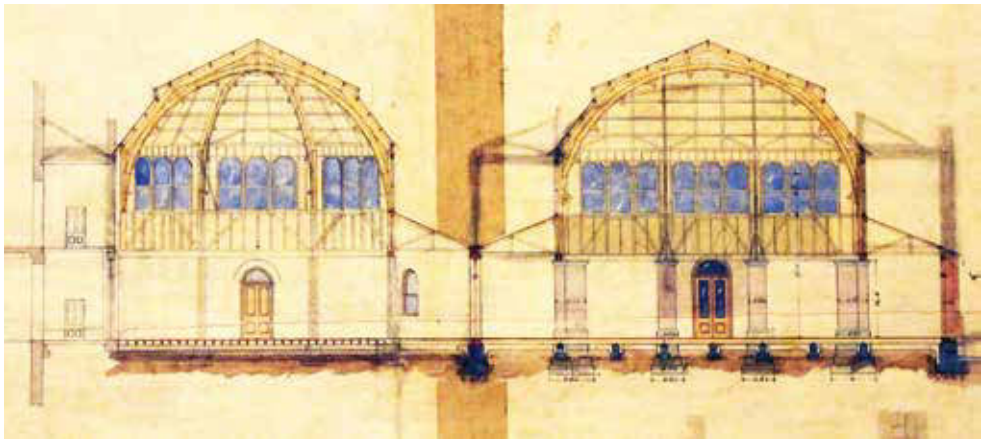
Miles Lewis

Building the Dome: an illustrated account

The Conception

The domed reading room of what was then the Melbourne Public Library marks the transition of the library from a nineteenth-century collecting institution to a twentieth-century reference service. The contents were now sorted according to the Dewey system, and buildings were henceforth custom-designed for their functions rather than automatically replicating the grander rooms of other institutions. It was also something of a milestone in local engineering. It was more or less fortuitous that it was perhaps – briefly at least – the largest reinforced concrete dome in the world. It was more important for the role it played in the development of reinforced concrete practice in Victoria and in Australia.

The Dome (Miles Lewis, November 2013).



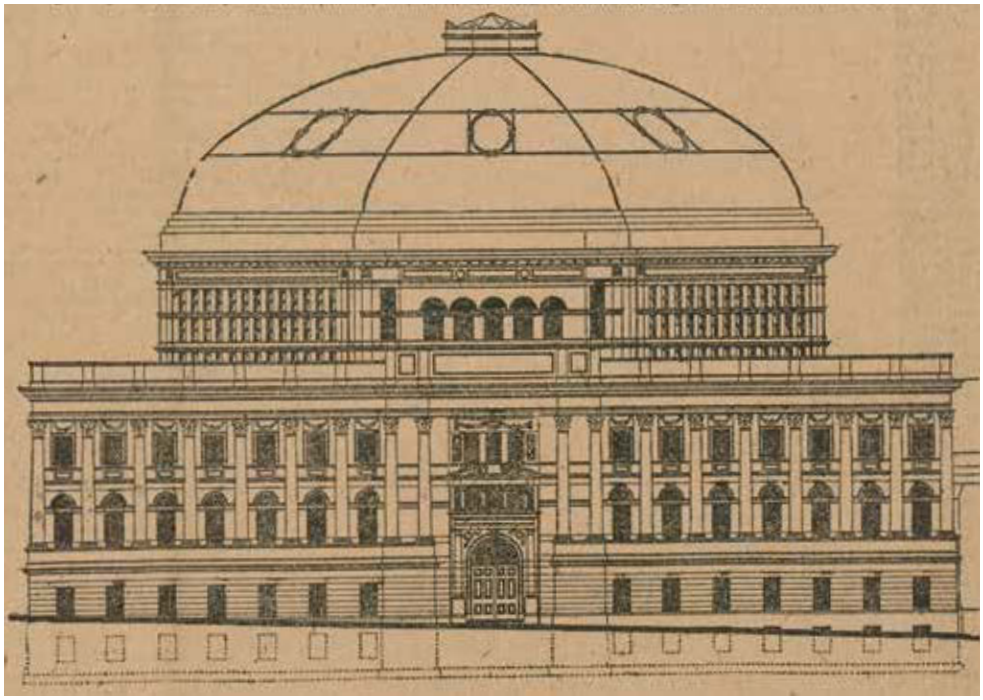
The previous dome. 'Public Library, Proposed Extension for Intercolonial Exhibition', contract signatures 1 May 1866. State Library of Victoria (hereafter SLV), H2010.69/16 LTAD 164. The dome is in section on the left, the hall on the right.

