Like a huge birdcage exhaled from the earth: Watson's Esplanade Hotel, Mumbai (1867-71), and its place in structural history

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"A traveller familiar with Bombay passed through it in 1867, and, on a morning walk, observed that opposite Forbes Street something like a huge birdcage had risen like an exhalation from the earth. This was the skeleton of the Esplanade Hotel." [1]

"... why is it that the ugliest of all ugly and ill-conceived buildings should be allowed to push its misbegotten meaningless front (in which the only thought displayed is in the construction and connexion [sic] of cast iron work,) far in advance of all its neighbours.... Looking like iron construction always does, as temporary makeshift, without the one advantage of its being so." [2]

"Messrs. Watson and Co.'s gigantic iron structure cannot fail to impress one as an excessively unsightly building - at present it is an absolute eye-sore; as to what it may be eventually when its skeleton form is draped, I know not, but it looks now as if corrugated iron would well suit it." [3]

Introduction

Long a decaying, crumbling mass of iron and brick, the edifice now known as 'Esplanade Mansions', crammed with scores of businesses and tenants, barely evokes the grandeur it enjoyed in its former incarnation as Bombay's premier nineteenth-century hotel (Fig. 1). Yet, remarkably, after 132 years of use and abuse, this designedly permanent prefabricated wonder still stands wholly on the frame action of its rigid column-beam connections, ample testimony to the Phoenix Foundry Company's fabrication and assembly skills and Rowland Mason Ordish's adroit structural design. It is clear beyond doubt that Ordish (1824-86), one of the nineteenth century's most gifted, yet unsung, structural engineers was personally responsible for the design of this extraordinary fully-framed building, the blatant iron skeleton of which caused so much consternation among contemporaries.

Despite being overshadowed both architecturally and historically by Mumbai's more exuberant and better-documented Victorian showpieces, Watson's Esplanade Hotel has not passed unnoticed by architectural historians. Perhaps the first to draw attention to its constructional interest, albeit in a local context, was Christopher London, who in 1986 wrote 'the construction of the building, a totally pre-fabricated cast-iron skeletal structure, with brick non-load bearing insertions, was a novelty for Bombay'. London was almost certainly the first modern commentator to ascribe (correctly) the structural design to Rowland Mason Ordish, (and not to John Watson as is frequently stated), noting the engineer's links to the Crystal Palace, Owen Jones and Andrew Handyside, and mentioning some of the engineer's major works.[4] Martin Meade *et al* noted that 'Watson's ... was also innovatory in its construction, being the first iron-framed building in Bombay'[5] - an assertion subsequently reiterated by Philip Davies,[6] Gillian Tindall,[7] and others. Norma Evenson saw Watson's as 'one of the most innovative buildings of the 1860s in Bombay ... Framed in metal, with

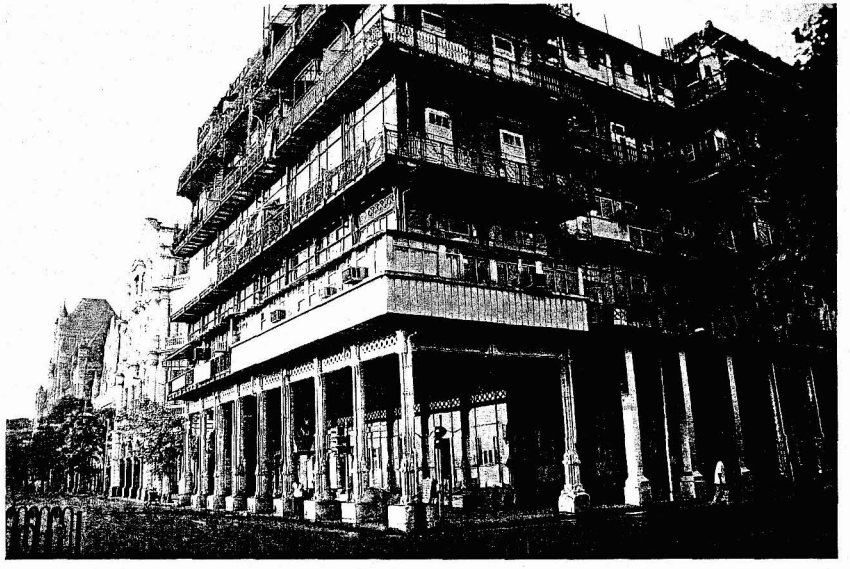

Figure 1. The former Wwatson's Esplanade Hotel (1867-71), now called Esplanade Mansion (Jonathan Clarke).

a plain surface of brick infilling, it eschewed traditional style for a direct expression of structure'.[8] More recently, the Rizvi College of Architecture, Mumbai, who recorded the building as part of an inter-college competition, stated that it 'was the first building in Mumbai to be built entirely with prefabricated cast iron members assembled on site.'[9] However, an altogether weightier structural significance on an international level has not been recognised or addressed.

It was not a visit to Mumbai, but perusal of the trade catalogues of the Phoenix Foundry Company, Derby, that brought the building to my attention. The earlier of the two surviving catalogues (*c*.1897) included a photograph of 'Watson's Grand Hotel, Bombay', captioned 'The whole of the framework of this well-known Indian Hotel is composed of Wrought and Cast-Iron made at the Phoenix Foundry, and marked for Erection'. The second (*c*.1904) included the same advertisement (Fig. 2), this time with the addition of the boastful but highly intriguing sentence 'This is believed to be the first example of an iron framework building'.[10] Clearly, by this date - when American engineers were hotly debating the origins of high-rise skeleton construction - Phoenix saw fit to lay their own claim to technological primacy. Of course, we now know, with the benefit of hindsight, and the classic papers by Bannister,[11] Skempton,[12] Larson and Geraniotis,[13] and Condit,[14] that this claim was misplaced. Nevertheless, had the advertisement included the caveat 'multi-storey habitable', then we are left with an assertion that not only holds true today, but one that alludes to the building's fundamental importance in the evolution of the skyscraper.

Though not a skyscraper itself, Watson's Hotel (1867-71) is - in our present state of knowledge - unquestionably the first multi-storey habitable building in the world in which all loads, including those of the brick curtain walls, are carried on an iron frame. Like the Crystal Palace (1851), the Sheerness Boat Store (1858-60), and the St. Ouen Docks warehouse (1864-5), Watson's Hotel is a landmark in the development of multi-storeyed, fully-framed construction, a subject that has fascinated historians for many decades. Viewed progressively, each of these buildings mark

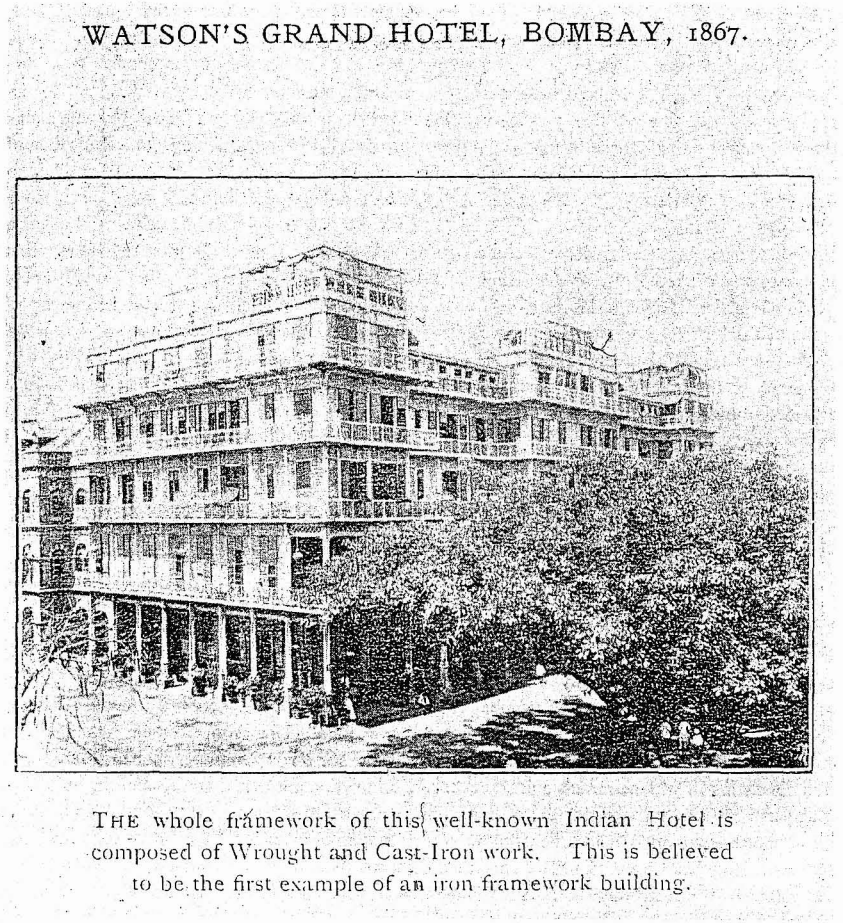

Figure 2. The Phoenix Foundrey Company's Catalogue *c*. 1904.

fundamental advances in framed construction, forming a line of structural development that culminates in the American skyscrapers of the 1890s, and other later frame buildings the world over. If the Crystal Palace introduced the world to a vast modular framework held stable by 'proto-portal' and full diagonal bracing, then Godfrey Greene's Sheerness Boat Store exploited the portal-frame concept to the extent that the entire stability was achieved solely by the rigid interconnections between the H-section columns and I-section beams.[15] Both structures lacked non-combustible floors and walls, a deficiency overcome in Hippolyte Fontaine's six-storey St. Ouen Docks warehouse, which, according to Sir Alec Skempton, 'used the Sheerness frame in conjunction with fireproof floors and brick wall panels'. 'The multi-storey iron-framed building with incombustible walls and floors had been achieved. It led, finally, to the creation of the first masterpieces of modern architecture, in Chicago, in the 1890s'.[16]

The first purpose of this paper is to situate Watson's Hotel within this technological lineage, which remains both intact and uncontested since its delineation almost half a century ago. With its timber-boarded floors, Watson's was perhaps 'inferior' to Fontaine's warehouse from the perspective of 'fireproof' construction.[17] Nevertheless, Watson's which was designed by an engineer who had worked on the Crystal Palace and who had worked under Godfrey Greene, marks the next step from Fontaine's warehouse in the maturity of the framed building - the application of the fully-framed structural system to high-profile commercial architecture. Prior to the Chicago developments of the 1880s, all other known fully framed multi-storey buildings were built to serve the needs of exhibitions, industry or storage. Watson's was designedly habitable, and as such provided for bathing and ventilation, and internal transportation, reputedly housing India's first power-operated elevator. Beyond such customary concerns of primacy, the circumstances surrounding the erection of this exceptional prefabricated building illuminate a number of important, inter-related themes of importance to constructional and architectural history. This is the second purpose of this paper. Indeed, the contextual importance of Watson's Hotel is of the first order, for it sheds light on the emerging role of consulting engineers in building projects, the representational potential of prefabrication, and attitudes to iron construction in Britain and abroad in the mid nineteenth century. The building also throws new light on one of the most vexed questions surrounding pre-skyscraper fully framed iron construction: why was it not more generally adopted?

Historical context: Bombay - *Urb Prima in Indis*

The construction of Watson's Esplanade Hotel went hand in hand with one of the most frenetic and far-reaching chapters in Bombay's urban history. During the early 1860s Bombay fast became a boomtown, the 'Cottonopolis of the East', and fast outgrew its coastal bounds. Seizing the opportunity to create not only a city of economic might, but one of political and cultural significance, the new Governor of Bombay (1862-7), Sir Henry Bartle Frere (1815-84) levelled the ramparts encircling the 'Fort' or European quarter, liberating land from obsolete industrial and maritime works for development. Frere's grand scheme for a new Bombay, dubbed 'Freretown', and consisting of widened roads and scores of government, commercial and residential buildings, was partly realised through the sale of this land. At the heart of his scheme was the Esplanade, a scenic north-south open maidan constituting 'the only lung of Bombay'.[18] Two advisory bodies, the Ramparts Removal Committee (RRC) and the Esplanade Fee Committee oversaw and expedited the sale of land to private buyers, the funds raised were used to subsidise the public buildings and Frere's imperial vision. Speed was of the essence, but of overriding concern was the architectural merit of the new designs, for Frere wanted to bestow Bombay with an architecture 'worthy of her wealth, pre-eminence and location'.[19] Supervision of this was entrusted to James Trubshawe (1804-75), Architectural Secretary to the RRC, who, as we shall see, took a dislike to the Watson's project.

The first auction of 15 plots on the Esplanade took place on 25 August 1864 and was attended by John Hudson Watson. His intended purchase was a double lot, Nos 11 and 12, measuring some 80ft by 167ft and occupying a prime site midway along the Esplanade where it intersected Rope Walk Row (Fig. 3). The Bombay Club also had designs on the same location.[20] Fierce competition between the two parties saw bidding run up, but 'old Mr. Watson, who had his shop at the south-west corner of Churchgate Street as a silk mercer, draper, hosier, etc., and had amassed a large fortune in his trade, and who was a man of great enterprise besides'[21] won through. Watson's purchase price of Rs 110 per square yard was exceeded only by that of one other, the average being Rs 95.[22] At this stage in the proceedings, it seems unlikely that individual buyers had to provide the Government with detailed drawings, outline proposals of their intended schemes probably sufficing.

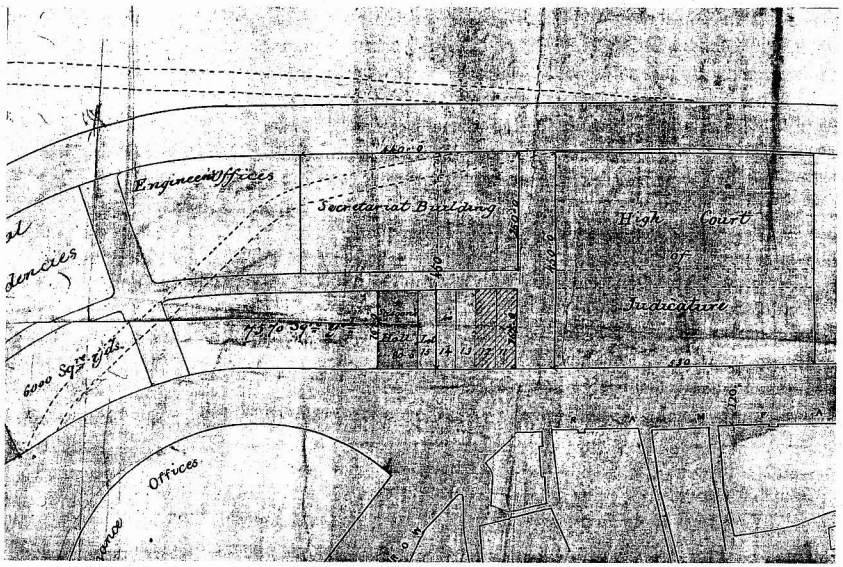

Figure 3. Plan produced by the PWD in c. 1865, showing plots 11 & 12, the Esplanade - the site of Watson,s Hotel.

Nevertheless, in the subsequent months, as plans were submitted, State control over architectural form and character became a serious issue that dichotomised the RRC's approach from that of its parent body, the Bombay Public Works Department (PWD):

> The Ramparts Removal Committee wished to impose several building conditions on the purchasers, fearing that if left to themselves they would not conform to any architectural uniformity or design. Government itself was in a dilemma. While it was keen to ensure both system and control, it did not wish to place harsh deterrents in the way of those wishing to build on plots recently purchased, fearing that this would affect future sales.[23]

The next few years saw the sanctioning, commencement, cessation, alteration and re-commencement of public and private building in Bombay on a massive scale, with the main focus of activity being along the Esplanade. Many of the projects were held up by the sudden end of the cotton boom - the Bombay crash of 1865-6 - which saw the collapse of banks and mercantile firms and the drying up of capital to finance building projects. Nevertheless, internal wrangling between Trubshawe and the PWD, amply documented, also contributed to delays and amendments to the original designs. Had it not been for the progressive attitude of the PWD, Watson's Hotel would almost certainly not have been the innovative structure it became.

Watson's Esplanade Hotel - from conception to erection

John Watson's original proposal was not for a hotel, but for additional office and showroom facilities to complement his thriving drapery and tailoring businesses on Churchgate Street, Hummun Street and Meadow Street, Fort. This is shown by the earliest surviving correspondence relating to the building on plots 11 and 12. On 17 April 1865 one John Gascoigne submitted five

drawings, marked *amended* designs, for approval by Trubshawe. The drawings have been lost, but the accompanying letter stated that:

> The ground floor will be used as a shop and show room. The first and second floors will be used as offices and the third floor as living rooms, but in case Messrs. Watson & Co. should find the ground floor insufficient for their business they will afterwards convert the first floor into a showroom.[24]

The letter also informed Trubshawe that:

> The building is intended to be done in wrought and cast iron with brick on rubble wall foundations, Moranjee hill stone plinths, and brick party walls. The structure above the plinth with the exception of the party walls will be formed with cast iron columns and wrought iron rivetted girders and a wrought iron double roof. The plain portions of the faces will be wrought iron and the ornamental portions will be executed in cast iron. The joists and floors will be of teak and the building will be lined with hollow bricks set in cement, the partitions inside will also be hollow bricks.[25]

John Gascoigne (d.1867), the presumed author of these amended designs, is a little-documented figure.[26] According to the Bombay directories, he emigrated to that city in 1865, beginning work as an assistant with the architectural practice Scott, McClelland & Company. The fact that Scott, McClelland & Company were involved with structural ironwork - they designed the internally iron-framed Victoria and Albert Museum, as well as the David Sassoon Institute on plot 15 - suggests Gascoigne may well have been the initial author of the designs before Ordish became involved. Alternatively, but equally speculatively, he may have been acting as an intermediary or agent for Ordish's partnership, Ordish & Le Feuvre. Whatever his role, Gascoigne never saw the building completed, for his brief obituary in *The Times* states that he died on 16 December 1867 at his home in Battersea.[27] In fact his letter to Trubshawe is the only direct evidence we have linking him to the project, so it is conceivable that Ordish took over in the latter part of 1865, when a revised design was in preparation.

