

Abstracts of Periodical Literature

Compiled by Simon Pepper and Peter Richmond.

N. W. ALCOCK, **The Origin of the Chester Mews: A Model**, *Medieval Archaeology*, Vol. XLV (2001), pp 226-9. The unique features of the Chester Rows are the continuous pedestrian walkways that run at first floor level through the complete series of buildings between one side street and the next. These walkways are carried on "undercrofts" at street level extending under the houses and out to the street, giving a two-level street frontage and a degree of shelter that has prompted numerous questions and theories about its origins. All have encountered a critical difficulty. The system cannot function for one property in isolation, and the apparent need for systematic coordination has demolished theories of gradual evolution but itself collapses in the face of a lack of documentary evidence for centralised planning (even following a widespread fire in 1278). The author of this short note offers an interesting theory which proposes stages of development, initially on top of a bank formed by Roman building debris, and later from the excavation of the debris to form the undercrofts at main street level. The diagrams which are essential to follow the argument are very clear and - to this reader, at any rate - support a theory which is worthy of serious consideration.

JAMES C. ANDERSON, **Emperors and Architects: Apollodorus, Rabirius and Hadrian**, *American Journal of Archaeology*, Vol. 106, No. 2 (April 2002), p. 270. Among upper level personnel introduced, or retained, in the imperial service by Trajan, the architectus Apollodorus of Damascus appears to have had one of the longest and most spectacularly successful careers. This career is examined first by asking how Apollodorus came to his position of dominance in the relatively new opera Caesaris, the imperial architecture ministry probably created under Domitian. How much of the architecture dedicated in Rome during Trajan's reign originated with Trajan and Apollodorus, and how much had in fact already been begun, or proposed, by Domitian and his architect, Rabirius, is the second line of investigation. Finally, the evidence for the continuation of Apollodorus's position after Trajan's death is examined, especially his putative responsibility for designing the Pantheon during the first decade of Hadrian's rule, and the supposed conflict between long-time *architectus* and new emperor over the temple of Venus and Rome. The paper touches on the history and ideology that informed Trajan's building programme, as well as those of his predecessor (Domitian) and successor (Hadrian) in shaping the topography of ancient Rome.

LARRY F. BALL, **How Did the Romans Install Revetment?** *American Journal of Archaeology*, Vol. 106, No. 4 (2002), pp. 551-73. Among the most familiar features of Roman architecture are the foundations and attachment equipment for decoration in stone revetment. While the actual revetment panels are rarely intact, the foundations remain, demonstrating remarkably consistent technique throughout the Roman imperial period. They are also very different from modern masonry techniques, posing questions about how and why the Romans used the equipment and materials they did. Especially mysterious are the shims pressed deeply into the bedding mortar, usually around the edge of each revetment panel. Not only do these interrupt the smooth surface of the setting mortar, but they also reduce the amount of adhesion available to hold the revetment panel in place. Using observations in Rome, Ostia, Tivoli and Pompeii, a complete reappraisal of the process of installing revetment has been conducted, indicating that the shims helped the masons

overcome the high viscosity of the mortar as they adjusted a revetment panel into its final position, reducing the amount of mortar that needed to be shifted and making it easier to place. The metal clamps served to lock the panel precisely in this position, not to support its weight. Larry Ball's thesis has been tested on what he calls a dynamic model - i.e. a real scale model, not a computer simulation - and the account of these experiments in replicated Roman building techniques will be of considerable interest to construction historians, as well as perhaps justifying what the author calls "a very short leap of faith to conclude that solving these problems is, in fact, why the Romans used their distinctive techniques."

MICHAEL BENNETT, **Richard II, Henry Yevele and a New Royal Mansion on the Thames**, *The Antiquaries Journal*, Vol. 82 (2002), pp. 343-9. A payment to a mason sent to Richard II in Ireland in December 1394 provides evidence of a proposal to build a new or substantially new royal residence at Iselworth, Surrey. The mansion was presumably intended as a replacement for the palace of Sheen, shortly to be demolished on the king's orders. The mason carried with him a model prepared by Henry Yevele and Hugh Herland. This entry in the issue rolls of the Exchequer thus offers an interesting perspective on Richard's domestic plans following Queen Anne's death at Sheen, and rare documentation of the use of architectural models in late medieval England. Further, it offers some support for the view that Yevele was actively involved in design work in the 1390s, and that Richard took a close interest in royal building projects.