Development of the Site

Although contemporary references often mention the Library alone, in fact the Public Library, Museums and National Gallery of Victoria formed a cluster of semi-autonomous institutions, within the one complex of buildings, and so it was to remain for a century. The schema of a quadrangle of buildings fronting the surrounding streets, with a circular or polygonal building in a court at the centre, goes back almost to the original design of this complex. A plan by Joseph Reed in about 1859 shows a rectangular block with a forecourt on Swanston Street, and behind it, on the Russell Street half of the site, a square block with an inscribed rotunda at its centre. A perspective rendering of this scheme, by Nicholas Chevalier, shows a high drum and dome over the rotunda.[1]

But it was the rectangle at the Swanston Street end which developed first, stage-by-stage, and in 1866 a hall with a domed rotunda was inserted to accommodate the Intercolonial Exhibition of Australasia. It was intended to be 'suitable for the requirements of a Museum, after the temporary purpose had been served'. The foundations and lower walls were therefore permanent, but the superstructure was of wood, although even this was 'capable of sustaining its position for many years,[2] as indeed proved to be the case. This semi-temporary expedient now set the agenda for the future development of the site.

A certain amount of painting and repair work was done at the Library in 1896,[3] and in 1899 tenders were called for a building for the National Museum, on the Russell Street frontage of the site.[4] This work, however, was set aside when the government withheld funding, and carried through only in 1906 to create Baldwin Spencer Hall.[5] At its formal opening the trustees made their claim for the library. Beside the dais was a marble bust

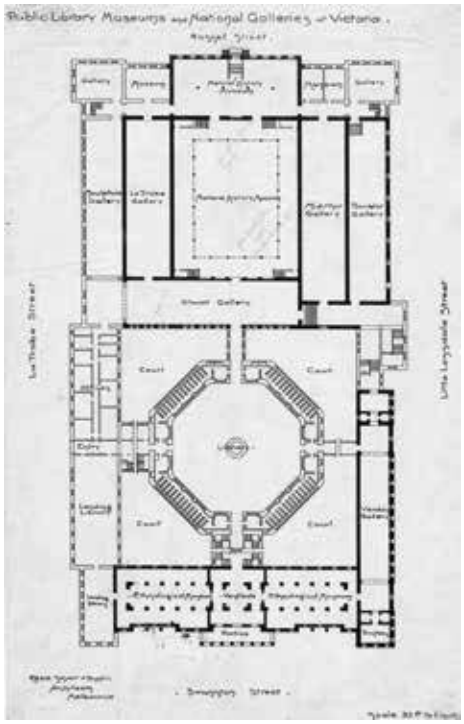


Proposed Public Library extension [La Trobe Street elevation], *Argus,* 23 June 1906, p. 6.

of Sir Redmond Barry, doubtless that which survives today, adorned with a chaplet of laurel. Immediately below the bust was seated the hapless premier, Sir Thomas Bent, who had already been approached for funding, 'looking much less cool than the marble'. When he came to speak Bent was amiable, but noncommittal so far as the funding went.[6]

In June 1906 the *Argus* reiterated that the library had run out of space. In the twenty years since the last additions were made, 100,000 volumes had been added to the collection, a lending library had been established, and the Gallery was about to begin a program of acquisitions under the Felton Bequest. The Library now accommodated nearly twice as many readers as the British Museum reading room. Bent was still not committed to the funding, so the trustees had turned up the pressure by commissioning the Library's architects, Reed, Smart & Tappin, to prepare plans to develop the whole block, starting with the library itself.[7] On 30 May they forwarded a plan of the existing wings to the trustees with the 'new octagonal library' inserted in place of the existing Rotunda and Exhibition Hall.[8]

The new building, an elevation of which was published, was to be an octagonal rotunda, inspired by the United States Library of Congress, Washington. It was to have three main floors, the catalogue room, the lending library, and the general reading room, unlike the two which finally eventuated. There were to be long vertical windows, clearly

