idea of arch girders with prestressed ties that were used in the building of submarine pens whose construction had to be proof against allied bombing. While the book deals with all these issues the authors would have done better to include more technical information from the extensive list of sources that they use. A number of projects are described but without a clear theme guiding the text it is difficult to know how these relate to the overall history of the technology.

The book has three parallel texts in German, English and French but the translation into English is not of the best and there were places where recourse to the French helped to disentangle the

English phrasing. The book is certainly not a simple account of the early development of prestressed concrete and, while providing some interesting detailed information, fails to place it in a clearly comprehensible framework.

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