PATRICK BOUCHERON, **Water and Power in Milan, c. 1200-1500**, *Urban History*, Vol. 28, Part 2 (August 2001), pp. 180-93. By the end of the middle ages, Milan was at the centre of the largest system of navigable rivers in Europe, and it owed this condition to three centuries of effort during which communal power and private initiatives had dug canals and connected the Rivers Ticino and Adda which flanked the city respectively to the West and East. Water management began as a defensive strategy, but quickly became a vital element in the city's economy and in the networks of regional power. If the prince succeeded in guaranteeing a supply of clean water, which flowed constantly for the good of the whole community, he would have found the best way not only of participating in the development of his city but also of ensuring that his own power was retained. This paper - as its title declares - is primarily about water management and its politics, but the footnotes (and *inter alia* the text) provide splendid access points to the construction history of these vast medieval undertakings. Water supply continues to provide an area of robust growth in the history of towns and of technology, as abstracts in this and previous volumes testify (see also items in this volume under Keen, TeBrake, and Van Dam).

JONATHAN CLARKE, **Remnants of a Revolution: Mumford's Flour Mill, Greenwich**, *Industrial Archaeology Review*, Vol. XXIV, No. 1 (2002), pp. 37-55. Grain elevators (to the Americans) or silos (to the British) inspired some early Modernists by their clean functional lines, civic scale, and unambiguous industrial purpose. The increasing size of mills and their location on prominent lake-front and river-front sites, and an emphasis on eye-catching designs, often plastered with advertising, meant that most late-Victorian mills would not have appealed to the Modernists. They were nevertheless highly sophisticated industrial buildings. This paper focusses on the actual revolution in milling which between 1875 and 1900 underwent radical changes in technology, and organisation of work - notably in the changeover from traditional stone milling to roller milling, in which steam-powered metal rollers supplanted horizontal mill stones for the processing of wheat to flour. It also contains an account of the vast grain silo built for Mumford's Mill at Greenwich by Aston Webb in 1897 which, behind a decorated façade of diaper brickwork featuring huge M's and Greek cross motifs (described by *The Builder* as an "unpromising subject cleverly handled"),

explored a number of new construction techniques in brick and steel which were needed to carry enormously heavy loads, and the fireproofing needed to reduce the ever-present risk of fire from spontaneous combustion in flour dust (shades of Pudding Lane).

ROBERT CRAYFORD, **The Setting Out of St Paul's Cathedral**, *Architectural History*, Vol. 44 (2001), pp. 237-248. Building a new cathedral on a site still covered with the ruins of a burnt out and partly demolished church was not an easy task, for dismantling the remaining standing walls had to be accomplished stone by stone from scaffolding so as to avoid accidents on the site road which was used to move and stack the loose rubble. Setting out for any large new work was a precise task and needed to be done at St Paul's in less than ideal circumstances. This article seeks to establish how the new cathedral was to be set out, and attempts to fix the dates and the precise relationship between the dimensions of the dome as built and that of the Great Model. In the course of this fascinating but essentially antiquarian search, a great deal is revealed about the methods employed in one of seventeenth century London's most important and closely observed construction sites.

COLIN CUNNINGHAM, **A Case of Cultural Schizophrenia: Ruling Tastes and Architectural Training in the Edwardian Period**, *Architectural History*, Vol. 44 (2001), pp. 64-81. Detailed accounts of the training of architects and other construction professionals are too little covered by historians, and discussion of professional training too easily collapses into folklore, and the often highly selective memories of those who have made their mark. This paper focuses on the school drawings prepared by Michael Waterhouse (1888-1956), grandson of the famous Alfred Waterhouse and son of Paul who was also to serve as President of the RIBA. After Eton and Balliol, Michael joined the Day School of the Architectural Association in the autumn of 1911. This was a two-year full-time preparatory course, which was followed by two more years of part-time Evening Classes which supported an office pupilage as the definitive stage of a young Edwardian architect's training. Michael Waterhouse's portfolio of drawings, the selection of certain drawings for exhibition, and the comments of distinguished critics which were published in the *A.A. Notes*, give an insight into the variety of projects tackled by students and the stylistic menu available in the years immediately following the RIBA's enlightened decision to allow students to choose between Classical and Gothic for their submissions. Michael's early repertoire embraced a Greek Agora, a Gothic Church and a Study in Timber Framing (incorporating Arts-and-Crafts detailing) - in all of which he demonstrated accomplishment. Cunningham's paper is a witty and socially perceptive contribution on what might be called the public school end of the profession's rites of passage.