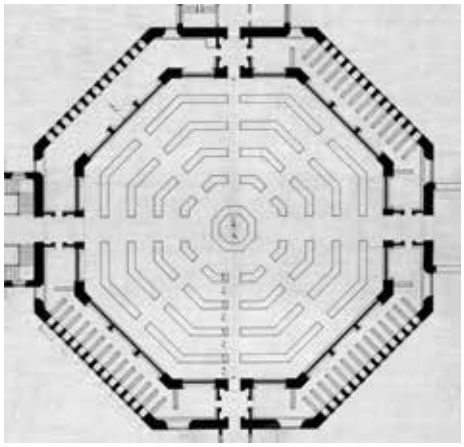


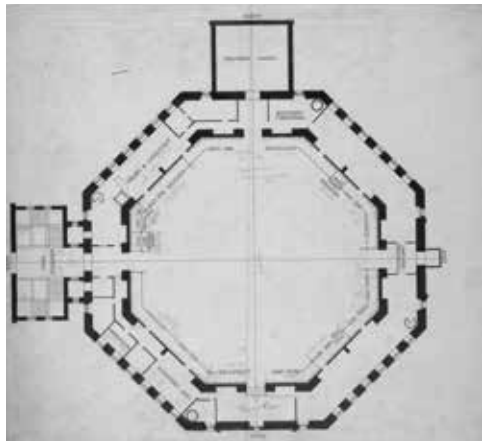
Public Library &c, the master plan, with the reading room, by Reed, Smart & Tappin, c. 1906. Bates Smart Collection, University of Melbourne Archives.

intended to allow the light to pass between the book stacks placed radially in the outer ring of space (later known as the Annulus). The general reading room would be in a three-story well of space, lit by glazing in the dome as well as from the side windows, and supervised from a central platform (this was the panopticon principle of Jeremy Bentham, familiar in Australia because its application in the planning of prisons).

The *Argus* complained, however, that the structure would copy the defects as well as the merits of the Library of Congress. This had a an iron dome painted to represent stone, while the new Melbourne building was to have brick walls clad in stucco to imitate stone, an equally egregious sham.[9] Nothing was said of the Melbourne dome itself, and nothing can be deduced from its rather crude profile in elevation. It is unlikely that reinforced concrete was contemplated at this stage, and more probable that it was thought of as timber, like the earlier dome on the site. However, reinforced concrete was always a possibility. In about 1898-9, the Rockhampton Court House was given a reinforced concrete dome (albeit much smaller than that proposed in Melbourne), built by the local Monier agents, Finlayson Brothers.[10] This was perhaps less due to the initiative of the Finlaysons, of whom little is known, than that of the Queensland Government architect A. B. Brady, who was an enthusiast for concrete technology.

It was at first proposed to have fourteen sets of shelving at right angles to each





Left: Melbourne Public Library. Proposed New Reading Room. First Floor Plan: rotated detail.
Right: Proposed plan, probably by Smart, Tappin & Peebles, c. 1908, showing the location of subject categories and Dewey number. Bates Smart Collection, University of Melbourne Archives. This seems to be a copy or version of the drawing with which Armstrong travelled overseas, and it illustrates the perceived nexus between the new Dewey system and modern centralised planning, both favoured by E. La Touche Armstrong, as opposed to the traditional library organisation and rectangular plan, both favoured by E. Morris Miller.

face of the octagon, with thirteen slit windows between them to admit light, later reduced to eleven. The Chief Librarian, Armstrong, later stated that: 'Mr Peebles . . . drew the original plans for the Reading Room, from rough sketches submitted by the Chief Librarian' [himself].[11] The prominence of N. G. Peebles, chief draftsman with Reed, Smart & Tappin, was fortuitous. Since the original competition-winning design by Joseph Reed in 1853, the Library had been served architecturally by his firm and its successors, now Reed, Smart & Tappin. The death of W. B. Tappin in 1905 had left the firm in the hands of F. J. Smart, who was possibly as much concerned with his public profile as with the practice, for he was elected president of the Royal Victorian Institute of Architects for 1907-8.[12]

Smart died on 10 August 1907, after which the Library trustees became nervous, and consulted Peebles, the former chief draftsman, as to whether he had the expertise to carry out so great an undertaking.[13] He responded by entering a new partnership with one of Smart's sons, the engineer Charles Pyne Smart,[14] under the style of Smart, Tappin & Peebles. Soon afterwards this partnership became Bates, Peebles & Smart, by taking in E. A. Bates, surviving partner of Hyndman & Bates, and himself a former pupil in the firm of Reed, Henderson & Smart. On 16 December 1907 C. P. Smart wrote that 'In compliance with the wishes of the Trustees we have entered into negotiations for taking another partner into our firm'.[15] This was a move likely to inspire confidence at the Library, since Hyndman & Bates were the architects patronised privately by H. G. Turner, the chairman of the Trustees.