On 27 April 1865 Trubshawe forwarded the designs for Watson's 'iron house' to the Secretary to Government PWD, adding 'The Committee do not approve of either the Design or the material (cast-iron) proposed'. Significantly, his accompanying letter stated that 'Mr Watson has been very urgent about it on account of the economy and despatch with which this building can be constructed'.[28] But the PWD thought differently. It is worth repeating *verbatim* their reply of 13 May 1865, for the rare insight it gives us into the mindset of an establishment confronted with a radically new building technology, yet eager for the realisation of grandiose civic plans:

> RESOLUTION.-It should be pointed out to the Rampart Removal Committee that the materials to be employed are not cast iron only, but wrought iron, bricks, stone, timber, and tiles, &c.
> 2. It is possible such a combination of materials may be a useful innovation in Bombay, where the materials now in use are so costly, and often so bad in quality; at any rate the experiment would be a valuable one, and it would not be made at the public expense.
> 3. For these reasons Government would be glad to see such a building as Messrs. Watson & Co., wish to erect, tried, on a suitable design. If it were a failure, self-interest would suffice to ensure its removal.
> 4. As regards the design, it is obviously not one which would be suitable in ordinary materials; but the objections to it in the materials proposed by Messrs. Watson & Co., and with colour

> introduced where appropriate, are not apparent as compared with some of the Palladian frontages which have been approved; and before rejecting it Government would wish to be favoured with the opinion of the Rampart Removal Committee as to whether some modifications might not be suggested which would enable the committee to approve of it ?
> 5. If this can be done to the satisfaction of the Rampart Removal Committee the assent of Government may be assumed without further reference
> 6. Government take this opportunity of asking whether none of the purchasers of private lots, on the Esplanade, or owners of houses about to be re-built, could be induced to adopt some suitable modification of the façade of a native house with carved teakwood Pillars, and projecting Balconies... The adaptation of this picturesque style to a well arranged house is an object worthy of experiment.[29]

Point 5 would seem to have given Trubshawe ample margin to impose his own modifications to the designs during the remainder of 1865 without detailed reference to Government. These modifications are not recorded, but by 23 May 1865, Trubshawe had informed Watson & Co, through their architect (presumably still John Gascoigne), that the design was sanctioned. Speculatively, Trubshawe may have heeded point 6 of the resolution, demanding that the elevations incorporate decorative pillars and balconies (albeit in iron) to blend in with the traditional Gujarati style.[30] But, equally speculatively, point 6 may reflect the fact that the design presented to the PWD already incorporated these features, providing a reminder of their eminent suitability both climatically and visually. Trubshawe subsequently wrote to The Secretary to Government over this point, pointing out that such a form of construction 'usually involves the necessity of having the upper walls of wood framing and half brick filling - a method the committee have uniformly endeavoured to discourage in external walls'.[31] The conceptual similarity between timber-framed and iron-framed construction, with brick panel infilling, was probably not lost on any party - Watson, Trubshawe or the PWD - and it may be that the PWD's appreciation of the practicality of the local vernacular, and its translation into iron, had helped swing the balance in Watson's favour.

John Watson wasted no time in getting his project off the drawing board, for on 26 October 1865 he wrote directly to J.S. Chapman, Chief Secretary to Government, informing him that a consignment of bricks and other materials for his 'warehouse' would be arriving from England in a few days, and requesting his permission to stack them on land adjoining plots 11 and 12. Clearly, Watson was deliberately circumventing the obstructive Trubshawe, artfully stating in his letter 'We are not sure whether we are right in addressing you on this subject or if we should have applied to the Rampart Removal Committee...'.[32] The matter was in any case referred to Trubshawe, now Secretary of a new body, the Architectural Improvement Committee (AIC), who, perhaps grudgingly, granted permission on 14 November.[33]

It was possibly in November or December of 1865 that John Watson 'conceived the happy idea of establishing an hotel of first-class reputation, on the model of the most well-equipped and well-managed caravanserais then springing up in the West End of London'.[34] Bombay needed hotels desperately, and long before the first general auctions in August 1864, the Government had already drawn up plans for the location of a proposed 200-bedroom first-class hotel.[35] Indeed, the Government was willing to smooth the path for those buildings it wanted to see built, and when the Bombay Club - thwarted by Watson - subsequently wrote asking for another choice site it resolved 'to extend to Clubs, as to Hotels, and other semi-public institutions, the privilege of letting the purchase money of building sites assigned to them remain on mortgage at 5 per cent, as long as the buildings for which the sites are granted are used as Clubs, or Hotels'.[36] In January 1866 Trubshawe forwarded copies of a new design submitted by Watson & Co., together with a tracing of the original design and the Committee's opinion on the subject. This new design, conceivably for a

hotel, was quite possibly drawn up in Ordish's office. Trubshawe's comments are not detailed, but his letter is recorded as being dated 3 January 1866. Remarkably, Government's response, which makes reference to 'the structure now on its way out', suggests that the frame of Watson Hotel was already made and at sea.[37]

What particular revision of the original design the sea-borne structure comprised is unclear, but either way it was ostensibly a rash, premature move on the part of Watson, or alternatively a master-stroke, given Trubshawe's apparent dislike of the project. What occurred during the remainder of 1866 was a series of bluffs, counter-bluffs and concessions on either side.[38]

In March 1866 Watson was seemingly content to change the site rather than the design, but further correspondence between the Acting Secretary to the AIC and Government in August 1866 shows that he subsequently reversed his priorities. The Acting Secretary forwarded '*for the favourable consideration of Government*, a fresh design by Watson & Co., for their buildings on lots Nos. 11 and 12' [emphasis added].[39] Government approved this amended design, which, with its mansard roof was more showy than that built, but woefully impractical for Bombay's searing heat (Fig. 4). Presumably Trubshawe's temporary replacement, who was probably Captain Cuthbert W. Finch of the Royal Engineers,[40] was more liberally disposed to prefabricated iron construction for permanent buildings,[41] for by this date component parts of the earlier proposal would surely have arrived, and it is difficult to imagine that he can have demanded radical changes to the structural design. Certainly, by 2 January 1867, *The Bombay Gazette* could inform its readers that 'a good deal of the materials has been for some time on the ground',[42] although this would appear to have largely been restricted to bricks and masonry.[43] According to the caption under the painting reproduced in figure 4, the bricks and cement were derived from the banks of the Thames, and the red sandstone plinth and column bases came from Penrith. This was organised by John Hudson Watson's brother-in-law, Thomas Thompson, a land steward from Wetheral, Cumbria.[44] In the absence of surviving drawings, there thus remains considerable uncertainty over just how far the original designs proffered differed from those accepted, and whether any ironwork had actually

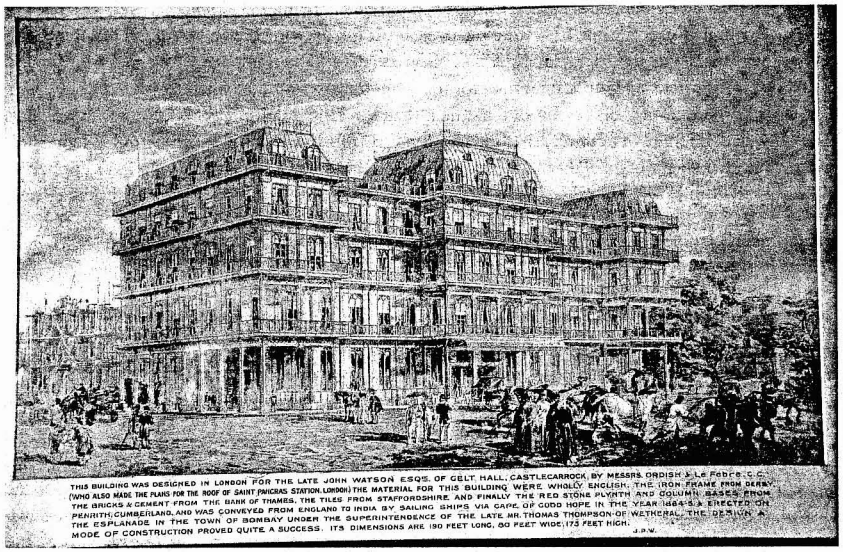

Figure 4. Ordish's proposed mansard roof design (Jonathan Clarke).

been fabricated and exported in 1866. The Phoenix Foundry Company's catalogue (Fig. 2) assigns the date 1867 to Watson's Esplanade Hotel, and it was in this year that on-site assembly of the framework began.

In February 1867 *The Bombay Gazette Overland Summary* recorded that 'Mr Watson is expected to arrive in England by next mail, and the works will then be begun without delay, Government having given its permission to build, and approved the plans'.[45] Following approval of the revised plans in September 1866, Watson may have chosen to meet with The Phoenix Foundry Company and/or Rowland Mason Ordish in London or Derby, to check the progress of his modified building. Exactly when he returned, and whether he was accompanied by Ordish or the 'English workmen ... engaged to superintend the raising of the framework'[46] is unrecorded. By 24 August 1867, Captain Finch could write that 'these gentlemen [Watson & Co.] have completed (at great expense) the foundations and plinth of their building, and have, in addition, a large amount of iron work and material on the spot'. The Acting Secretary was submitting an application from Watson & Co. for a three-year extension to the time allowed for completion of their building. This letter was written exactly three years from the date of the purchase of the site, suggesting an initial three-year term for completing the works. Government granted Watson & Co. a two-year extension.[47]

Granted their revised deadline, Watson & Co. would seem to have made rapid progress over the next couple of months, if not *weeks*, if the awed and unfavourable commentaries given at the start of this paper are reliable.[48] They are made credible by the fact that on 8 October 1867 Ordish wrote to Captain Finch seeking approval of a modified roof design, presumably the flat roof that survives to this day. Ordish pointed out that since submitting his original, approved mansard roof design 'I have taken the opinion of architects, who have great experience in India, and I have been compelled to alter my opinion as to these "Mansard" Roofs being suitable for India'.[49] Ordish urged Finch's opinion as soon as possible 'as the top story of the building cannot be proceeded with until the sanction of your committee is obtained'.[50] Finch expedited matters with the PWD, and on 26 November, Government, presumably eager for progress, stated they had 'no objection to the proposed alteration'.[51]

In January 1868, *The Bombay Builder* noted that the only new buildings to have commenced in 'Frere Town' were the new Secretariat, the Mechanic's Institution, Treacher & Co.'s shop, and Watson & Co.'s building.[52] Throughout the rest of 1868, the progress of the hotel would seem to have gone largely unreported in the newspapers, trade press and PWD proceedings, and we can only presume that with the novelty aside and major planning hurdles surmounted, the framework, walls and floors were quietly, steadfastly nearing completion.

Remarkably, the following year could have seen the construction of another fully-framed building by Watson and Co., had the PWD not thwarted plans. On 28 June 1869, John Hudson's son, business partner and attorney, John Proctor Watson, wrote to Colonel James Augustus Fuller (1828-1902), Architectural Executive Engineer and Surveyor of the PWD. The letter stated that they wanted to rebuild one of their existing premises, on the southwest corner of Churchgate Street, 'so as to straighten the Rampart Row frontage and bring it into a line with the existing buildings'.[53] Fuller forwarded the letter to Colonel W. Kendall, R.E., Acting Chief Engineer of the Presidency Division, cautioning him that:

> From what Mr Watson told me personally, it is his wish to erect an iron building out of the same moulds (to save expense) as those in the iron structure now in course of erection. This I think it would be as well to prevent if possible as duplicate buildings are not desirable.[54]

Kendall seemingly agreed, for a duplicate structure was never built. Government did ultimately sanction the extension of the Churchgate Street premises, but surviving correspondence shows the Watson enterprise dragged its feet over the whole affair, presumably begrudging the fact that they

were charged for the land and that they had to resort to traditional building materials. However, the Watsons had more pressing matters. With the spectre of the Government's two-year completion deadline for their hotel looming, Watson & Co. - in common with many other Esplanade property owners - were well behind schedule again. In the autumn of 1869, Watson & Co., successfully applied for further time, extended until 1 May 1870.[55] One of the final planning sanctions Watson seems to have obtained for his hotel was for a proposed rear veranda, granted on 13 November 1869.[56]

In December 1869, news of the building reached *The Architect* - seemingly the only British publication to include mention of it. Quite possibly at the request or notification of the building's designer Rowland Mason Ordish (an occasional contributor to the magazine), on 11 December it illustrated 'one of the most recent structures put up in Bombay - a building which in many particulars deserves the attention of architects' (Fig. 5)[57] A week later it carried details of the building *'now nearly completed'* (Fig. 6) [emphasis added].[58] On 14 February 1870, the *Times of India*, in an article entitled 'Watson's New House', comforted its readers with news of progress, and offered explanation for its long gestation:

> Whatever answer it may have been customary to give in the past, it may now truthfully be stated that the work is advancing towards completion with great rapidity. There have been some aggravating delays hitherto - aggravating to no one more than to Mr. Watson himself - owing to the necessity of procuring every pound of the ironwork from England, and of having some of it altered after its arrival in Bombay. As the work progressed, new ideas suggested themselves; and, with a view to have the hotel as perfect as possible in every detail from the first, these ideas have always been put into execution. . . . But the heavy portion of the work has now been completed; there are no more cast iron beams to pierce or cut; the workmen have chiefly now to do with what are playthings by comparison - teak, mahogany, and Manton's [sic] tiles.[59]

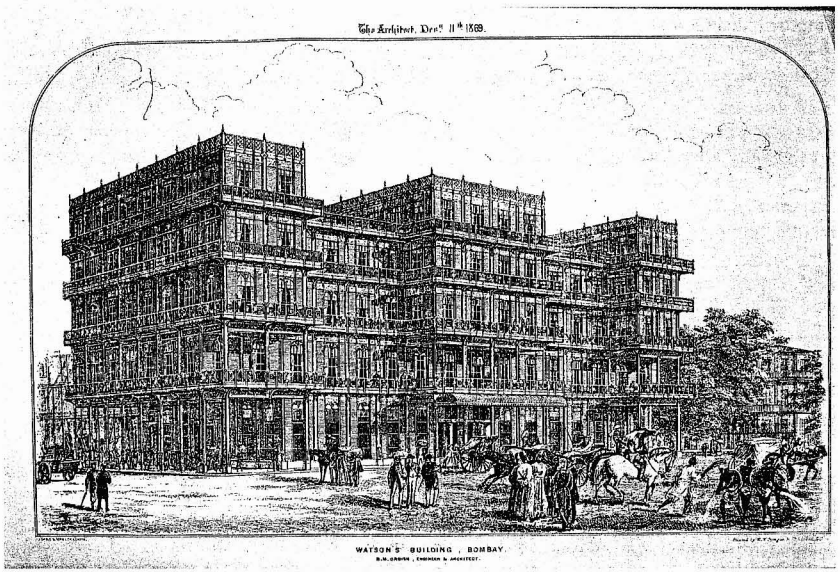

Figure 5. Watson's as depicted in *The Architect*, 11 December 1869.

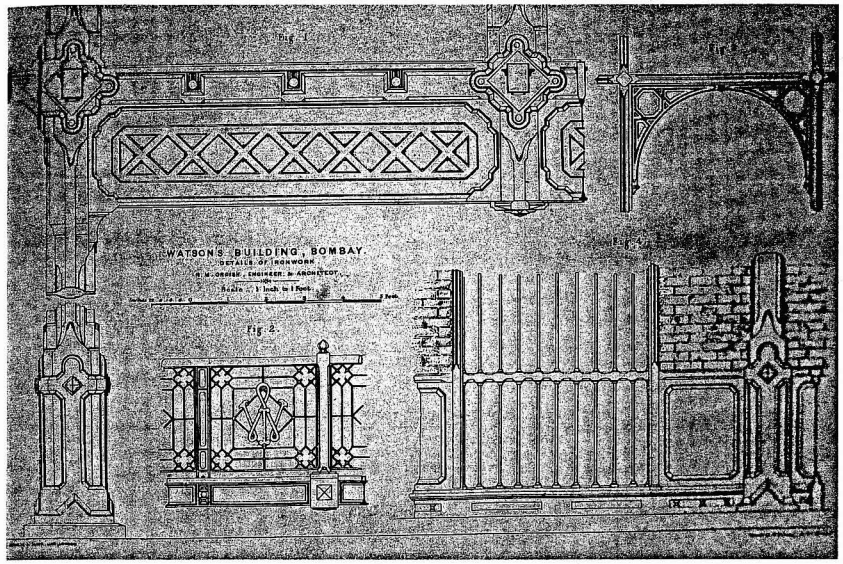

Figure 6. Ironwork details as illustreted in *The Architect*, 18 December 1869.