THOMAS DAY, **The Failure of Inverythan Bridge, 1882**, *Journal of the Railway and Canal Historical Society*, Vol. 33 Part 6, No. 177 (November 2000), pp. 404-15. On 27 November 1882 the railway bridge that spanned the Aberdeen to Banff turnpike road at Inverythan, Aberdeenshire, failed as a train crossed it. Drawing mainly upon the Public Record Office papers from the Board of Trade inquiry, this article provides a most detailed description of the construction of the railway bridge which - like some 300 contemporary structures elsewhere in the country - relied upon two cast iron girders. Each were cast in two sections and bolted together at the centre, and initial concerns focussed on the strength of the connection near where the failure in one of the two girders had occurred. However, the inquiry vindicated the connection, finding instead that a pattern of small blow-holes invisible to external inspection had caused "honeycombing" in the casting, which greatly reduced the strength of the girder at the point of maximum bending. By casting a girder in two sections the chances of honeycombing occurring at the point of maximum stress were greatly increased, of course, because blow holes were more likely anyway to occur near the ends of castings

and these would be at the point of maximum bending in a two-piece girder. The Board of Trade inspector concluded that wrought iron with its greater tensile strength should be used for long spans, and castings used only for short spans or in arched girders where compressive forces predominated.

RICHARD FAWCETT, Robert Reid and the Early Involvement of the State in the Care of Scottish Ecclesiastical Buildings and Sites, *The Antiquaries Journal*, Vol. 82 (2002), pp. 269-84. As a result of the Act of Annexation of 1587, and the removal of bishops from the Scottish church in 1689, the Crown in Scotland incidentally acquired ownership of a large number of monastic and cathedral churches. By the late eighteenth century, as interest in medieval architecture grew, occasional grants were made towards their maintenance; but between 1827 and 1839, when a Scottish Office of Works was established under the architect Robert Reid, major efforts began to be made to stabilise considerable numbers of those buildings. The approaches to this work are of interest for what they tell us about emerging attitudes to architectural conservation.

E. C. FERNIE, Technical Terms and the Understanding of English Medieval Architecture, *Architectural History*, Vol. 44 (2001), pp. 13-21. The meaning of words has recently been exhaustively investigated by deconstructionist philosophers such as Jacques Derrida, and Eric Fernie makes good use of Derrida's concept of conceptual pairs - man/woman, light/dark, activity/place - in this essay (part of an issue dedicated to John Newman) to explore the meanings, together with their potential insights and the pitfalls of ambiguity which are embodied in the technical terminology of English medieval architecture. A leading authority on Norman (or should it be Romanesque) architecture, Eric Fernie is equally at home in Latin, French, German and English and is able to extract a good deal of interest from terminology which all of us employ and most of us would do well to consider more carefully.

MICHAEL H. GOULD, The Development of All-Metal Water Towers, *Industrial Archaeology Review*, Vol. XXIII, No. 2 (2001), pp. 113-23. Water towers were an early feature of modern water supplies, and initially consisted of a rectangular metal tank on - or sometimes surrounded by - a brick or stone base. From the 1840s a number of country houses, hospitals and railway undertakings had towers of this kind, while a scheme at Portsmouth Dockyard (dated imprecisely to the same decade) may well be the first to have carried the tank on a framework of cast-iron columns. Since then such structures have become a familiar feature of the landscape in many countries, notably the American West, but represent a special engineering challenge because of the need to support and brace a very heavy weight often high above the ground. This paper discusses the development in Britain and Ireland of all-metal water towers, concentrating on those for bulk public supplies and railways. After 1900 panel tanks formed of steel flanged plates generally supplanted earlier forms of tank construction and it was not until the 1950s that other more pleasing styles came to be erected - although these found little favour in the water industry and few were built. An earlier study of reinforced concrete water towers was abstracted in Volume 17 (Gould and Barton), and both papers form part of a larger study of the development of all forms of water tower being undertaken by the Institute of Civil Engineers's panel for Historical Engineering Works.

A. R. GREN, The Lords Committee on Compensation 1845, *Journal of the Railway and Canal Historical Society*, Vol. 33 Part 7, No. 178 (March 2001), pp. 460-5. Nearly all forms of development take over extensive areas of private property, and the powers of compulsory purchase which are widely used today have their origins in the great canal and railway undertakings of the eighteenth and nineteenth centuries. Surprisingly late in this process the question of compensation was still under discussion, and the House of Lords Committee on Compensation sitting in 1845 was

charged with examining the principles of compensation to be applied both to those whose property was taken, and also the "question of severance [i.e. the breaking up of formerly contiguous estates] and that of injury to residences." The last topic included what today would be called amenities - increasingly a hot political issue in development - and this paper presents some interesting cameos, including the exchange between the committee and Edward Driver, a surveyor for the Great Western, who was asked when "a railway goes in front of an old ruin, for instance, Jervaulx Abbey or Bolton Abbey ... so as to spoil entirely the picturesque effect of the abbey, on what principle do you compute your Compensation?" Driver had never heard of such an instance, but felt "that public utility must prevail, and that they should pay nothing for any loss of beauty or anything else." Surprised at this Philistinism, the committee pressed the question only to be told that "if it was so beautiful a spot, [the owner] should get a station made near it, and turn it into building land."

BONNIE L. GUMS, Earthfast (Pieux en Terre) Structures at Old Mobile, *Historical Archaeology*, Vol. 36, No. 1 (2002), pp. 13-25. Early colonial descriptions and illustrations - sometimes apparently quite detailed - often need to be backed up by archaeology if a real understanding of the construction details is to be achieved. Recent investigations at the early eighteenth-century French colonial site of Old Mobile (Alabama), included excavations of the first European-built earthfast buildings to be discovered in this part of North America, which probably served as barracks for soldiers at nearby Fort Louis and may have been built by them. Portions of the fort were built from hewn beams placed one on top of another in what was known as the *pièce sur pièce* technique. The earthfast *pieux en terre* technique, with walls formed from poles placed upright in trenches, was commonly used for small structures and (not surprisingly) proved highly susceptible to rot. *Poteaux sur sole* structures, with upright timbers attached to wooden sills laid on the ground, at Old Mobile were generally large, multi-roomed buildings, often with fireplaces, and wooden plank or prepared clay floors. Space between the wall timbers in both *pieux en terre* and *poteaux sur sole* was often packed with *bousillage*, a mixture of clay and Spanish moss. Old Mobile structures apparently had roofs thatched with river cane (perhaps augmented with palmetto fronds), although the homes of colony officials and some buildings at Fort Louis may have been covered with wood shingles. Terracotta tiles were used sparingly on all of these structures to cap roof ridgelines.

SUSAN R. HENDERSON, Ernst May and the Campaign to Resettle the Countryside: Rural Housing in Silesia, 1919-1925, *Journal of Society of Architectural Historians*, Vol. 61, No. 2 (June 2002), pp. 188-211. Ernst May is best known for his work as the *Stadtbaurat* of Frankfurt am Main (1925-1930), where he launched the *Neue Frankfurt* programme and produced a ring of modern housing estates circling the city, employing a variety of industrialized construction techniques, as well as the standardized house plans, furniture and equipment which ensured him a place in the Pantheon of early Modernism. This paper addresses May's housebuilding activity in Silesia in the immediate postwar years, when he headed the Silesian Rural Settlement Authority and took this opportunity to begin his experiments in rationalization of housing design, mass production and the use of new materials - including the use of modified vernacular housing forms and construction techniques (which curiously parallel some contemporary developments in Britain). Much of this paper focuses on the complex politics of the Weimar Republic and the special regional context of Silesia where social housing was built for a number of distinct groups including industrial workers, miners, farm labourers and the German refugees displaced by the international boundary changes that followed the peace settlement of 1919. The designs, plans and experiments in construction are well described and anticipate many of the approaches later made famous in Frankfurt.