Another cause of delay that the *Times of India* did not know about was an omission in sending some of the ironwork from Derby, necessitating the casting or fabrication of some components locally.[60] Richardson and Robson, probably the only Bombay founder producing structural sections at this date, may have manufactured these.[61]

The building was structurally complete and largely fitted out by autumn 1870, by which time John Watson had taken up residence.[62] Nevertheless, the third deadline (1 May 1870) had been missed. It was not until 10 January 1871 that Watson, in requesting a Government completion certificate, could write 'that the building on plots 11 and 12 has now been completed fit for habitation ... I am anxious to have the certificate as soon as possible and I have the furniture now ready to place and intend to open the hotel immediately'.[63] Ironically, the final delay to the building's completion was down to Watson's obstinacy. Having failed to sign the first extension (26 August 1867 to 26 August 1869), and meet the final deadline, he demanded additional clauses to the Government's completion certificate before he would sign it. Watson was aggrieved that the High Court, originally earmarked for a neighbouring plot, was not going to built there after all, and therefore demanded clauses that would enable him to bring legal action. Fuller, on the advice of the Government solicitor (who knew Watson could never prove prospective loss of revenue) acquiesced, granting the certificate on 2 February 1871.[64]

The "Esplanade Hotel": 'without a doubt the finest hotel in Bombay'

Finally, on Saturday 4 February 1871 'The huge, and ugly, erection on the Esplanade known as Watson's Building . . . [was] . . . opened to the public under the name of the "Esplanade Hotel." '[65] (Fig. 7). The opening was briefly announced in the Indian press, but the *Times of India* reneged on its earlier promise 'to give a complete account of this stupendous building'.[66] Nevertheless, Bombay

Figure 7. Watson's in the 1870s. By permission of The British Library, Photo 717 (57).

finally had a first-rate hotel, the *Bombay Gazette* proclaiming it 'without a doubt the finest hotel in Bombay'.[67] Watson's, 'built, at enormous cost ... on perhaps the best site in Bombay'[68] could boast a sumptuous, top-lit ground-floor restaurant with attached billiard-room, a first-floor dining saloon (with another attached billiard-room), and three upper storeys given over to 130 bedrooms and apartments, the uppermost of which were reserved for 'bachelors and quasi-single gentlemen'.[69] With over 120 baths fitted - almost one to each bedroom - it outdid European levels of luxury in this regard.[70] It was thoroughly ventilated throughout (thanks not just to the careful design, but also to the punkah wallahs serving every room), it commanded breathtaking views across the harbour, bays and distant hills, and, 'for the benefit of those to whom stairs [were] a great trial [who might otherwise] be appalled by the height of the building', it boasted India's first steam-powered elevator.[71] Watson's brought to Bombay a new level of sophistication that 'marked the introduction of the large-scale European or American hotel type of the period'.[72]

Behind the unconventional, grid-like exterior lay some adroit planning serving the needs of shoppers, diners and short and long-stay guests. In plan-form it was fairly complicated, consisting essentially of a central entrance block housing the main stairs, flanked by two symmetrical wings that wrapped around a top-lit central atrium housing the restaurant (Fig. 8). Above this level the building opened out with a central well and a break in the rear elevation. Such openness of plan allowed free circulation of air and also shaded the interior portions of the hotel. Until 1896, when the Army & Navy building to the south was built, it backed onto private gardens, meaning that it was entirely open to the sea breeze. Diners and guests would have entered the 20ft-high ground-floor portion of the central block through tall double-doors; straight ahead, beyond Minton-tiled flooring was the top-lit restaurant, to the left were the stairs and to the right, the elevator. A side

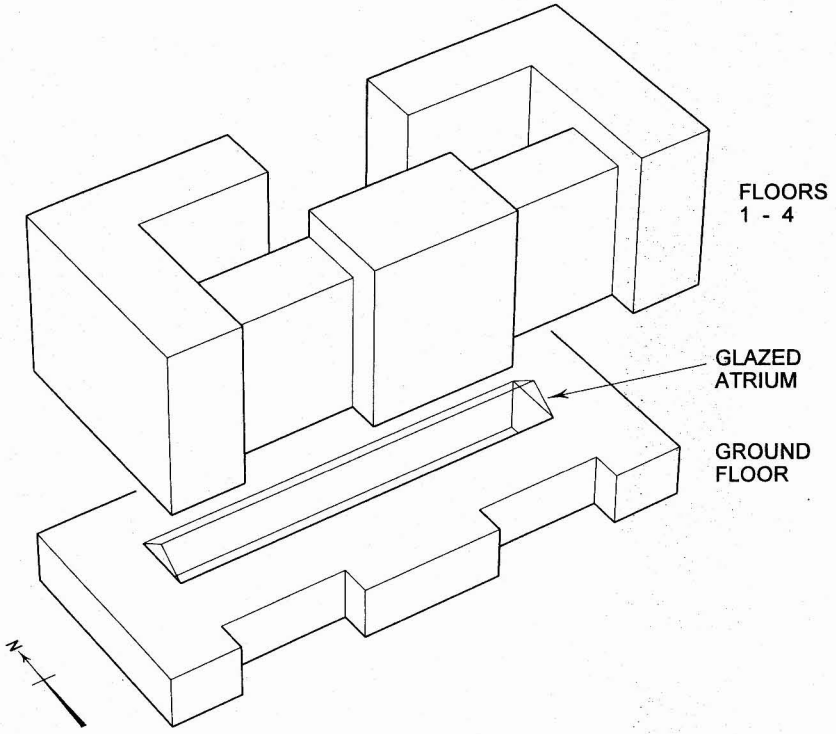

Figure 8. Sketch showing the plan-form of Watson's. (Jonathan Clarke).

entrance on the Esplanade, under the pedestrian arcade, probably served people who were intent only on browsing the ground-floor drapery and tailoring shops. The whole accent of this 'composite Hotel and marvellous multum in parvo shop combined' was on the showy shops, dining halls, drawing and billiard rooms on the ground and first floors. By contrast the private, upper part of the building 'was broken up into a cellular system of small rooms as sleeping apartments' - small cubicles divided by thin partition walls and served by narrow corridors 'hardly worthy of the edifice'.[73] Room heights decreased up the building: 20ft on the ground floor, 17ft on the first, 15ft on the second and 14 ft on the third and fourth. Only the first floor was provided with double rooms, although virtually all were provided with en-suite baths or attached bathrooms - the water presumably conveyed and discharged manually by servants who lived on the fourth floor. Clearly Watson wanted to extract as much profit as he could from the building, cramming in as many guests as possible, yet appeasing them with fine European cuisine and sumptuous social spaces where they could mix with Bombay's resident British elite (Fig. 9). *The Times of India* was magnanimous in this regard, noting 'The interior economy of the hotel is replete with devices for the comfort of the guests, and every effort is to be made to render the lower portions of the establishment a place of favourite resort'.[74] Having been a part of Bombay society for over a decade, it was undoubtedly Watson himself who contrived this exaggerated dichotomy between public opulence and private,

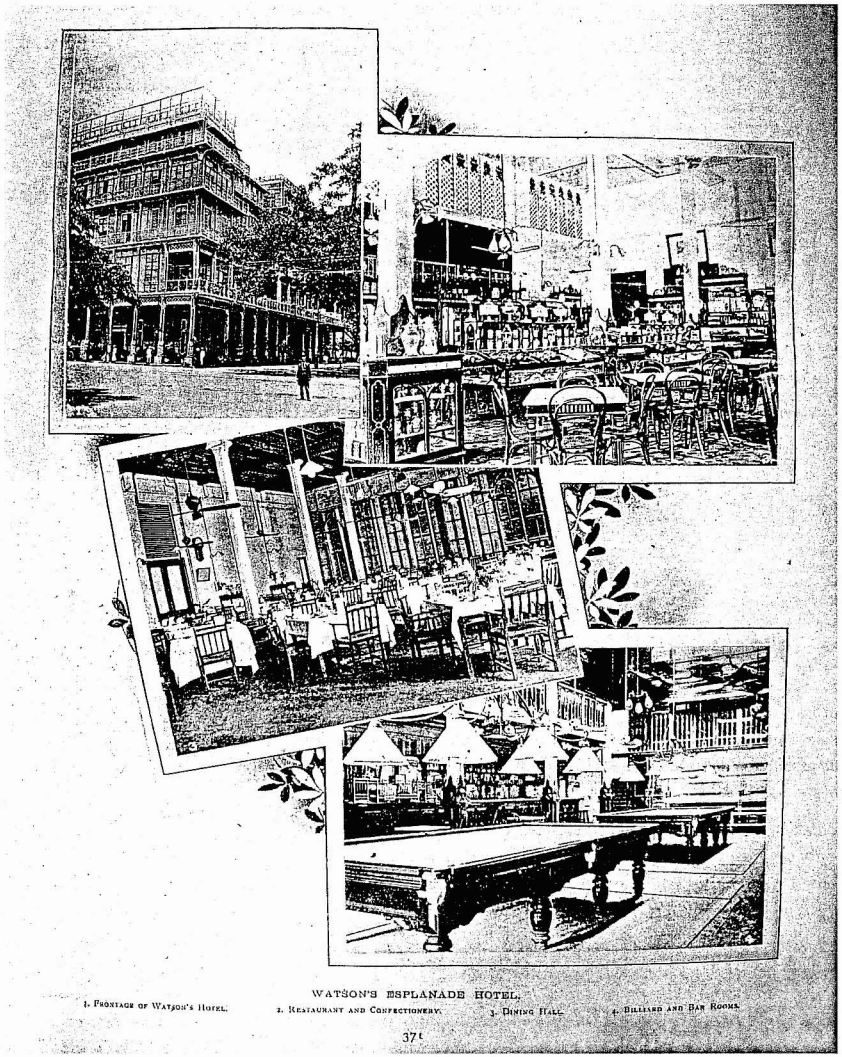

Figure 9. Watson's sumptuous interior (Somerset Playne et al, *The Bombay Presidency,* 1920.

'make-do' utilitarianism, arguably more acceptable in a distant colony than a European city. *The Architect* noted 'The general scheme and arrangement of the building may be described as due to Mr. Watson himself, the promoter and proprietor of the work'.[75]

Watson's Esplanade Hotel enjoyed a period of unrivalled splendour, patronised by notable and distinguished guests, and even being fictionalised in two of Rudyard Kipling's stories.[76] Such was the financial triumph of the venture, that the hotel erected an annexe in 1888 on a site behind the

Royal Bombay Yacht Club, within walking distance of the original. Built to the designs of Robert Fellowes Chisholm (*c*1839-1915), one of the most gifted architects practising in India, this eclectic pile (now demolished) eschewed the innovative skeletal construction of its precursor for load-bearing brick, masonry and timber.[77] (Fig. 10). By the early 1890s the original had been fitted with a hydraulic lift and electric lights and bells. Soon after it made film history. On 7 July 1896, Watson's Esplanade Hotel offered screenings, just six month's after their Paris debut, of some of the Lumière Brothers' first films, including the Entry Of Cinématographe, Arrival Of A Train, The Sea Bath, A Demolition, Leaving The Factory and Ladies And Soldiers On Wheels. This was India's first taste of the moving image.[78]

But the turn of the century also saw the appearance of a new breed of larger, grander establishments such as Green's Hotel and the Majestic Hotel, reflecting the culmination of Frere's civic improvement programme. Ironically, the most sensational of these, the Taj Mahal (1903-4), may have arisen because of racial attitudes typical of the era:

> There is a persistent story that several decades earlier J. N. Tata suffered the humiliation of being asked to leave the then-best hotel in Bombay, Watson's on the Esplanade, on the grounds that he was a native. He swore then that he would one day build a hotel of his own which would far outdo Watson's in splendour and convenience: his Taj was designed regardless of expense ... [and] ... is still the best in Bombay eighty years later.[79]

This competition spelt the death-knell for the Watsons' hotel venture, who, having made their fortune, returned to their native Cumberland, leaving the hotel under local management. By 1920 it had ceased to be a hotel, having been renamed 'Mahendra Mansion' by its then owner, Maharaja Morvi Singh. Ironically, the building was purchased by the Tata dynasty in 1944, becoming 'Esplanade Mansion'. Today, Chisholm's annexe is long gone, and the former Watson's Esplanade Hotel is an endangered relic.[80]

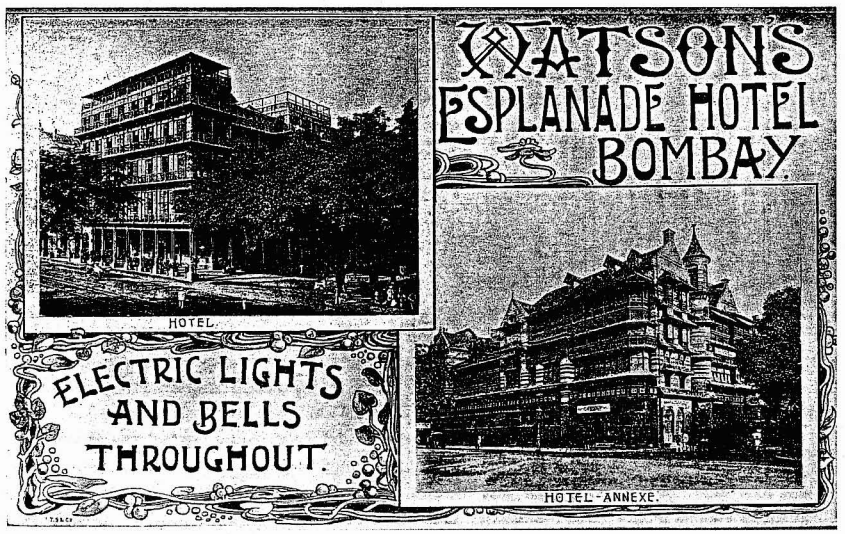

Figure 10. Watson's (1867-71) and Watson's Annexe (1888). (*Thacker's Indian Directory*, 1901).

The structural design of Watson's Esplanade Hotel

Structurally Watson's Hotel comprises a grid of vertically linked cast-iron columns connected by wrought- and cast-iron beams (Fig. 11).[81] Like the Crystal Palace it is a modular assembly with a limited range of standardised interfaces. The structural unit here is based on a 11ft 9in-by-11ft 9in grid, with columns and beams running in both directions. Multiples of this module were used in framing the ground-floor arcade and the stairwell. The size of this module probably reflects the architectural strictures of the PWD/AIC regarding Esplanade buildings, a dictate of *c.*1864 demanding a 24ft arcade over the footpath[82] - roughly two modules width. The module was not however, in Tom Peters' parlance, structurally nondirectional,[83] because it was not strictly the same in both the x and the y axes; the beams framing into the columns were not all the same size. Nevertheless, it served as the basic unit that ordered the structure, meaning that it spanned and expanded equally in both directions and was stackable in multi-storey heights. The aggregate dimensions of the building - 190ft long in the east-west axis, 80ft wide in the north-south axis - exceed the size of the double-plot John Watson originally purchased, which measured 167ft by 80ft. Similarly, with a total height to the flat terrace roof of 80 feet, the building's height exceeded the 55ft originally specified by government for the Esplanade plots.[84] Both revisions suggest that special waivers were obtained.

Three different column types are employed, each cast with projecting lugs or brackets to carry the beams, and terminating with a standardised, faced, horizontal bolting face for column-to-column connection (Fig 12). Type 1, the thickest and most elaborate, was used to carry the deep, cast-iron open-web beams running along the exterior of the ground floor (Fig. 6). Because these beams, with their obvious similarity to the trellis girders of the Crystal Palace, spanned only in one direction, the column incorporated just two projecting lugs. Type 2, which has two, three or four projecting lugs, seems to be used throughout the interior of the 20ft high ground floor. Type 3, which was used on the first floor upwards, is 'double-headed' to enable a vertically continuous assembly, each cast with two 12in-square bolting faces top and bottom, with bolt-holes in each of the four corners. They were cast with one, two, three of four brackets at either end, depending on their position within the building.

For the most part built-up wrought-iron I-section beams, 12in by 6 in are used to span between the column heads, but larger 'boiler-plate' girders, 19in deep with 9in flanges, are also used (Fig 13). Chamfered timber joists, seated in cast-iron hangers bolted to the web of the beams, support the teak boarded floors, but rolled-iron joists carry the flat timber roof (originally of timber, now reinforced concrete). The entire stability of the building is seemingly dependent on the portal bracing derived from the rigidity of the column-beam connections. These connections appear to derive from those used at the Crystal Palace, in which the ends of the beams were held between brackets at the top and bottom of collars, although 'blind rivets', not wedges, appear to have been used to fix the joint rigid. In Watson's Hotel, strips of iron were welded onto the flanges, transverse to the beam axis just short of either end (Fig. 14). These strips were then clasped by the cupped brackets of the columns above and below and held securely when the bolts connecting the column splice at mid depth were tightened. The smaller section, 12-inch by 6-inch, beams were ingeniously fabricated so that the web plate projected a little above and below the flanges (made up of angles). This web plate slots into corresponding notches in the column brackets, and because these beam-ends are also provided with welded transverse strips, their ends are effectively restrained in both axes. What appear to be blind rivets, driven into close-tolerance holes in the bracket lugs via prepared holes in the flanges, look as if they fix the joint to make a rigid connection. On the smaller beams, four such rivet heads, aligned with the column lugs, indicate this form of interface fit, but, curiously, the same technique is not apparent for the larger beams. Indeed, how the larger beams were secured remains unclear, for as Figure 14 (conjecturally derived from a number of photographs) shows, they were not all fitted with top brackets.