DEREK KEENE, **Issues of Water in Medieval London**, *Urban History*, Vol. 28, Part 2 (August 2001), pp. 161-79. Water is essential to any functioning city, but London's tidal river port, waterfront, and its famous bridge exercised enormous cultural, social and economic importance in all periods. This paper concentrates on the three centuries up to 1300, when the city achieved its medieval peak with a population of perhaps 80,000 souls. It describes the topography of the Thames waterfront and the tributary streams and road network feeding it, as well as the many roles the river performed in the medieval community. Construction historians will be particularly interested in the (relatively modest) systems of control established by civic authorities over a river which was at once the principal source of water for all private domestic uses, and the main means of refuse and soil dispersal, commercial bathing and washing, as well as transport, commerce and recreation (with the ever present risks of death to a population which contained few swimmers). Also described are the wells, cess pits, and the development of the conduits which conveyed spring water from a settling tank near the present Bond Street underground station to the public taps in the Great Conduit building (constructed probably in the 1230s or 1240s) on Cheapside - London's first continuous piped water supply. Modestly presented as a "fruitful theme for medieval urban history", Keen's article is thought-provoking at many different levels, and one of a series of water-works papers abstracted in this issue (see also Boucheron, TeBrake, and Van Dam).

AXEL KLAUSMEIER, **Houghton, Raynham and Wolterton Halls. On Thomas Ripley's Major Works in Norfolk - Architectural Success amidst Political Tensions**, *Norfolk Archaeology*, Vol. XLIII, Part IV (2001), pp. 607-29. The reputation of the architect Thomas Ripley (1682-1758) was not high amongst his contemporaries, and architectural history has neglected the work of this shadowy Neo-Palladian. A protégé of England's most powerful politician of his time, Sir Robert Walpole, Ripley's most important building activities were on the Walpoles' Norfolk country seats at Houghton and Wolterton in the 1720s and 1730s. For Sir Robert's brother-in-law, Viscount Townsend of Raynham, Ripley directed major alterations to his stately home at Raynham Hall after 1725. To Ripley's disadvantage, the relationship between Townsend, Sir Robert and Horatio Walpole of Wolterton was overshadowed by severe private and political tensions. This article focuses on the complicated working relationships between Ripley and his clients and colleagues, and - without downplaying the architectural skills of its subject - concludes that his greatest strength lay in the effective management of large projects such as Houghton and Raynham.

LEEANN BISHOP LANDS, **"Speculators Attention!" Workers and Rental Housing Development in Atlanta, 1880 to 1910**, *Journal of Urban Studies*, Vol. 28, No. 5 (July 2002), pp. 546-72. During the late nineteenth century, house builders throughout urban America developed a taste for suburban middle-class development. In Atlanta, Georgia, real estate agents and land speculators eagerly embraced this trend. The 1880s and 1890s saw the creation of tranquil residential peripheral enclaves at Inman Park, Ansley Park and Druid Hills. However, even as the middle-class suburbs took shape, aggressive speculators created a vigorous land development market in the core city geared, not for the middle class owners but for working class renters. By analyzing working-class rental housing - too often overlooked in this author's view - this article suggests that suburban growth was merely one of several dynamics that shaped local housing markets and residential geography in the industrial era.

SARAH PEARSON, **Broughton Monchelsea: the Pattern of Building in a Central Kent Parish**, *Architectural History*, Vol. 44 (2001), pp. 386-93. Broughton Monchelsea, two miles south of Maidstone, was in the first part of Kent to rebuild on a large scale following the Black Death; and

late medieval buildings here are consistently larger, finer and more densely distributed than those elsewhere in the country. However, the relationship of these medieval buildings to those erected later has hardly been explored. Logic suggests that the more prosperous farmers of the seventeenth or eighteenth centuries would rebuild their old medieval hall houses, and that the increased population of the later sixteenth century would result in the building of many new houses. In fact most of the medieval farmhouses in Broughton Monchelsea were not rebuilt, but had their smokebays replaced by stone and brick fireplaces and other relatively minor modifications to give heated rooms. Only one completely new farmhouse and one new cottage have been identified. This essay is concerned with charting the chronological distribution of thirty-two of the thirty-nine surviving houses in a single parish in central Kent and it suggests here, at any rate, there was no "great rebuilding" of the late sixteenth or seventeenth centuries because the main building campaigns had taken place considerably earlier.