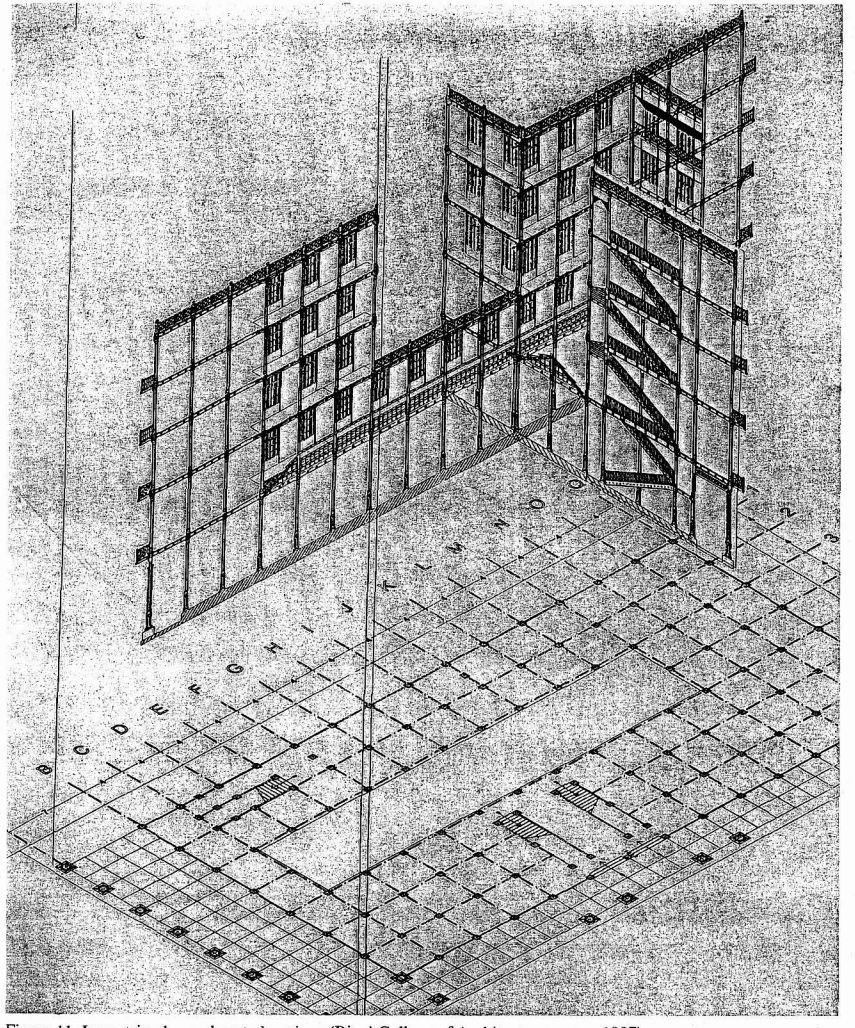

Figure 11. Isometric plan and part elevations (Rizvi College of Architecture poster, 1997).

With the beams firmly restrained at their ends, strengthened by their interaction both with the columns flanking them and the beams beyond the columns, the overall frame acts as a series of interconnecting portals. Unlike the Crystal Palace, no diagonal bracing was used to triangulate any of the structural bays. The frame was certainly sufficiently stable and self-supporting during construction, as the opening quotations, referring to a skeleton of iron, suggest. Stability may be enhanced by the interaction of the brick partition and spandrel walls with the frame, which could act as rigid diaphragms within the column to beam angles. However, these thin walls, half a hollow brick thick, do not provide any direct load-bearing role. This is made clear by the fact that there

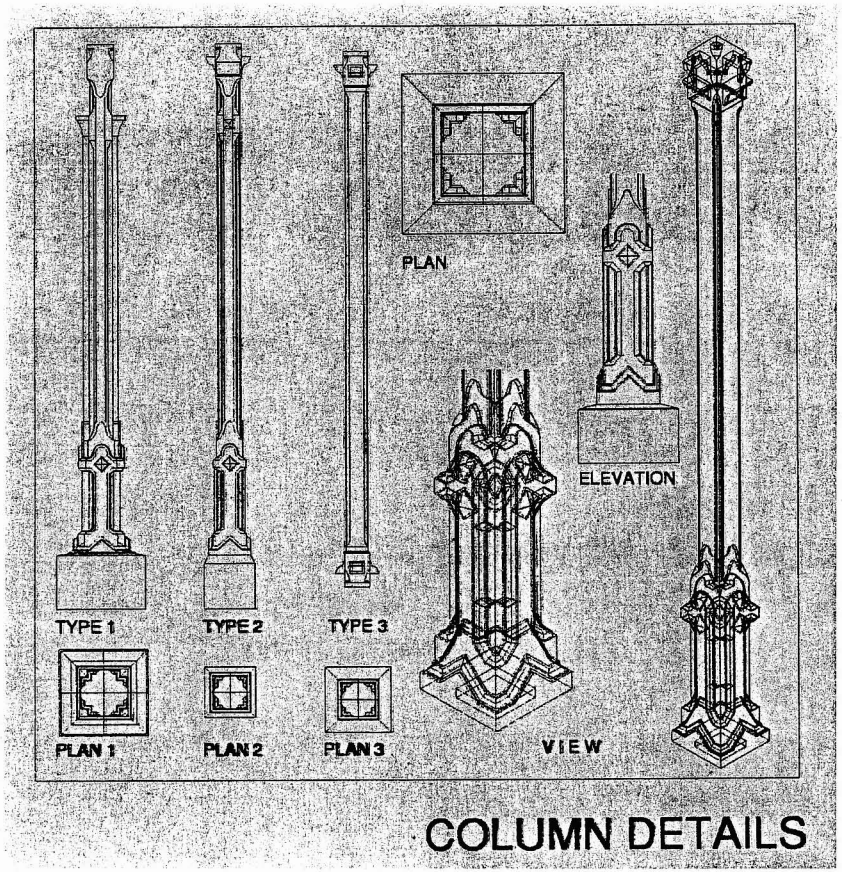

Figure 12. Column details (Rizvi College of Architecture poster, 1997).

was an 18in. gap between the top of each partition wall to permit a free flow of air through the bedrooms, a source of criticism both on account of the view people ascending the stairs had into the bedrooms, and the general noisiness.[85]

Expansion joints were surely called for given Mumbai's searing afternoon heat, but it remains unclear how these were effected. Thick layers of paint obscure any evidence that, like the Crystal Palace, hardwood wedges were used in the connections in the longitudinal axis of the building. Perhaps the central atrium served as a large expansion joint rather like the Crystal Palace's transept vault did in Tom Peter's analysis,[86] meaning that there were fewer continuous frame segments running the full length or width of the building.

The frame was unambiguously carried through to the outer walls on all sides of the building. Indeed, these brick spandrel walls - subdivided into whole-bay brick panels - are supported directly on decorative cast-iron beams, with bosses covering the column-beam junctions. Because these panels were just half a brick thick, the heavy window frames were carried by a secondary external

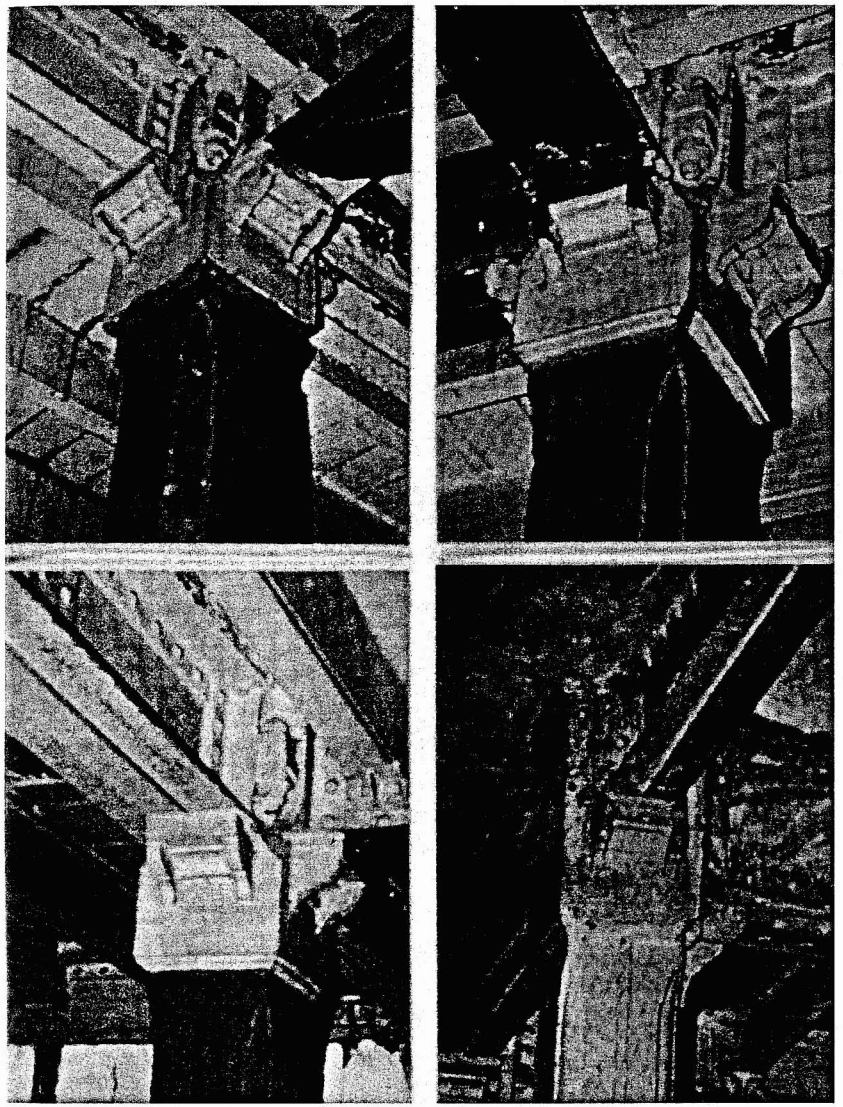

Figure 13. Column-beam connections (Jonathan Clarke).

frame system, composed of two cast-iron 'mullion' posts extending between the beams (Fig. 15). Additional horizontal bracing was provided by wrought-iron rods, linking the columns above the windows. Elegantly proportioned cast-iron brackets, cantilevered from the columns, were used to carry the balconies encircling the building.

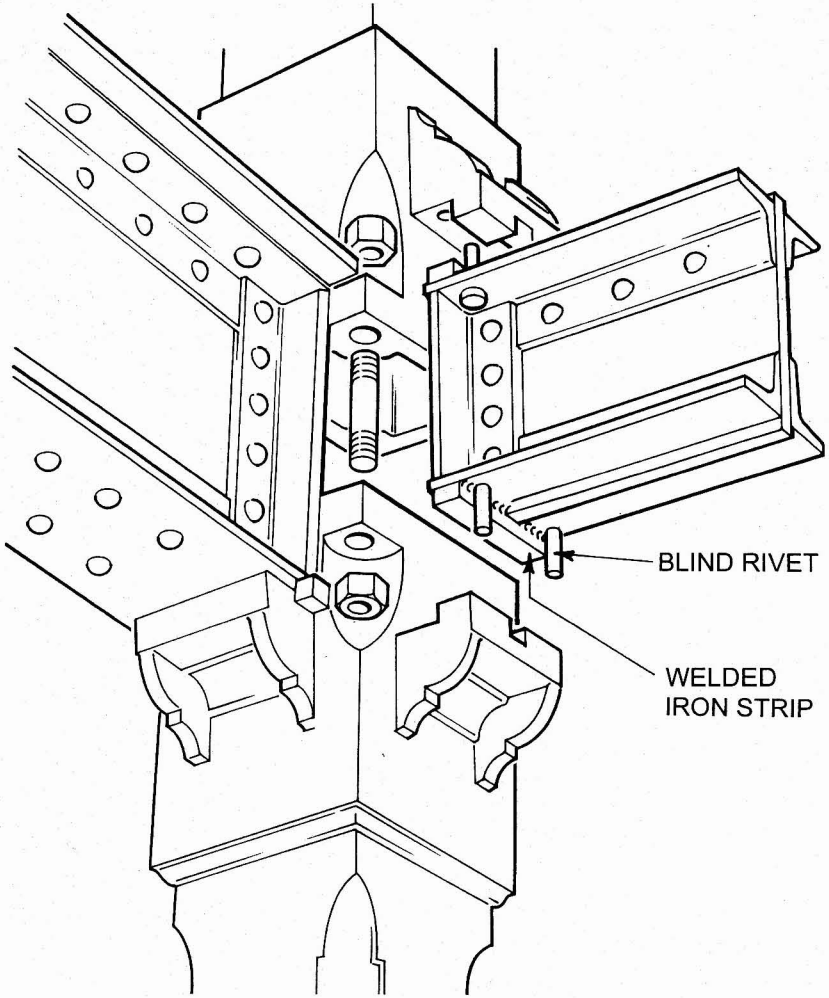

Figure 14. Conjectural drawing showing presumed method of fixing the joint (Jonathan Clarke).

No mention is made within the PWD archives of the foundations of the building. The columns were probably bolted directly onto brick, stone or concrete bases, surmounted by planed iron bed plates. In common with other exported iron buildings of the era, the columns were most likely erected on bases using pre-positioned iron wedges, which were driven inwards to achieve the necessary alignment. The space between the column and the base would then have been caulked with molten lead, iron borings, or (most commonly) Portland cement.[87]

Ordish's structural framework was in some senses an adroit solution to Watson's presumed design brief, the modular form enabling economy through standardisation of structural members

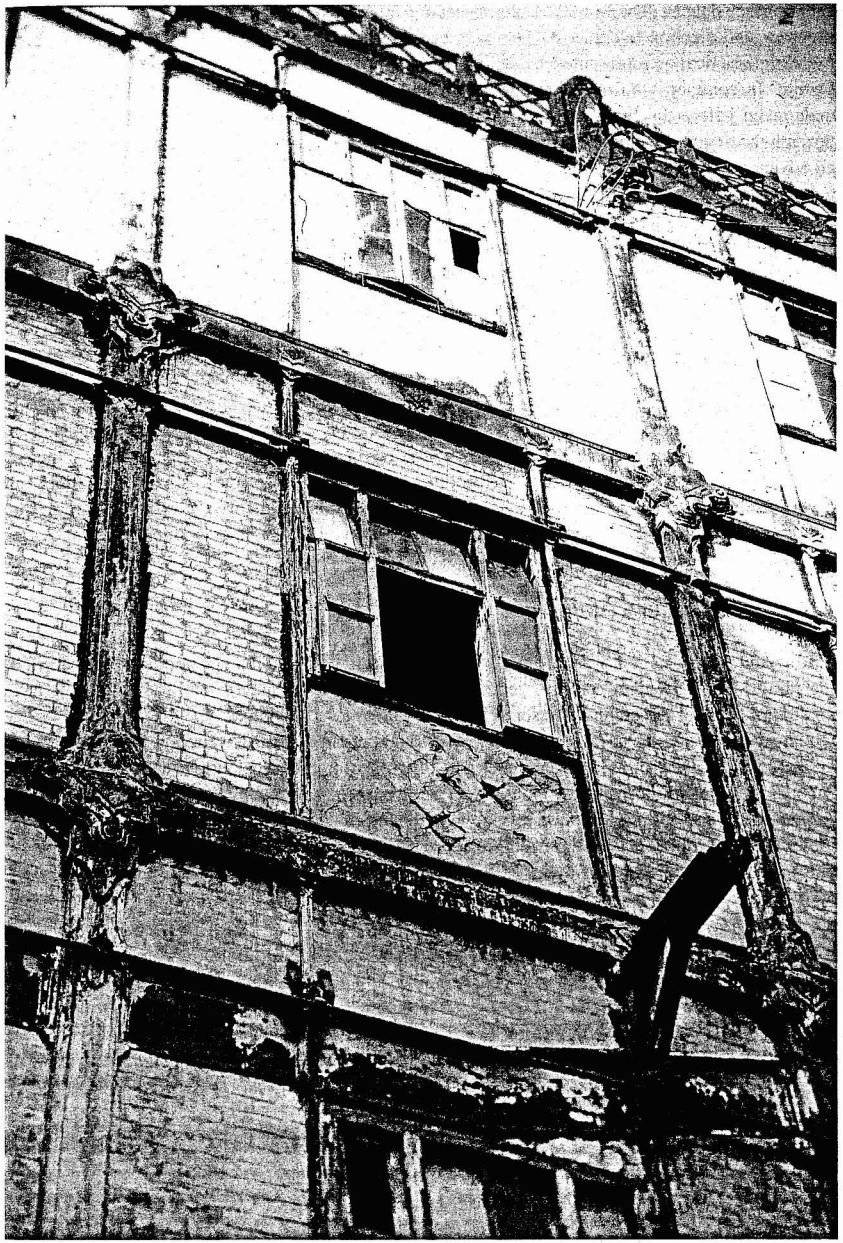

Figure 15. Secondary external frame system for carrying the windows (Jonathan Clarke).

and interface details. The form of column-beam connection demanded state-of-the-art fabrication accuracy and erection tolerances. This was certainly not beyond the capabilities of 1860s iron-founding practice, as represented by one of its leading firms, the Phoenix Foundry Company of Derby. In common with most prefabricated buildings, a full trial erection was almost certainly undertaken before the frame was shipped. The connections, with the columns spliced midway through the depth of the beams seemingly present an entirely novel, logical technique, representing an advance over the Crystal Palace, eliminating the need for interconnecting collars between the columns and offering greater end-fixity. Whilst drawing from a wealth of his own empirical-based experience, Ordish may well have used mathematical analysis for the detailing and overall structural behaviour of the frame of Watson's Esplanade Hotel, as he did in the Dublin International Exhibition.[88] Structurally, the regular grid of Watson's was 'ideal', the collected loads from the stack of floors descending vertically and in compression through regularly spaced columns extending uninterrupted the full height of the building. Yet in its modular co-ordination and economy, it could not offer much flexibility to the internal planning of the building. Watson's scheme was necessarily 'shoehorned' into the dictates of an economically viable, yet spatially defining structural grid.

Watson's Esplanade Hotel arose from the collaboration of three main agents: John Hudson Watson, the patron; Rowland Mason Ordish, the engineer-architect, and the Phoenix Foundry Company, the contractor/fabricator. In producing this remarkable and distinctive building, all occupy an important, albeit largely unrecorded, place in Mumbai's history. More significantly from a construction history perspective, both Ordish and Phoenix were hugely important forces that deserve wider recognition.

Rowland Mason Ordish (1824-1886)

Rowland Mason Ordish was one of the most prolific, inventive and accomplished engineers of the mid-to-late nineteenth century, yet, surprisingly, only two modern published accounts have given him some of the credit he deserves.[89] Best known for patenting a type of suspension bridge with a rigid girder deck suspended by inclined straight chains ('Ordish's straight-chain suspension system', 1858), and, within his huge repertoire of works in iron, the Albert Bridge, Chelsea (1872-3), his greater significance lies in the fact that he took iron construction to new levels of technological and aesthetic sophistication. One of the first consulting structural engineers in the modern sense of the term, he achieved more than most in helping to dispel some of the prejudices with which the architectural community viewed both engineers and structural iron.

Ordish was born in 1824 at Melbourne, near Derby, the son of John Ordish, a land agent and surveyor. He received no formal technical education, other than the skills he picked up in his father's office, in common with the great majority of engineers and contractors of the period. From 1844-45, he began independent professional life, working in the office of an (unrecorded) engineer during the 'railway mania' boom. Here he was principally engaged in 'putting the writing on the drawings of others, for which he had special aptitude'.[90] At the age of 22 or 23, he went to London to enter the office of R. E. Brounger, an engineer chiefly occupied with designing iron railway bridges. Whilst with Brounger in the late forties, Ordish worked principally in Denmark on a survey for a proposed railway, possibly giving him a taste for international contracts that was to persist throughout his working life. On his return, he was entrusted with structural work in addition to his duties as a draughtsman. In this he showed 'conspicuous talent',[91] and his adroit detailing of the successful competition designs for the Victoria Bridge over the Thames at Windsor earned him a prominent position within the firm.

Quite when Ordish's budding skills as a designer came to the attention of Charles Fox is unrecorded, but in 1850 Brouger loaned Ordish to Fox and Henderson as an assistant draughtsman

for the Crystal Palace design team. There, Ordish's talent and efficiency ensured 'that the important work gradually fell to him; and he with Mr. Fox made at the office in Westminster the whole of the detail drawings for execution at the Soho Foundry, Birmingham'.[92] Just prior to the formal opening, Ordish was called away from the project to assist in making the working drawings for the Birmingham New Street Station roof. When relinquished from that, he worked on the re-erection of the Crystal Palace at Sydenham in 1852-54, presumably under the superintendence of Charles Heard Wild. Although Wild's principal design and organisational role in the larger, more robust structure is unquestionable, it seems likely that Ordish exercised a greater influence than has hitherto been acknowledged. *The Engineer*, in its obituary, stated 'Mr. Ordish never was of the opinion that such light structures of iron and glass were the most suitable for permanent purposes, and the endurance until now of the Crystal Palace is mainly due to the admirable skill with which the columns and girders are arranged and braced to transmit the various strains to which they are subjected'.[93] *Engineering* went further, saying he superintended the erection of the Hyde Park building, and 'had charge of its re-erection at Sydenham as the Crystal Palace'.[94]

Whatever the true division of responsibilities, Ordish was doubtless within the employ of Fox and Henderson by the early fifties, and became a 'trusted friend and coadjutor in the numerous works on which Sir Charles Fox was engaged'.[95] In January 1856, the year Fox, Henderson & Co. went bankrupt, Ordish took up a position as chief draughtsman in the Director of Works Department of the Admiralty under Colonel Godfrey Greene (1807-86) at Somerset House. Lasting until March 1858, this engagement quite possibly arose as a result of Fox, Henderson & Co's contractual work at the Royal Dockyards. Whilst Skempton's research makes it clear that Ordish had no direct involvement in the design of the Sheerness Boat Store (1858-60), it is both tempting and plausible to suggest that he nevertheless had input into some of the iron-framed dockyard structures that preceded it.[96] Ordish had thus not only had the opportunity of working alongside the foremost engineers who were designing buildings in iron, but also time to test and refine his own ideas. Together, these experiences surely forged a decisive foundation for his independent career, formulating his progressive conception of iron, structure and architecture.

In 1858 Ordish tendered his resignation with the Admiralty and went into private practice at 18 Great George Street, Westminster. From then on, 'he was constantly being consulted by architects and engineers on questions of detail ... his courteous manner, and his readiness at all times to give information to those who would take the trouble to consult him, [winning] for him a reputation as a kind friend and a willing adviser'.[97] Initially in partnership with a Mr. Dewdney, his subsequent alliance with William Henry Le Feuvre (fl. 1858-96) marked the beginning of his productive and creative acme. During their partnership from *c*.1861 to 1867,[98] Messrs Ordish & Le Feuvre were responsible for some of the most accomplished and iconic iron structures of the nineteenth-century: bridges, exhibition halls, winter gardens, market halls, railway stations and prefabricated buildings for export. Both men were members and one-time presidents of the Society of Engineers throughout this period,[99] but it was unquestionably Ordish who possessed the greater talent and authorial voice. The partnership ended in September 1867, quite possibly as a result of legal action brought by the Patent Plumbago Crucible Company, and Handysides, regarding overpayment of fees and accusations of financial impropriety on the part of Le Feuvre.[100] From then until *c*.1874[101] Ordish, with a coterie of assistants, appears to have worked alone as a consulting engineer from his Great George Street premises, his solid reputation ensuring a near-constant supply of work. The number of projects he worked on during the 1860s and 1870s was truly phenomenal, and saw him working alongside the foremost architects, engineers and ironwork contractors of the day including Owen Jones (1809-74), George Gilbert Scott (1811-87), William Henry Barlow (1812-1902), Max

am Ende, Ewing Matheson (1840-1917), and Andrew Handyside & Co. Many of these projects, such as the railway stations in Amsterdam (1863),[102] Glasgow (1876) and London (St. Pancras),[103] the Dublin Exhibition (1865) (Fig. 16),[104] the Albert[105] and Franz-Josef[106] suspension bridges (1871-3 and 1865-8, respectively) and the dome of the Royal Albert Hall (1869-71)[107] are familiar. Others, such as the restoration of the roof over the chapter house at Westminster Abbey, the Leeds Infirmary Winter Garden Roof (1868),[108] bridges in Singapore,[109] Russia and Georgia,[110] the Nictheroy Gasworks roof, Rio de Janeiro (1869),[111] the Cape Town Railway Station roof,[112] the ironwork for the Buxton Sanatorium and the Holloway College, Egham (1879 to 1887, W.H. Crossland architect) are perhaps less well known.

Despite the string of commissions, Ordish failed to capitalise on the opportunities they presented for self-promotion and advancement. Frequently invited to join professional and scientific institutions besides those two he had joined (the Society of Engineers and the Society of Arts), he never accepted, having 'little or no taste for society, which he shunned rather than courted'. *Engineering* lamented that because of this, 'however regrettable, it is not altogether surprising to find that, with slackening times, Mr. Ordish's professional engagements slackened also'.[113] For his last five years, marred by ill-health, Ordish worked for engineering contractors Dennett and Ingle, of No. 5 Whitehall. Little is known of his work during this period, but one of the major projects he worked on was the Pandora Theatre, Leicester Square (1882-84, demolished 1927 for Empire Cinema). The architect, Frank T. Verity (1864-1937) drafted Ordish to design the structural ironwork, including exactly calculated wrought-iron cantilever girders supporting the balconies.[114] One of the last buildings Ordish worked on, in collaboration with H. H. Collins, was a building at the corner of Haymarket and Coventry Street - the first block erected in the Piccadilly Improvement Scheme.[115]

Ordish never reached the front rank of the engineering profession, and was little known outside of it. *The Engineer* nonetheless proclaimed him 'the ablest and most original engineer in this country for all matters of structure during the last twenty years'.[116] His strengths as a draughtsman

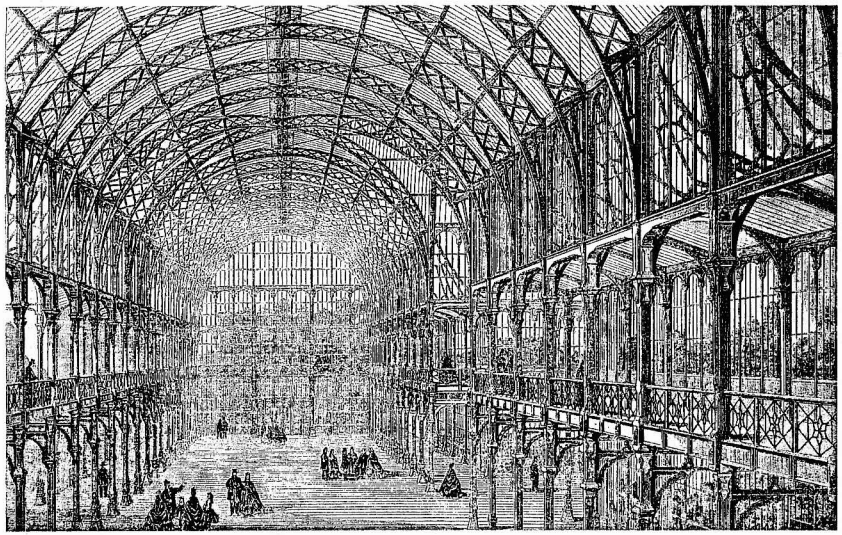

Figure 16. Ordish's Dublin Exhibition, as depicted in *The Builder*, 22 April 1865.

and surveyor were manifold, from the neatness of his assiduously dimensioned and annotated drawings to a remarkable ability for mentally estimating quantities. As a designer he was gifted with 'a marvellous feeling for strength and proportion in the materials he handled ... a man of fertile resource, hardly ever repeating himself, and able to solve difficult engineering problems where no one else could see a way of doing so'.[117] Wherever possible, he worked graphically in the calculation of stresses, but he also appreciated mathematical analysis. He also possessed an uncommon aptitude for imbuing his works with architectural flair that won the plaudits of the architectural profession. *The Architect*, which had welcomed Ordish's articles on the importance of co-operation among architects and engineers, noted that 'there were few men more closely associated with the history of iron construction in our time'.[118] The historical legacy of his works was perhaps equalled by his influence on the succeeding generation of engineers, itself testimony to the man's willingness to impart his knowledge and give credit to the most junior of his pupils. *The Builder's* obituary noted 'There are numbers of his old pupils now about Westminster, and holding good positions in the country and abroad, who owe their practical knowledge of ironwork to the experience gained in Mr. Ordish's office'.[119] Two of these, Max am Ende,[120] and Perry Fairfax Nursey (see below) are known, but many other figures of consequence to late-nineteenth and early-nineteenth-century structural engineering doubtless await disclosure.

The Phoenix Foundry Company, Derby

In 1834 James Haywood established the Phoenix Foundry in Derby, situated on the banks of the River Derwent at Exeter Street and Nottingham Street. This modest-sized works was always disadvantaged in being sited away from railway sidings, but the company nevertheless assumed an enviable reputation among Derby's numerous foundries and constructional engineering firms. The trade directories suggest that initially, James Haywood, together with his brother and partner, George Haywood, diversified into many manufacturing aspects: ornamental brass and ironwork, agricultural implements, cutlery and general ironmongery. However, it is the design and construction of structures that concerns us here, and it is in this capacity that the firm excelled from the 1840s. One of its earliest big contracts was for the constructional cast-iron work in the four galleries enclosing the court of the third Royal Exchange, London (1841-44, Sir William Tite, architect), another was for the construction of a series of cast-iron bridges in London in 1848-9 for the London and South Western Railway, marking that company's inauguration. Prefabricated in Derby, the components were transported directly by canal to their respective sites.

Through the 1850s and 1860s, the company constructed numerous wide-span iron enclosures to the designs of leading engineers and architects. Market Halls were one such application, and beginning with Britain's first of iron, the 422ft-long, 244ft-span Smithfield Market, Manchester (1854, William Fairbairn, engineer), they erected many more, including Market Hall, Stockport (1861, H. Lloyd, architect), Wolverhampton Market (1853, G.T. Robinson, architect), Market Hall, Derby (1866, Ordish & Le Feuvre, engineers),[121] and London's massive Columbia Market (1866-9, Henry A. Darbishire, architect). These decades also saw Phoenix vigorously engaged with industrial buildings (gas works, goods sheds, warehouses and so forth), triangulated and arched roof structures, and bridges. The erection in 1854 of the first iron bridge to span the Egyptian Nile, at Kafr-el-Zayat, to designs by Robert Stephenson, launched the firm's reputation in the overseas market for prefabricated bridges. Phoenix's standing in this area was confirmed by one of their largest ever contracts, a series of Warren Girder bridges for the Great Indian Peninsular Railway, built in the early 1860s.

Watson's Esplanade Hotel was the Phoenix Foundry Company's first foray into iron skeleton construction for buildings, but not its only one. In 1869 the firm erected a four-storey shop at No.

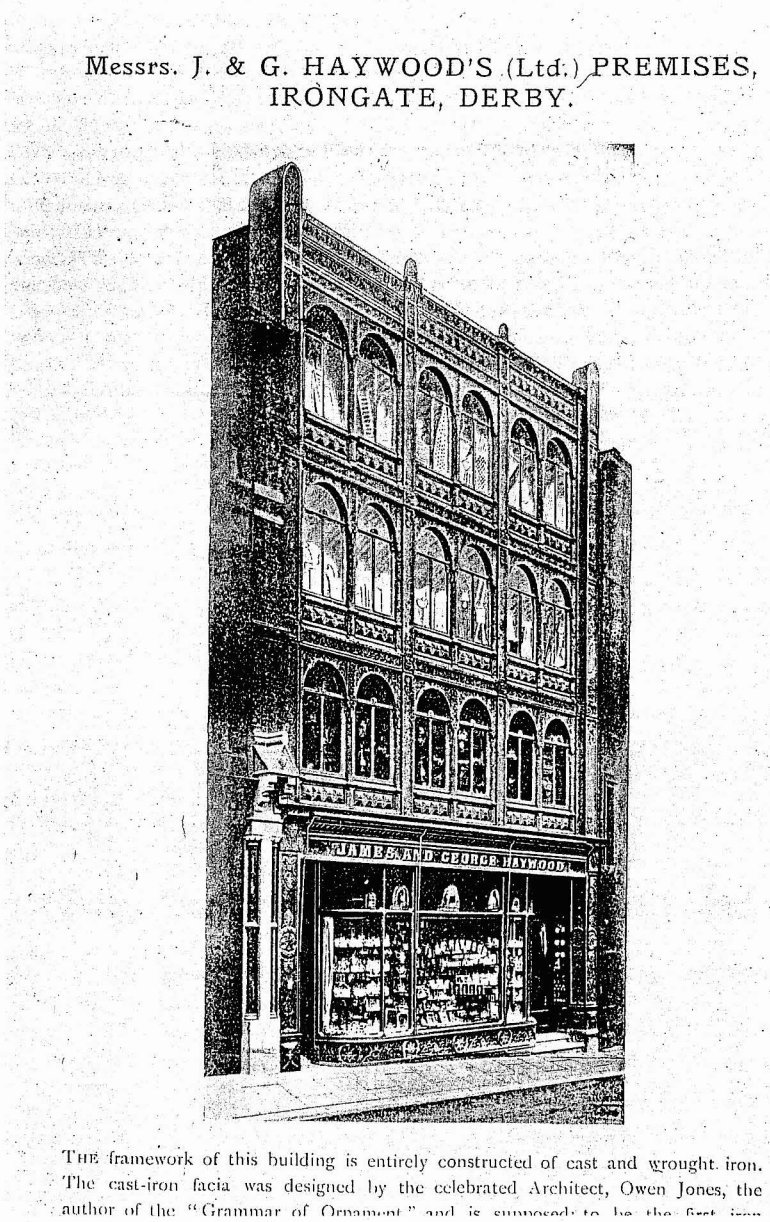

Figure 17. Fully-framed shop erected by Phoenix in 1869, as illustrated in the Phonenix Foundry company's Catalogue c. 1904.