MICHELA ROSSO, **Georgian London revisited**, *The London Journal*, Vol. 26, No. 2 (2001), pp. 35-50. Sir John Summerson's *Georgian London* was a seminal work in post-war British architectural history, and one that pioneered an approach to the subject which gave a central role to the developers, landowners and contractors who actually built the early modern city, together with the wider influence of the "market" which established the cyclical economic climate within which all of the other contributors had to operate. Summerson could discuss "style" with the best of traditional architectural historians, of course, but it was his rounded approach to the "building world" - a phrase which was to be used in the title of *The London Building World of the Eighteenth-Sixties* (1973) - which made Sir John the obvious first choice as patron of the Construction History Society when it was founded in 1984, and who contributed an introduction to Volume 1 of this journal (1985). *Georgian London* had a lengthy gestation. Commissioned in 1939 by the Cresset Press as *The Building of Georgian London*, it built on Summerson's earlier experience of the wider construction world gained as a journalist for the *Builder* and the *Architect and Building News* before the war, as well as his scholarly monograph on *John Nash* (1935). Events intervened, however, and the book first appeared under its current title in 1946. Revised in 1962, 1969, 1977 and 1991 (the year before his death), *Georgian London* has been continuously in print and kept pace with current developments. Michela Rosso's fascinating article explores the genesis of the book, its sources, influences, evolution, and critical reception and perhaps itself sets a standard for the way that other historians' works can be evaluated. Can we look forward to *Victorian Suburb* revisited?

SAM SMILES, **Data, Documentation and Display in Eighteenth-Century Investigations of Exeter Cathedral**, *Art History*, Vol. 25, No. 4 (2002), pp. 500-19. Antiquarian inquiries into mediaeval architecture developed new approaches in the eighteenth century. In England, empirical observation, drawing inferences from the built structure and its embellishments, was championed as a corrective to the authority of written accounts. Starting in the middle decades of the eighteenth century, mediaevalist research was put on a new footing, with careful surveys and accurate drawings promoted as a means to trace the development of mediaeval building techniques and architectural style. The work done on Exeter Cathedral is an early example of this turn in antiquarian research. With two nationally important antiquarians serving successively as Deans, Charles Lyttleton and Jeremia Milles, work on restoring and researching the cathedral was undertaken from the 1740s onwards. The cathedral was also one of the first to be published by the Society of Antiquaries (1797), with important engravings after John Carter's drawings, and essays by Charles Lyttleton and Sir Henry Englefield. The success of Lyttleton, especially, in overturning the received understanding of the cathedral's development is notable, but his terminological looseness and his respect for textual authority were to be challenged in their turn by Englefield. The clarification of

the history of Exeter Cathedral can thus stand as an epitome of wider changes in method in antiquarian scholarship in the second half of the eighteenth century.

ROGER STALLEY, **The Architecture of St David's Cathedral: Chronology, Catastrophy and Design**, *The Antiquaries Journal*, Vol.82 (2002), pp. 13-45. This article reassesses the design of the nave of St David's Cathedral in the light of modern scholarship, arguing that the cathedral has been a victim of an overly historicist approach to architectural writing. New documentary evidence is presented, including information about the existence of two churches on the site. Anomalies in the west bay are defined and some of the explanations offered by Lovegrove (1922, 1926) are rejected. Following an analysis of the design, the background of the scheme is firmly located in an English west-country environment and suggestions of French influence are dismissed. Although a vault may have been envisaged when the nave was first begun, it is unlikely that a stone vault was ever erected. Nonetheless, the design of the nave emerges as a more significant and creative piece of architecture than is generally realized.