2 Irongate in the centre of Derby to serve as an extension to their market-place premises (opened 1871, demolished 1920s) (Fig. 17). The ornamental cast-iron shop-front, emblazoned with 'James and George Haywood', was designed by Owen Jones, who may also have had some input into the structural design, given his aptitude in this area.[122] *The Architect* however credited James Haywood with the engineering, noting 'The example under notice is a decided success, and Messrs. Haywood deserve credit for thus effectively developing the system of iron architecture, which is gradually growing up in our midst'.[123] Yet this building, and a number of iron-framed warehouses seemingly built for the company, were the result of a collaborative effort in which Ordish,[124] with the assistance of Perry Fairfax Nursey (1830-1907), played a key role. Nursey, an engineer of polymathic abilities best known for his work on mining and explosives, had worked in the office of Ordish & Le Feuvre from 1862-4.[125] In 1878 he wrote 'Some ten years since Messrs Haywood, of Derby, engineers and ironfounders, erected extensive stores and premises, which I had something to do, in that town'.[126] Whether Fairfax was at this time a staff member of the firm is unclear, but in any case it seems likely that Phoenix had a large in-house team of skilled designers responsible for the majority of its work. Certainly, the company could draw on the expertise of the brothers Alfred and Frederick Davis (1843-1900) who later became partners in the firm. In this respect, as in many others, it was like its more renowned competitor, Andrew Handyside & Co.

Phoenix do not seem to have specialised in portable, demountable buildings for the export market like so many other ironwork companies did at mid century. But, like Handysides, whose exported buildings reached a creative zenith in terms of decorative expressiveness from about 1860 to the early 1880s,[127] Phoenix too had its own heyday in this regard, albeit earlier. Watson's Esplanade Hotel, the Derby premises, and the market halls - largely products of the 1850s and 1860s - rank amongst the company's most articulate and eloquent expositions of iron architecture. Thereafter, as iron was increasingly driven 'underground' in response to changing philosophical dictates and concerns over fire safety, construction of a more utilitarian nature seems to have become the company's hallmark. By the late nineteenth century it was building power stations, docks, harbours, hydraulic lift bridges and so forth for the home and export market, and works of a more representational nature, such as Halifax New Markets (1895, Leeming & Leeming, architects) were by far the minority. Exactly when the company folded has not been established, but its distance from the railway was ultimately its downfall. The *Derby Mercury* gave this as its coda: 'It was unfortunate that those responsible for its growth lacked foresight in allowing a heavy engineering concern to develop on a site surrounded by insurmountable obstacles. One impression that lingers is the inspiring sight frequently seen in the early hours, when huge pieces of work were being drawn from the yard to the railway by long double teams of horses.'[128]

John Hudson Watson (1818-1871)

Figure 18. John Hudson Watson (1818-1871) (Sanjit Narwekar).

John Hudson Watson (Fig. 18) was born in 1818 in the village of Castle Carrock, Cumberland, some 11 miles east of Carlisle. The first son of John Watson (1790-1880), a yeoman farmer, and his wife Jane Hudson (c.1783-1826), he and his siblings Margaret (1817-1900), Peggy (b.1820), William (b.1822) and Joseph (b.1826) spent their childhood in Gelt House, one of a number of substantial properties in Castle Carrock owned by the Watson family. John Hudson Watson may have continued the family farming

tradition in his early working life, but in the 1840s, following his marriage to Hannah Mariah Proctor (1816 or 1817-1875) in 1841,[129] he and his brother William moved to London, setting up a drapery business at No. 428 Oxford Street and Moorgate Street Chambers.[130] This change in occupational direction may have been influenced by John Hudson Watson's American-born uncle, James Watson, who was a draper. In *c.*1853 John and brother William emigrated to Bombay, setting up as silk mercers, and clothiers in Hummun Street, Fort. The following year they formed a partnership under the name J. & W. Watson & Co., and, in 1856, two of John and Hannah's children, James Proctor Watson (1843-1923) and John Watson junior (unknown dates) joined the firm as assistants. The business flourished, and in the early 1860s J. & W. Watson & Co. opened additional tailoring premises in Meadow Street and Churchgate Street, Fort, which continued to function alongside the new showpiece premises on the ground floor of Watson's Hotel.[131]

John Hudson Watson was, by all accounts, a man of great enterprise and sagacity. One example of this was that in February 1870, with the hotel structurally complete but formally unopened, Watson capitalised on the much-anticipated Bombay visit of Queen Victoria's second son, the Duke of Edinburgh. He charged Rs20 per ticket for viewing the magnificent firework display at Backbay from the lofty vantage of the hotel's terrace.[132] By this date John Hudson Watson was almost certainly living in the hotel, but it may be that he never witnessed the building's formal opening in February 1871. Sometime in 1869 or 1870 he purchased and took up residence in a speculative villa in Fellows Road, South Hampstead. The move back to England may have been prompted by failing health, and it was at 'Sebergham Villa' that he died on 12 May 1871. His wife died four years later in the same house, and both were buried alongside the other Watsons in St Peter's Church, Castle Carrock.[133]

William Watson appears to have extricated himself from the drapery business in the early 1860s, setting up his own business in 1867 as a general shipping agent in Bombay under the name William Watson & Co. The company thrived, becoming an international concern with offices around the world, until 1904 when it was forced into liquidation, the result of a lawsuit brought against it for illegally trading with the Maharajah of Patiala.[134] It was thus James Proctor Watson and John Watson junior who oversaw the drapery and hotel business following the death of their father.

James Proctor Watson, and his wife Clara returned to Castle Carrock as gentry *c.*1896, taking up residence in Garth Marr, a large 17th-century farmhouse flaunting beautifully carved hardwood ceiling joists imported from India. The following year he had built the 'The Watson Institute', an educational building for the community housing an artist's impression of what Ordish's preliminary mansard-roofed design would have looked like (Fig. 4). With the title 'The John Watson Building, Bombay, India', and the caption signed 'J.P.W.', this rendition of a more imposing building than that built was probably commissioned *c.*1896 in his father's honour. Previously, James had funded the restoration of St Peter's Church, including the stained-glass east window, inscribed underneath 'To the memory of John and Hannah Mariah Watson of Gelt Hall, erected by their son James and daughter Elizabeth, A.D. 1888'.

Watson, Ordish and Phoenix

How these three main agents came together to produce such an exceptional building is a question of considerable historical interest, the answer to which remains incomplete. An earlier connection between Ordish and Phoenix seems clear, but that between them and Watson is more problematic and speculative. Ordish was almost certainly in working contact with Phoenix by the early 1850s, when he was collaborating with Sir Charles Fox. One of their projects, a three-span cast-iron tubular bridge for the Queensland Railway may have been prefabricated and exported by Phoenix.[135] Among Phoenix's list of (undated) works executed, the trade catalogues mention 'Queensland Government Railway - Bridges'. The same source also records that Phoenix had executed roofs for

H.M. Dockyard, Chatham, and it seems likely that Ordish was in communication with Haywood, or other representatives of Phoenix either in his employ of Fox Henderson or the Admiralty. Certainly, by 1865-66 at the very latest, Ordish and Haywood were collaborating, working together on the design and construction of the wrought-iron roof of the Market Hall, Derby. There is some suggestion that Ordish & Le Feuvre stopped working with Handysides around this time because of a legal dispute,[136] so it could be that Ordish privileged Phoenix for the Watson contract. Given that Ordish and Nursey subsequently worked on Haywood's Derby premises there is every implication that their working and personal relationship was a happy one.

John Hudson Watson is an elusive figure and the mechanism by which Ordish and Phoenix came into his orbit remains unknown. Ordish's involvement with Bombay during the mid-1860s seems a likely route. We know that Ordish and Le Feuvre worked on the structural detailing of Handyside's celebrated 'Iron Kiosk' or smoking lounge, designed by Owen Jones (1865-66) (Fig. 19).[137] Destined for Bombay as part of that city's proposed but unrealised International Exhibition,[138] this speculative venture fell victim to the economic crash and never reached India. It remained standing on land previously used for the 1862 Exhibition on the south side of the Royal Horticultural Society's gardens in South Kensington until at least June 1869,[139] but thereafter its fate remains a mystery. Around this time, Ordish and Le Feuvre were contracted by the Bombay PWD to design a long iron roof to cover the Wellington Pier, a fashionable resort frequented by promenading equestrians and pedestrians. Much of this elegant structure, prefabricated by Handysides, was standing by October 1867.[140]

To suggest that Watson became aware of Ordish through either or both of these commissions is problematic; the former never reached Bombay, and the latter seems too late. Conceivably, Ordish & Le Feuvre may have submitted tenders for the unrealised Bombay exhibition building itself,[141] which might have been financially supported by business leaders like Watson. Perhaps Watson, whilst on business in London, had simply looked up, or been recommended, an engineer capable of designing a multi-storey building in iron. Perhaps he had been an admirer of the Great Exhibition,

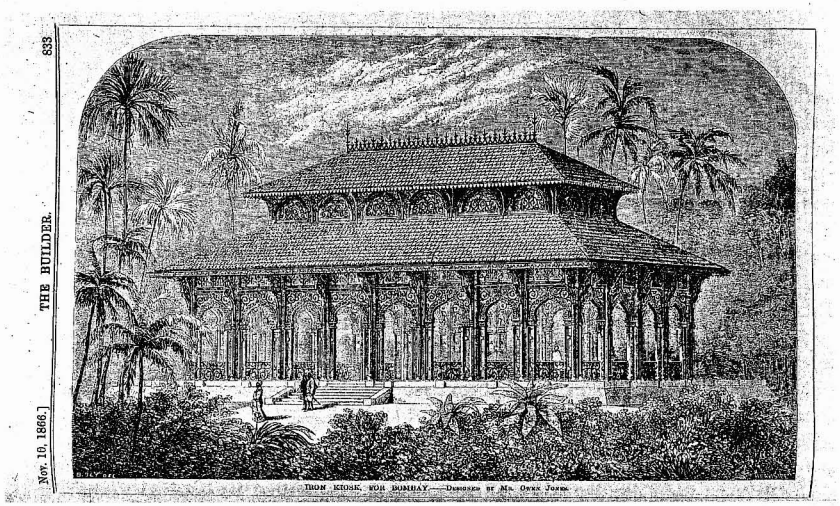

Figure 19. Handysides celebrated 'Iron Kiosk' for Bombay: designed by Owen Jones and Ordish & Le Feuvre (1865-6), it never left Britain. (*The Builder*, 10 November 1866).

and wanted something that was constructionally similar. Whatever the circumstances, it seems likely that Watson found Ordish, who in turn appointed or recommended Phoenix.

Watson's Hotel in the context of mid-nineteenth-century prefabricated buildings: a cut above the rest

From the first appearance of military dwellings, barracks and hospitals in the 1820s,[142] the design and manufacture of prefabricated iron buildings for the colonies became a commercial enterprise, growing to phenomenal proportions by the mid nineteenth century. Iron houses, churches, hospitals, warehouses and factories were exported in huge quantities by pioneering companies such as Richard Walker, John Porter, Edward T. Bellhouse and Samuel Hemming.[143] Exploiting a niche where local building materials and skills were deemed inadequate to meet the recurrent demands for such buildings, many evolved ingenious and sophisticated structural systems tailored around the exigencies of climate, portability, demountability and ease of re-erection. Whilst Watson's Hotel can be placed broadly on this canvas (its design was influenced by the need for ventilation and shade, and it was reliant on imported structural iron and expertise) it was exceptional in a number of important respects.

First, in scale and massing it was unequalled. Gilbert Herbert's classic work cites a number of substantial prefabricated iron buildings from the catalogues of nineteenth-century ironfounders, yet none of these were built to a height exceeding three stories. Although the reason for this is probably more a question of local availability of sufficiently large 'footprints' of land than technological proficiency, it is nonetheless symptomatic of the extraordinary nature of the Watson's project. More significantly, Watson's structural design, whilst based on a repetitive modular system, was almost certainly never influenced by the customary concerns of demountability and portability. A designedly permanent, specific solution tailored to unusually illustrious local circumstances, it was probably initially never intended to be repeated on further occasions, despite John Watson's subsequent attempt to invoke it for the rebuilding of his Churchgate Street premises in June 1869. Allied to this was the degree of investment in architectural form and character. Simply by eschewing corrugated iron - a material much vilified by the 1860s and synonymous with cheap prefabrication, utilitarianism and temporaneity - in favour of brick, Watson's proclaimed an architectural identity that at least demanded attention, if not respect. Such an explicit, logical combination of structural form and materials - brick panels set within a grid of loadbearing iron - had possibly only been tried on this scale once before, at the St. Ouen Docks warehouse, Paris (1864-5) (Fig.20). Unlike that building, and the majority of prefabricated iron buildings, Watson's was firmly within the public gaze. Few, if any, exported prefabricated buildings had to meet the exacting architectural and planning requirements demanded by the functionaries of 1860s Bombay, and hence few came close to Watson's representational scale and handling. Lastly, Watson's boasted the signature of probably the leading engineer of the day involved with structural ironwork. The great majority of prefabricated buildings were designed 'in house' by the staff of those companies who specialised in this field, such as Handysides, Charles D. Young, and those referred to above. Certainly, there are some instances where engineers or architects were the principal authors, including Fairbairn's Turkish Corn mill (1840),[144] Mathew Digby Wyatt's proposed corrugated iron church for the East India Company (1857-8),[145] J & R Fisher's Queensland railway station buildings for Sir Charles Fox & Son (as agents of the Queensland Government) (*c*.1867),[146] and an elaborate market for Santiago, Chile, designed by the engineer Edward Woods and the architects Goodman and Driver (1869).[147] But within this select grouping, Watson's Hotel survives as the only multi-storey, fully framed building, arguably the most ambitious and technically accomplished of all the exported buildings of the nineteenth century.

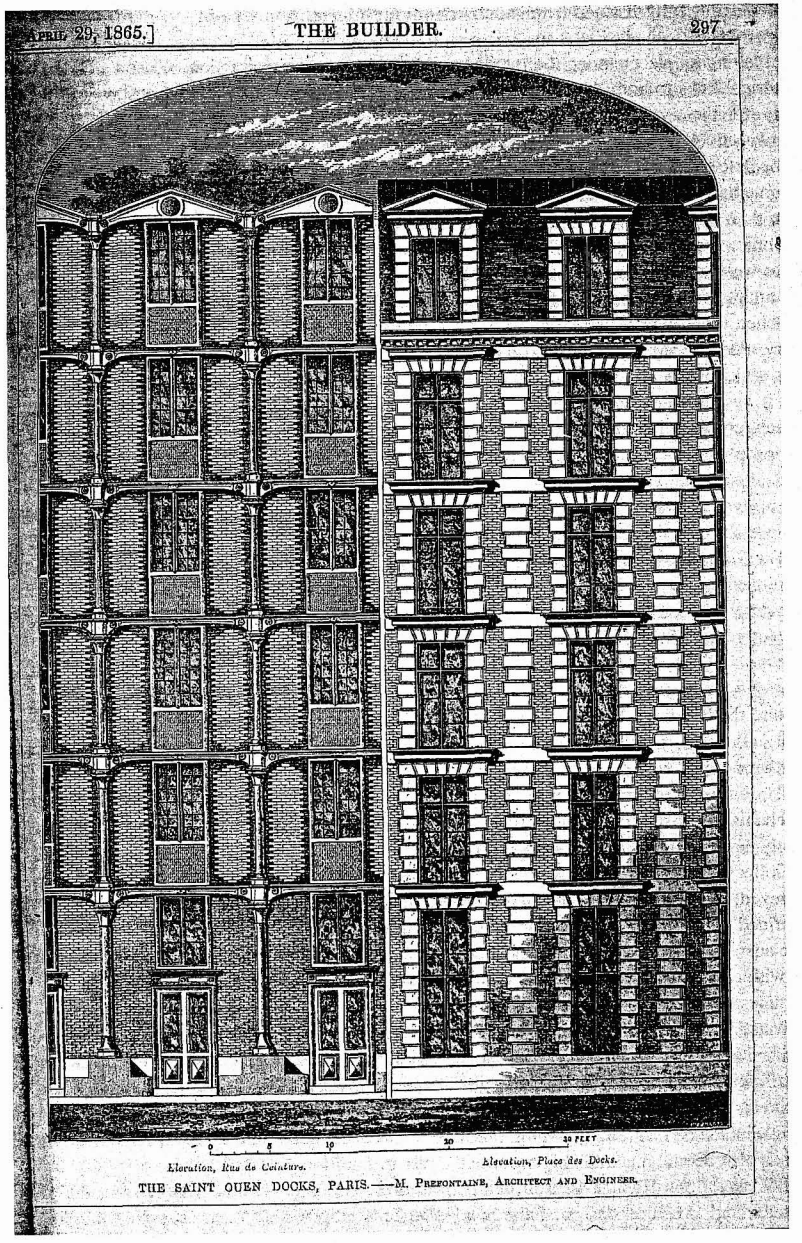

Figure 20. Fontaine's St. Ouen Docks warehouse (1864-5), as depicted *The Builder*, 29 April 1865.

Mid-century fully-framed iron construction: an intermittent legacy

In taking its place among the familiar milestones of iron construction, Watson's Hotel, with its historical links to both the Crystal Palace and the Sheerness Boat Store, contributes to the wider story of the evolution of multi-storeyed, fully framed building. Taken collectively and retrospectively, these buildings, and others such as the St. Ouen Docks warehouse and the Menier Chocolate Factory, form a discernible lineage open to progressivist interpretation. Still, as Robert Thorne has pointed out, the 'problem posed by these major structures concerns their influence rather than their design . . . They were highly inventive yet they had few immediate progeny'.[148]

Some reasons have been advanced for this lack of direct repercussion. It has been shown that there were vacillations about the Crystal Palace on structural and aesthetic grounds, and that once the architectural profession - marginalised by the project - turned against it, a pervasive stigma was attached to systematic iron construction. There was certainly an element of this in the Watson's story. Despite the representational nature of Watson's Hotel, contemporary architectural opinion was divided, and it raised the hackles of many commentators aghast at its unabashed metal frame. Yet it was ultimately sanctioned by the people that mattered, the Bombay Public Works Department, which, composed largely of Royal and civil engineers, was arguably less bound by the 'anti-iron' philosophical dictates of the architectural establishment back in England. In this sense, the Watson's project arose by a kind of fluke, enabled by the progressive attitude of the PWD who saw it as a 'valuable experiment'. By contrast a permanently habitable commercial building flaunting its iron skeleton did not find a home in 1860s London, or Paris, or New York.

The Sheerness Boat Store remained unseen and unwritten about for almost a century, closeted from the public and architectural gaze within a naval dockyard.[149] Want or dearth of reportage by the popular, architectural or engineering press might also be advanced for other, lesser known examples of (ostensibly) fully framed construction, such as a remote paper mill near Aberdeen of 1871.[150] Watson's Hotel might arguably have suffered from lack of publicity. *The Architect* thought Watson's 'deserve[d] the attention of architects', yet was the only organ of the architectural press to feature the building. Nevertheless, with the exception of The Sheerness Boat store and the paper mill, all these buildings received varying degrees of coverage in contemporary literature. Furthermore, if we take into account the immediate influence of the earliest 'iron-framed' textile mills, built before professional journals and periodicals appeared, it seems clear that the mechanisms for the transmission of innovatory techniques were both many and complex and not solely dependent on the published word.

Collectively, these landmark trabeated buildings show that the technical ability to erect multi-storeyed, fully framed buildings existed in the third quarter of the nineteenth century, albeit largely confined within an elite coterie of structural engineers, engineering contractors and ironfounders. The answers to the question why the technique was not invoked more often probably have more to do with economics and expediency than any other root cause, although aesthetic and philosophical attitudes did matter to non-industrial buildings.[151]

Watson's Hotel was built on a skeleton frame, chiefly so that the interior partition walls could be reduced in thickness to non-bearing status, permitting an 18in. gap at their top to allow for cross-ventilation, and a greater amount of cubical space for bedrooms. Speed of erection was a major initial concern, but as the construction history of the building shows, in the event this was nullified by other factors, including planning obstacles. It became economically feasible to use iron as the principal structural material only because the cost of traditional materials in Bombay rose markedly, and because John Hudson Watson, the patron, was extremely wealthy. By reusing the ironwork patterns and structural design of the hotel, Watson's proposed duplicate structure on Churchgate Street might even have been highly cost-effective, had the authorities permitted it. The four-storey-shop at No. 2 Irongate, Derby, built for J & G Haywood, possibly to exhibit Phoenix's structural virtuosity, was extremely expensive, the cast-iron front alone costing £900, including patterns.[152] In this case however, the contractor's costs were borne in-house, and, speculatively, the same structural members and iron fascia were used in the associated warehouse development. A further example that may be cited is a six-storey warehouse in Tib Street, Manchester erected for Messrs John Rylands and Reuben Spencer (1878, demolished 1985). Fabricated by Messrs William and Sons of Stalybridge and erected by local contractors Messrs Robert Nield and Sons to the designs of engineer James Henry Lynde (1843-1919), *The Engineer* proclaimed 'this class of building' as 'altogether a new feature in Manchester'.[153] Apart from the brick rear wall, the building was ostensibly fully framed in cast iron, using columns and 1ft 9in. square E-section stanchions tied 'firmly together' by cast-iron girders and spandrel beams which carried the timber floors and iron fronts.[154] Such a mode of construction enabled a saving in wall space (the window frames being within 6in. of the face of the building), and enabled the iron-fronted elevations to be glazed with large sheets of glass to admit maximum light, granting the owners a special tariff from the Fire Officers' Committee.[155] Yet all this was made economically practicable by the then low current price of iron, and the economies of scale of using repetitive structural elements on such a large scale (the building covered some 600 square yards).[156]

Before American developments of the 1880s and 1890s, full iron framing for multi-storey buildings was invoked only under highly unusual conditions, involving a delicate interplay of economic, technological, practical and aesthetic factors. The increasing adoption of structural wrought iron from the 1850s permitted stiffer frames better able to resist bending and shear stresses, but material and fabrication costs were perhaps the most important disincentive to constructing entire buildings around them. In Britain, despite the influx of cheaper rolled iron joists and built-up girders from the continent, it was not until the end of the century, when British manufacturers finally began producing structural steel sections cheaply and in bulk that fully-framed metal construction finally had the potential to become an economically feasible alternative to traditional methods. The other most important, and related, factor was expediency, and it seems clear that Marian Bowley's analysis of the retarded take up of steel frame and reinforced concrete in Britain can be applied to mid-century iron construction in the 'developed' world:

> [The] developments of modern steel frame construction and of reinforced concrete were not necessary to fulfil any obvious requirements in the country in the late nineteenth century. They offered new and better ways of providing buildings to perform functions already performed by existing buildings'.[157]

Watson's Esplanade Hotel was the result of unusual pragmatism, a rare convergence of individuals and circumstances on the other side of the world, as important for what it tells us about what did not happen as it is for what it tells us about what did happen.

Acknowledgements

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References

1. James Douglas, *Bombay and Western India: A Series of Stray Papers* (2 vols., 1893), 1, p. 218.
2. Contribution by unidentified correspondent ('M.N') entitled 'Past Architecture and Present Building', railing against Bombay's new architecture. *The Bombay Builder* (5 September 1867), p. 92.
3. Letter entitled 'Architecture in Bombay', also denunciating the city's new architecture, signed 'A.R.I.B.A.'. *The Times of India* (5 October 1869), p. 2. This may well be the first use of the expression 'skeleton' applied in the context of an iron-framed building. Three years earlier German-born Olaus Magnus Friedrich Erdmann Henrici had written a book using the expression 'skeleton structure', but only in the context of metal truss bridges. See Sarah Bradford Landau and Carl W. Condit, *Rise of the New York Skyscraper 1865-1913* (London and New Haven, 1996), p. 22.
4. Christopher Walter London, 'British Architecture in Victorian Bombay', (Ph.D. thesis, University of Oxford, 1986), pp. 109-114. The belief that the patron, John Watson was the designer - still pervasive in Mumbai today - possibly stems from Sir D.E. Wacha's observation that Watson 'was not only the proprietor but also the architect, engineer and builder of the hotel.' Sir D. E. Wacha, *Shells from the Sands Of Bombay: being my recollections and reminiscences 1860-1875* (1920), p. 298.
5. M. Meade, J. Fitchett, and A. Lawrence, *Grand Oriental Hotels* (1987), p. 21.
6. P. Davies, *The Penguin Guide to the Monuments of India* (1989), p. 444: 'It was the first iron-framed building in Bombay and caused a sensation when it was built on the former Esplanade'.
7. G. Tindall, *City of Gold: The biography of Bombay* (2nd ed., 1991), p. 13: 'it was the first iron-framed building constructed in Bombay'.
8. N. Evenson, *The Indian Metropolis: A View Toward the West* (Yale, 1989), pp. 164-5.
9. Poster produced by the Rizvi College of Architecture, Bandra, Mumbai (1997).
10. The Phoenix Foundry Company Limited, Derby, England (trade catalogues, c.1897 and c.1904), held in the British Library, shelf mark MF 75Y.
11. T. C. Bannister, 'Bogardus revisited. Part II: The iron towers', *Journal of the Society of Architectural Historians,* 16 (1957), pp. 11-19.
12. A.W. Skempton, 'The Boat Store, Sheerness (1858-60) and its place in structural history', *Transactions of the Newcomen Society,* 32 (1959-60), pp. 57-78; A. W. Skempton, 'Evolution of the Steel Frame Building', *The Guilds Engineer,* 10 (1959), pp. 36-51.
13. G.R. Larson and R.M. Geraniotis, 'Toward a better understanding of the evolution of the iron skeleton frame in Chicago', *Journal of the Society of Architectural Historians,* 46 (1987), pp. 39-48.
14. C. W. Condit, 'The two centuries of technical evolution underlying the skyscraper', *Second Century of Skyscraper,* ed. Lynn S. Beedle (New York, 1988), pp. 11-24.
15. For a recent summation of these buildings, see R. J. Mainstone, *Developments in Structural Form* (2nd ed., 1998), pp. 294-97; See S. B. Landau and C. W. Condit, *Rise of the New York Skyscraper 1865-1913* (London and New Haven, 1996), p. 21

16. Skempton, 'The Boat Store', *TNS.*, p. 32.
17. Yet even that warehouse was far from the ideal of having all members of the frame encased by incombustible sheathing, a vital feature of the 1890s skyscraper. See Mainstone, *Developments,* p. 297.
18. *Bombay Saturday Review* (14 June 1862), pp. 237-8, quoted in M. Dossal, *Imperial Designs and Indian Realities: The Planning of Bombay City 1845-1975* (Delhi, 1991), p. 195.
19. P. Davies, *Splendours of the Raj* (1985), p. 156.
20. 'Sale of Building Land on The Esplanade', *The Bombay Gazette* (27 August 1864), p. 3.
21. Wacha, *Shells.*, p. 297.
22. 'Sale of Building Land on The Esplanade'.
23. Dossal, *Imperial.*, pp. 193-94.
24. John Gascoigne to James Trubshawe, 17 April 1865. PWD General Volume 52 (1865), Maharashtra State Archives (henceforth MSA).
25. *ibid.*
26. A 'JG', probably John Gascoigne, was C. J. Freake's clerk of works for the rebuilding of No. 40 Grosvenor Square in 1858-9, and for the building of Prince's Gardens, Knightsbridge, in 1858-60. I am grateful to John Greenacombe for this information. Whether these initials relate to the same John Gascoigne referred to here is not known.
27. 'On the 16th inst., Mr John Gascoigne (late of Bombay), civil engineer, at 8, Eilen-terrace, Battersea, after a short illness, deeply regretted.'. *The Times* (19 December 1867), p. 1.
28. Trubshawe to the Secretary to Government, PWD, 27 April 1865. PWD General Volume 52 (1865), MSA.
29. IOR/P/353/53 item No. 100 C.W./1059 (13 May 1865). A note dated 4 May 1865, signed with the initials 'AME', authorising the draft version of this resolution states 'I concur. I shall only be too glad to see anything built. While waiting for perfection, we get nothing done'. Presumably written by one of the senior functionaries within the PWD, it betrays a degree of irritation at Trubshawe's perfectionist obstructions. PWD General Volume 52 (1865), MSA.
30. In this respect, Gillian Tindall wrote 'its cast-iron pillars and tiers of wrought-iron galleries are reminiscent of French nineteenth-century colonial architecture, but its true genesis is probably the many-tiered wooden Gujerati house of which Bombay can still provide examples.' Tindall, *Gold,* p. 13.
31. J. Trubshawe to the Secretary to Government, PWD, 23 May 1865. PWD General Volume 52 (1865), MSA.
32. J & W Watson & Co. to J. S. Chapman, 26 October 1865. PWD General Volume 52 (1865), MSA.
33. Report No. 2596 of 16 November 1865 (signatures indecipherable), PWD General Volume 52 (1865), MSA.
34. Wacha, *Shells,* p. 297.
35. 'Plan Shewing site of Proposed Hotel, Bombay', lithographed in the Office of the Superintending Engineer, P.D. Bombay 19 May 1864 (IOR/X/2637/2). This plan, presumably drawn up under the supervision of either Lieutenant-Colonel James Augustus Fuller (1828-1902) or Trubshawe, was sent to London, with a request that the accompanying draft advertisement be publicised in the newspapers. Giving notification for the auction of a two-acre plot of land 'on which is to be built a first-class Hotel to contain not less than 200 bedrooms', this superseded an earlier advertisement included in a despatch from Bombay to London, dated 14 December 1863. It is unclear who purchased the land, but throughout 1864 and 1865 the government was in negotiation with the Western India Hotel Company over possible sites and designs. See IOR/P/353/52 and IOR/P/353/53.

36. IOR/P/353/52 item No. 2108 (4 November 1864).
37. 'Government regret they cannot approve of the new design submitted by Messrs. Watson and Co. for their houses on lots Nos. 11 and 12, Esplanade, which adjoins the Sassoon Mechanic's Institute Hall, and other public buildings, but being unwilling to throw on Messrs. Watson and Co. the loss that would otherwise be entailed if *the structure now on its way out* were not permitted to be built, will give them the choice of any unoccupied plots on a cross road where their shop would not be in juxtaposition with any of the proposed public edifices [emphasis added]'. IOR/P/441/64 item No. 98 C.W./216 (3 February 1866).
38. See IOR/P/441/64 item No. 123 C.W./740 (24 April 1866).
39. IOR/P/441/64 item No. 789 C.W./1785 (4 September 1866).
40. Captain Finch, R.E. acted as Architectural Executive Engineer to Government on behalf of Lieut. Col. Fuller, R.E., during much of 1867. By 5 December 1867, Fuller returned from furlough to resume his former position, and Finch temporarily replaced Colonel Wilkins as Executive Engineer for the Bombay Harbour Defences. *The Bombay Builder*, (5 December 1867), p. 72.
41. Trubshawe was not 'anti-iron' *per se*, merely against its use for permanent architecture. Both he and 'tropical' architect T. Roger Smith (see note 49) drew up the specifications for the unrealised Bombay International Exhibition building. This huge, modular, cross-shaped edifice, 880 feet long and 200 feet wide was to have been made up of 12 interconnecting blocks, 'so designed as to admit of being re-erected separately for various uses, after the building has served its present purpose'. The architects 'proposed to construct the framework of the building of iron columns properly connected by girders or trusses and firmly braced and tied together'. Bombay International Exhibition, January 1865. PWD Volume 25 (1865), MSA.
42. *The Bombay Gazette* (2 January 1867), p. 2: 'We understand that Messrs. J.W. Watson and Co. intend building a first class hotel on the site of land on the Esplanade purchased by them in August 1864... Nearly the whole of the building materials are to be sent out from England, but a good deal of the materials has been for some time on the ground... '.
43. *The Bombay Gazette Overland Summary* (28 Jan to 13 Feb 1867), p. 3: 'We have been shown plans of the hotel.... The erection is to have an iron framework, which like all the other materials required is coming from England. Indeed the stone and bricks have already been brought from England, and are now lying on the ground. English workmen have also been engaged to superintend the raising of the framework...'.
44. Thomas Thompson (1818-1882), a schoolmaster then land steward, married Margaret Watson (1820-1900) in 1845. I am grateful to John Thompson for sending me a copy of his family tree.
45. *The Bombay Gazette Overland Summary*, p. 3.
46. *ibid.*
47. IOR/P/441/67 item No. 743 C.W./2144 (2 September 1867).
48. See opening two quotations and corresponding notes.
49. One of the London architects Ordish consulted may have been Thomas Roger Smith (1830-1903), a recognised authority in designing buildings for the tropics. See T. Roger Smith, 'On Buildings for European Occupation in Tropical Climates, Especially India', *The Builder* (2 May 1868), pp. 311-13; (16 May 1868), pp. 349-50 (republished from a paper read at the RIBA, 27 April 1868). Smith was responsible for the designs of the European General Hospital, Bombay (1864-69), won in competition. See *The Builder* (5 November 1864), pp. 809-11.
50. R. Ordish to Captain Finch, 8 October 1867. This hand-written copy of Ordish's letter, presumably reproduced by one of the clerks within the PWD, shows that Ordish was in London at this time, the address given being '18 Great George Street, Westminster S.W.'. PWD General Volume 32 (1867), MSA.
51. IOR/P/441/67 item No. 928 C.W./2841 (26 November 1867).
52. *The Bombay Builder* (6 January 1868), p. 236.
53. John Watson (by his attorney J.P. Watson) to J.A. Fuller, 28 June 1869. PWD General Volume 503 (1868-89), MSA.
54. J.A. Fuller to W. Kendall, 5 July 1869. PWD General Volume 503 (1868-89), MSA.
55. IOR/P/441/69 item No. 775 C.W./2409 (7 October 1869).
56. IOR/P/441/69 item No. 872 C.W./2685 (13 November 1869).
57. *The Architect* (11 December 1869), p. 286
58. *The Architect* (18 December 1869), p. 298
59. *The Times of India* (14 February 1870), p. 2.
60. John Thompson to J.A. Fuller, 3 May 1871. PWD General Volume 503 (1868-89), MSA: 'We regret that we have been unable to finish it in the time specified but delay in the arrival of Iron work from England and the omission of some being sent which we had to get cast here have thrown us back considerably with the work.'.
61. Founded in 1858 by Noble Carr Richardson, Richardson & Robson (subsequently Richardson & Crudas) started out as iron and brass founders, smiths and engineers, initially operating from the Byculla Ironworks in northern Bombay. An advertisement of 1869 shows the company were manufacturing girders and boilers, suggesting they could produce both cast and wrought iron sections by that date. Of the small handful of Bombay iron founders listed in directories for the period 1868-72, only this company were seemingly involved with heavy structural sections. For further information on this dominant firm, see Somerset Playne *et al, The Bombay Presidency, The United Provinces, The Punjab, Etc. Their History, People, Commerce, and Natural Resources* (1920), pp. 317-18; Richardson & Crudas, [Trade Catalogue, 1909].
62. In reply to *The Times of India* correspondent Tom Cringle's criticisms about his hotel, on 2 November 1870 John Hudson Watson penned a reply from The Esplanade Hotel. *The Times of India* (4 November 1870), p. 2.
63. John Watson to The Architectural Surveyor to Government, 10 January 1871 (handwritten copy of original letter), PWD General Volume 503 (1868-89), MSA.
64. Correspondence in PWD General Volume 503 (1868-89), MSA.
65. *The Bombay Gazette* (6 February 1871), p. 1. *The Architect* (22 April 1871), p. 214, restated this sentence verbatim, but omitted the words 'and ugly'.
66. *The Times of India* (14 February 1870), p. 2.
67. *The Bombay Gazette* (6 February 1871), p. 1.
68. J. M. Maclean, *A Guide to Bombay* (Bombay, 1875), p. 166.
69. *The Times of India* (14 February 1870), p. 2.
70. John Hudson Watson, writing from The Esplanade Hotel on 2 November 1870 pointed out 'There will be altogether over one hundred and twenty baths in the Hotel'. *The Times of India*, 4 November 1870, p. 2. Pevsner noted that in the mid-to-late nineteenth century Europe lagged behind America in the provision of bathrooms, and that Guyer could still write in 1885 that 'Bathrooms should not be totally absent in any good hotel'. Even London's Savoy (1884-89), which famously prompted the builder, Perry & Reed, to enquire whether the client was catering for amphibian guests, had just 67 bathrooms to over 400 rooms. N. Pevsner, *A History of Building Types* (1987), p. 186.
71. *The Bombay Gazette* (6 February 1871), p. 1.
72. Meade *et al., Hotels*, p. 21.
73. Tom Cringle, 'Architecture in Bombay', *The Times of India* (2 November 1870), p.2.