TIM TATTON-BROWN, **The Quarrying and Distribution of Reigate Stone in the Middle Ages**, *Medieval Archaeology*, Vol. XLV (2001), pp. 189-202. During the Middle Ages the "Freestone of Reigate" was used more than any other building stone in London. For Old St Paul's Cathedral, Westminster Abbey or the Palace of Westminster, it was to the quarries at the base of the North Downs, sixteen miles to the south, that masons turned for their main supplies; although the much smaller quantities of hard stone from Quarr and Binstead in the Isle of Wight, from Caen in Normandy, and from the local Kentish Ragstone quarries all came in by water up the Thames and are much better known because their durability better suited them for special external finishes. Post-medieval re-surfacing has also concealed much original external Reigate stone. Reigate Freestone is a fine grained sandstone containing glauconite (hence its distinctive green colour) and mica (which glitters), and is found in narrow beds (1.5m maximum height) in a very small (about 8 miles East to West) strip of land in the Reigate and Merstham areas. It was largely quarried in underground mines which have been identified by cavers but never properly explored by archaeologists, although a great opportunity was missed when some deep cuttings were made during the construction of the M23 and M25 motorways between 1972 and 1974. The author relies upon both documentary and geological information for this introductory investigation into the extraction and distribution of London's staple stone, which seems - from the archaeological evidence of the building itself - to have started in the 1050s with the construction of Edward the Confessor's new church at Westminster, one of the largest churches to be built in Britain at a time when large masonry building was only just beginning again in North-West Europe. It is now being sought once again for conservation and repair work to medieval and Tudor buildings.

RABIN TAYLOR, **Perfect Ten: Vaulting the Pantheon**, *American Journal of Archaeology*, Vol. 106, No. 2 (April 2002), p. 269. This paper considers the process of building the concrete vault of the Pantheon, contending that the engineers took an experimental approach by carefully testing designs on the ground and rehearsing the assembly and easing process. There were four logistical phases, none of which has ever been adequately discussed. (1) Centering: Somehow the great meridional ribs of wood, each several tons in weight, had to be positioned and then held in place while the circumferential struts were installed. The coffer molds slid freely on the centering surface, otherwise they would have thwarted de-centering. (2) Application of the concrete: Never did the centering have to bear more than a fraction of the liquid weight of the entire dome, since the liquid below was hardening into a self-supporting compression ring as additional liquid was added to it in layers. As the effects of weight increased toward the top, thin layering took precedence over speed.

(3) Easing: Loosening the centering from the high pressure of the concrete surface required successfully springing strategically placed wedges. The eased centering, once stripped of its skin and the coffer molds, served as a scaffolding framework for the decorators. (4) Decentering: Centering could not be removed in the manner that it was built. The author discusses the intricate process of disassembling the wooden armature without cranes and without damaging the building. It is further suggested that two ostensibly aesthetic decisions, the inclusion of an oculus and the choice of 28 meridians, may have pragmatic origins.

WILLIAM H. TEBRAKE, **Taming the Waterwolf: Hydraulic Engineering and Water Management in the Netherlands during the Middle Ages**, *Technology and Culture*, Vol. 43, No. 3 (July 2002), pp. 475-99. The introduction of systematically managed hydraulic engineering in the lowland zones of the mid-thirteenth century Netherlands marked an important turning point. Until the mid-twelfth century straightforward drainage by means of shallow ditches allowed agriculture but caused unintended subsidence (as peaty soil dried out) and dramatically increased the risk of flooding. "A waterwolf stalked the land." The author's vivid phrase describes an environmental crisis caused by human settlement and its accompanying agricultural improvements. Faced by the prospect of losing everything they had created, the inhabitants of the lowland zone responded by fashioning complex systems of dikes, sluices, and drainage canals, designed to perpetuate drainage while protecting against inundation. However, the deeper drainage made possible by the introduction of hydraulic engineering led to yet further subsidence, and yet deeper drainage, trapping those involved in a cycle of intervention that has continued to the present. Professor TeBrake's paper is primarily concerned with the institutions developed by the end of the middle ages to manage these increasingly complex engineering systems, but it also provides a splendidly clear exposition of the geographical and scientific background to what is perhaps Europe's most sophisticated and large scale civil engineering undertaking. Part of a special issue dedicated to the "water history" of the Netherlands, this paper is a notable achievement in environmental history (see also Van Dam).