74. *The Times of India* (1 February 1871), p. 3.
75. *The Architect* (18 December 1869), p. 298.
76. 'Sitting at the bottom of the sand-trap, the memory of Watson's Hotel, with its swinging punkahs, white-robed attendants, and the sallow-faced Armenian, rose up in my mind as vividly as a photograph, and I burst into a loud fit of laughter. The contrast was too absurd!'. 'The Strange Ride of Morrowbie Jukes' in *The Man who would be King and other stories* (Oxford, 1999) p. 9 [originally published in 1889]. Watson's also receives mention in 'Yoked with an Unbeliever' in *Plain Tales from the Hills* [first published in the Civil and Military Gazette in 1886].
77. London, thesis, p. 112.
78. S. Narwekar, 'Mumbai's First "5-star" Hotel' [Web page http://members.rediff.com/narwekar. September 1999].
79. Tindall, *Gold*, p. 10.
80. S. Bhowmik, 'Heritage building's fight for survival', *The Mumbai Local* (11 December 2001), p. 17.
81. Detailed analysis of the structural design has not been possible, permission for recording being withheld, and archive drawings being unforthcoming. A limited measured survey was undertaken in 1997 by students of the Rizvi College of Architecture, Mumbai, but this leaves many questions of detail unanswered. The fact that the great majority of the building has been compartmentalised into private living and business spaces means that most of it is effectively off-limits for even casual inspection. A plethora of later modifications, including partition walls and boarding, suspended ceilings and plaster and cement covering to much of the ironwork, compounds the problem.
82. 'Articles of agreement for intended lessees of Esplanade plots', PWD General Volume 503 (1868-89), MSA (filed within Vol. 503, but probably originally drawn up in 1864).
83. Peters, *Building the Nineteenth Century* (Cambridge Mass and London) p. 248.
84. 'Articles of agreement for intended lessees of Esplanade plots'.
85. Cringle, 'Architecture', *The Times of India*, p. 2.
86. Peters, *Building*, pp. 234-36.
87. M. Higgs, 'The Exported Iron Buildings of Andrew Handyside & Co. of Derby', *Journal of the Society of Architectural Historians*, 24 (May 1970), pp. 175-180.
88. The Dublin International Exhibition building was probably the first structure of this class to dispense with diagonal bracing, relying fully on the rigidity of Ordish's connections which were 'carefully calculated to resist the various strains.' *The Builder* (22 April 1865), p. 281.
89. C. D. Elliot, *Technics and Architecture: The Development of Materials and Systems for Buildings* (Massachusetts, 1992), p. 86; J. S. Curl, *A Dictionary of Architecture* (Oxford, 1999), p. 466. Peters, *Building*, p. 226 & 262 makes brief mention of Ordish *vis-à-vis* The Crystal Palace and Fox and Henderson.
90. *Engineering* (17 September 1886), p. 298.
91. *ibid.*
92. *ibid.*
93. *ibid.*
94. *Engineering* (17 September 1886), p. 298.
95. *The Engineer* (17 September 1886), p. 233.
96. Given that the drawings of the Smithery at H.M. Dockyard, Sheerness (1856) - the immediate prototype of the Boat Store - have been lost, and thus unattributed, it may be that this was one of the first projects that Ordish worked on.
97. *The Builder* (18 September 1886), p. 412.

98. *Kelly's Post Office Directories* for 1859 and 1860 list both William Henry Le Feuvre and Rowland Mason Ordish separately as resident at 18 Great George Street, but for the period 1861 to 1867 their names are combined as Ordish & Le Feuvre. Following the dissolution of their partnership, Le Feuvre relocated to 107 Victoria Street (c.1868-9), then to 9 Dowgate Hill (c.1870-1), before settling at 26 Budge Row (c.1872-96).
99. Ordish became a member of the Society of Engineers in 1857, and held the office of president in 1860. In 1857 he read a paper on 'Suspension Bridges', and the following year one entitled 'The Forms and Strengths of Beams, Girders, and Trusses'. Le Feuvre became president of the same body in 1867.
100. 'Handyside V. Le Feuvre and Another', *The Times* (22 June 1869), p. 11; 'Morgan v. Ordish and Another - Over-Payment of Architects' Account', *The Architect* (17 December 1870), p. 353.
101. *Kelly's Post Office Directories* suggest that in the mid 1870s Ordish relocated to 2 Middle Scotland Yard, already occupied by John Robinson, architect, and Max Am Ende. His last mention is for 1881, thereafter he disappears from the directories. From c.1881, until his death, he worked for Dennett and Ingle.
102. See William Humber, *A Record of the Progress of Modern Engineering; comprising civil, mechanical, marine, hydraulic, ... and other engineering works, with essays and reviews*, (London, 1864), p. 23; Ewing Matheson, *Works in Iron. Bridge and Roof structures* (London, 1873), p. 269; *The Mechanics' Magazine* (16 March 1866), pp. 170-71; The Builder (7 January 1860), pp. 7-9.
103. In his description of the 240ft-span shed before the Institution of Civil Engineers, Barlow stated 'For the details of the roof the author is indebted to Mr. Ordish, whose practical knowledge and excellent suggestions enabled him, while adhering to the form, depth, and general design, to effect many improvements in its construction'. *Minutes of the Proceedings of the Institution of Civil Engineers*, 30 (1869-70), p. 82. At the station's opening, 'Mr Barlow stated publicly that the design of this roof was Mr. Ordish's'. *The Engineer* (17 September 1886) p. 233. See also *The Engineer*, May and June 1867, p. 484, 495, 505, 514 and 517; *Engineering*, (August 1867), p. 148; *The Mechanics' Magazine* (16 March 1866), p. 171; *The Architect* (6 February 1869), pp. 77-8.
104. See William Humber, *A Record.*, p. 39; *The Mechanics' Magazine* (9 March 1866), p. 149; *The Builder* (31 January 1863), pp. 80-1 and 22 April 1865, pp. 278-79, 281.
105. See *The Engineer*, October and November 1873, p. 281, 288, 301, 304, 316 and 322; *Engineering* (May 1871), p. 373; Matheson, *Works.*, p. 171; *The Mechanics' Magazine* (23 December 1864), p. 458; *The Builder* (15 April 1865), pp. 259-61.
106. Anticipating the cable-stayed form, this bridge was also notable for utilising steel suspension chains, supplied and erected by Messrs. Howell & Co. See *The Architect* (2 January 1869), pp. 7-8; *The Mechanics' Magazine* (27 April 1866), p. 263-5; *The Engineer*, (6 November 1868), pp. 343-80; W. Humber, *A practical treatise of cast and wrought-iron Bridges and Girders as applied to Railway structures, and to buildings generally, with numerous examples, etc..*, (3rd ed., 1870), p.258; Matheson, *Works*, p. 81.
107. The execution of this work, designed in conjunction with John William Grover (1836-92), was so exacting that when the scaffolding was removed, the roof sank just 5/16in. See *The Engineer* (31 March 1871), p. 221; *Engineering* (20 August 1869), p. 117.
108. See Matheson, *Works*, pp. 241-2 and *The Architect* (19 June 1869), p. 319. Designed as a winter garden for Sir George Gilbert Scott's Leeds Infirmary, this lofty roof was constructed as a rectangular dome without abutments or tie rods. Thereafter, until his death, Scott 'consulted Mr. Ordish on all important questions of structure'. *The Engineer* (17 September 1886), p. 233.

109. Like the Albert and Franz-Josef bridges, the Cavanagh Bridge, Singapore, was built on the straight-chain suspension system. It was fabricated by the Glasgow firm of P & W McLellan, and erected by that company in c.1868. A recent photograph of it appears in M. Lewis, 'The Asian Trade in Portable Buildings', *Fabrications*, 4 (June 1993), p. 49.
110. This 90ft-span cast and wrought-iron truss bridge, spanning the river Kura at Tiflis (Tblisi) was manufactured by Handysides, part of a series of road bridges in the Caucasus for the Russian Government. *The Architect* (24 September 1870), p. 174 & illustrations.
111. This beautifully detailed structure, erected by Handyside's, is illustrated in Matheson, *Works*, p. 256-58.
112. 'Station Buildings of Queensland Railways', *The Builder* (1 June 1867), p. 391 and 393.
113. *Engineering* (17 September 1886), p. 298.
114. A. W. Tanner, 'The construction of Theatres', *The Builder* (10 February 1883), pp. 190-93.
115. *The Builder* (3 September 1887), p. 345.
116. *The Engineer* (17 September 1886), p. 233.
117. *ibid.*
118. *The Architect* (17 September 1886), p. 159.
119. *The Builder* (18 September 1886), p. 412.
120. Max am Ende was Ordish's chief assistant during the construction of the roof of the Albert Hall, South Kensington. *The Engineer* (17 September 1886), p. 233.
121. See *The Mechanics' Magazine* (9 March 1866), pp. 149-50; The Builder (26 May 1866), p. 385-86.
122. See M. Darby and D. Van Zanten, 'Owen Jones's iron buildings of the 1850's', *Architectura* (1974), pp. 53-75.
123. *The Architect* (18 May 1872), p. 256.
124. Ordish's contribution was only acknowledged posthumously, in one obituary, which stated 'The Amsterdam railway station roof was also designed and put up by Mr. Ordish, as well as an iron-fronted house erected in Derby for Messrs. Haywood and Co.'. *Engineering* (17 September 1886), p. 298.
125. *Journal of the Iron and Steel Institute*, 78 (1907), p. 343; Transactions of the *Society of Engineers* (1907), pp. 245-6. Ordish would subsequently work conjointly with Nursey on a scheme for a double cast-iron tunnel railway on the bed of the English Channel between Dover and Cape Grinez, proposes in 1876. Engineering (17 September 1886), p. 298. The obituary in *Iron* restates this, but gives the date of proposal as 1867. Iron (17 September 1886), p. 265.
126. Letter entitled 'Iron Houses' and signed 'P.F.N.', *The Times*, 17 January 1878, p. 8. That the author is Perry Fairfax Nursey (a member and one-time Secretary and President of the Society of Engineers), is unequivocal: soon after, the Journal of the Iron and Steel Institute noted 'The Secretary of Society of Engineers, speaking of the use of iron for building, in a letter to the "Times," says that ten years since Messrs. Haywood, of Derby ...'. 'Iron for building purposes', *The Journal of the Iron and Steel Institute* (1878), p. 274.
127. Higgs, 'The Exported', *JSAH*, p. 175.
128. 'Lost Industries - Passing of Derby Engineering Firms', *Derby Mercury* (27 November 1925).
129. Much of this information is derived from John Thompson's family history research and T. Bulmer & Co., *History, Topography, and Directory of Cumberland* (Preston, 1901), pp. 174-76.
130. *Times of India Calendar and Directory* and *Kelly's Post Office Directories*, various editions covering 1860s and 1870s.
131. *The Bombay Almanack and Directory*, various editions covering the 1850s and 1860s.
132. S. Narwekar, ' 'Mumbai's First "5-star" Hotel'.

133. *The Carlisle Patriot* (19 May 1871) p. 8, (23 April 1875), p. 5.
134. *The Times*, (17 February 1904), p. 3, (2 February 1905), p. 13.
135. *The Engineer*, (17 September 1886), p. 299.
136.'Handyside V. Le Feuvre and Another', p. 11
137. See Higgs, 'The Exported'; *The Bombay Builder* (5 October 1867), p. 156; *The Mechanic's Magazine* (30 August 1867), p. 144.
138. *The Builder* (28 January 1865), p. 71, (11 February 1865), p. 168.
139. Handyside V. Le Feuvre and Another', p.11.
140. *The Engineer* (18 October 1867), p. 333; The Bombay Builder (5 October 1867), p. 126.
141. See note 41.
142. See J. Weiler, 'The Making of Collaborative Genius. Royal Engineers and Structural Iron 1820-1870' in R. Thorne, ed., *The Iron Revolution*: Architects, *Engineers and Structural Innovation 1780-1880* (a published collection of essays accompanying an Exhibition at the RIBA Heinz Gallery, June-July 1990), pp. 41-7.
143. See G. Herbert, *Pioneers of Prefabrication. The British Contribution in the Nineteenth Century* (Baltimore, 1978). Besides this classic study, other examples are given in Miles Lewis, 'Portable Buildings', *Fabrications*, p. 49.
144. Skempton, 'The Boat Store', p. 67; Herbert, *Pioneers*, pp. 41-2.
145. Herbert, *Pioneers*, pp.110-11; Davies, *Splendours*, p. 10.
146. One of these, the two-storey Toowoomba Station (1867) would, on the basis of an illustration and brief description, seem to be perhaps the most structurally analogous building to Watson's Hotel. It was based on a 15ft-square module, using cast-iron H stanchions, wrought-iron girders and joists, and the open trellis type girder used in the Crystal Palace. *The Builder* (1 June 1867), p. 393.
147. *The Architect* (3 April 1869), p. 179-80.
148. Robert Thorne, ed., *Structural Iron and Steel, 1850-1900: Studies in the History of Civil Engineering Vol. 10* (Ashgate, 2000), p. xviii.
149. *ibid*, pp. xix-xx; Peters, *Building*., pp. 205-11, 226-54.
150. Speaking before the Aberdeen Architectural Association on 'Structural Ironwork and Steelwork for Architects', Harbourne McLennan said 'The beginning of this construction in America may be said to have been about 1883, and it is sometimes supposed to have been an American invention; but this is hardly the case, as examples of skeleton construction, on a much less scale, certainly, but having all the requisite features, are to be found in this country long before the above date. At Stoneywood Paper Works, near Aberdeen, for instance, iron-framed buildings of several stories in height and thin panel walls are to be found bearing the date 1871, and at Union Works, in Aberdeen, there is a similar building which appears to be even older. *The Builder* (1 December 1911), p. 628.
151. F. M. Locker, 'Full Framed Construction in Britain: The Early Years of Confrontation With Established Attitudes and Beliefs', *Edinburgh Architectural Research* 7 (1980), pp. 30-63.
152. *The Architect* (18 May 1872), p. 256.
153. *The Engineer* (12 April 1878), p. 267.
154. *The Building News* (10 May 1878), p. 486.
155. A. Cooper, 'The Manchester Commercial Textile Warehouse, 1780-1914: A Study of its typology and practical development' (Ph.D. thesis, University of Manchester, 1991), p. 153, citing Manchester corporation plan register E. BK 2. 26.
156. 'Iron for building purposes', *JISI* (1878), p. 274.
157. Marian Bowley, *The British Building Industry. Four Studies in Response and Resistance to Change* (Cambridge, 1966), p. 34.