PETRA J. E. M. VAN DAM, **Ecological Challenges, Technological Innovations: The Modernization of Sluice Building in Holland 1300-1600**, *Technology and Culture*, Vol. 43, No. 3 (July 2002), pp. 500-20. A series of innovations in hydraulic technology in the fifteenth and sixteenth centuries played a key role in Dutch economic and overseas colonial success by enlarging the capacity of the drainage system and reinforcing protection against the sea. These technological changes responded to changes in the wetland peat bog environment that were partly human-induced, since drainage for agriculture and digging peat for fuel were the main factors causing the bogs to sink (see also TeBrake above). This article - part of the journal's special issue on the "water history" of the Netherlands - focuses on the development of the sluices and the relationship of innovations in this area to other hydraulic activities, such as the construction of dams, dikes, windmills, and the introduction of reservoirs. Where TeBrake (q.v.) concentrates on official policy formation, Van Dam also draws on archaeology, archival drawings and plans, and the early treatises on hydraulics to provide a fascinating account of technical developments in this area of civil engineering.

ROBERT WALKER, **Cambridgeshire Bell Frames**, *Proceedings of the Cambridge Antiquarian Society*, Vol. XC (2001), pp. 81-114. The support of church bells inside the campanile has something in common with the structural considerations in water tower construction (q.v. Gould above and vol. 17) in so far as heavy loads are held far above the ground. Bell frames also have to resist considerable movement from numerous heavy loads. The parts of frames which have received most

attention are the trusses or vertical panels onto which the bells rest directly. It is these elements which most clearly exhibit evolution, fascinating variety, regional idiosyncrasies and the rough wooden beauty which devotees of timber-framed buildings will know and understand. Indeed, argues the author, there are many parallels between buildings and bells frames which might benefit from comparative study. The same scale of members and form of joints are obvious similarities. There were specialist bell hangers, for example Edmund Aleyn of Elsing, at the beginning of the sixteenth century, but there is no evidence of their exclusive occupation, and the hanging of bells and the making of bell frames must have been but parts of the carpenter's repertoire alongside building roofs, houses and barns.

JEFFREY WELLS, Contract Specifications for a Bridge over the Heywood Branch Canal - Manchester and Leeds Railway, *Journal of the Railway and Canal Historical Society*, Vol. 33 Part 8, No. 179 (July 2001), pp. 576-82. On 29 January 1837 the *Manchester Courier* carried a contract advertisement referring to the engineering work on a section of the Manchester and Leeds Railway between Middleton and Rochdale which included heavy excavation work, embankments and the construction of a number of bridges. Thomas Gooch, George Stephenson's assistant, estimated the cost of the contract to be £84,000 and John Evans won the contract with a tender of £82,408. The bridges included the surviving well known cast-iron bow-string structure at Chadderton, and a half-elliptical brick arch which can still be seen at Three Pits, Middleton. The third bridge over the Heywood Branch canal no longer survives but the construction specifications of all stages of this bridge's arched masonry piers with cast-iron girders carrying the central span are in the possession of the author and are presented in this paper. It deals with the preparation and driving of larch foundation piles (hooped and iron shod, driven by a ten hundred weight ram, falling thirty feet until the pile shall sink only one inch with ten blows, the spaces filled with concrete, and the works protected by coffer dams), the masonry and its ashlar finish, and the placement of the ten cast-iron girders (two under each of the four rails, and another pair carrying the ornamental parapet). The detailed instructions for the methods of construction to be employed at all stages give valuable insights into degree of control exercised on these early railway projects.

J. W. R. WHITEHAND and CHRISTINE M. H. CARR, The Creators of England's Inter-War Suburbs, *Urban History*, Vol. 28, Part 2 (August 2001), pp. 218-34. Despite the transformation of English cities by the growth of suburbs in the inter-war years, there is a dearth of reliable information about the processes that brought these suburbs into existence. There is much still to be learnt of the firms, organizations and individuals responsible for their construction, especially the developers, builders and architects. Using data from Birmingham and London, the authors attempt to analyse the participants in a variety of enterprises and to explore the nature of their involvement and mutual relationships. Contrary to accepted wisdom - and paradoxically, in view of the scorn heaped upon suburbs by the architectural literati - architects are shown to have been heavily involved in the preparation of building applications for the construction of suburban houses (although the authors acknowledge that definitions of "architect" were far from straightforward before statutory registration, and that the preparation of building applications is not always the same as design). In spite of the unprecedented amount of housebuilding in the inter-war period, the geographical spheres of influence of both builders and architects were generally highly localized, and characterized by small scale operations and small operators. However, unlike in the nineteenth century, there is little evidence of speculative building having been undertaken by people whose livelihood was not primarily derived from house building or house selling.

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