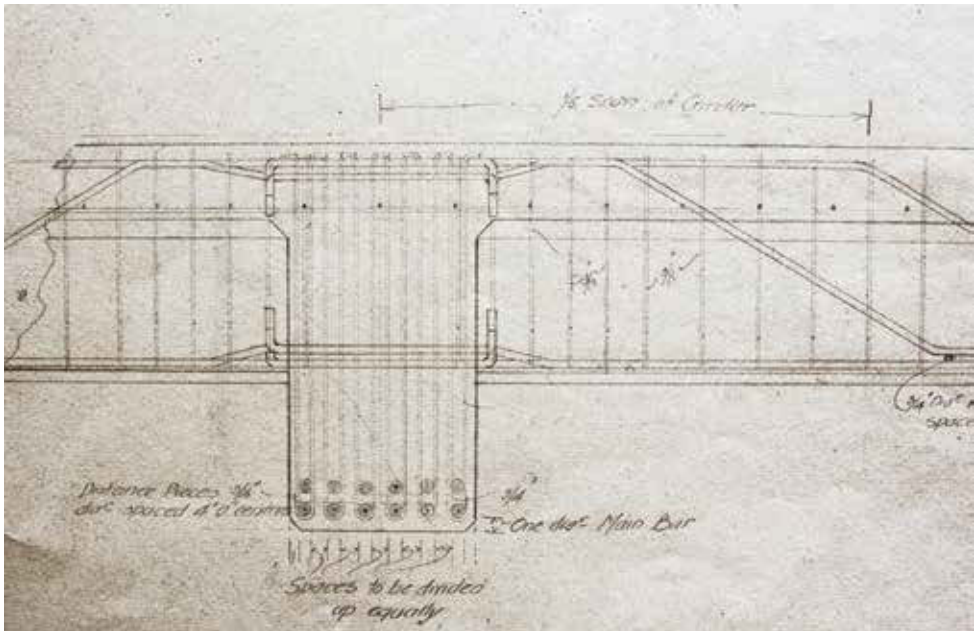
In 1907 the Premier, Bent, responded to the importunities of the Public Library

Trustees and promised £10,000 for the commencement of a new building,[16] to cost a further £50,000 over the next few years.[17] When the reconstituted firm of Bates, Peebles & Smart was established, the Trustees cancelled all previous arrangements and appointed them as their architects. An attempt was made by Bent to have their fees for the new building reduced to 3%, but when told that this was contrary to the usage of the Royal Victorian Institute of Architects [RVIA] he withdrew the proposal.[18] By February 1908 it was reported that Bates, Peebles & Smart were preparing plans for the work,[19] and these were forwarded within weeks.[20]

A red herring then appeared in the form of a proposal that the Library, Museum and Galleries should transfer to a new site on the Domain, leaving the existing site for the expansion of the Melbourne Hospital, and this received general approval from the Library Trustees. However, when it was determined to redevelop the hospital on its existing site, the proposal lapsed. During the year the old wooden Rotunda and Lending Library buildings were demolished to clear the site.[21] At this time Armstrong was given six months leave on health grounds, and he was asked by the Trustees to inspect libraries abroad.[22] Far from this being (as was once supposed) the occasion when he determined upon a domed reading room like those of the British Museum and the Library of Congress, he not only knew the Trustees' views already, but even seems to have been able to take with him Peebles's drawings for a polygonal structure. But the issue may not have been finally decided, as a scheme for a rectangular structure also survives, unfortunately not dated.[23]

The polygonal space seems to have been seen as appropriate for introduction of the Dewey Decimal system, which was then a matter of some controversy in the library. It implied a continuous sequence of book stacks, and it is significant that one of the architect's drawings – most probably the one which travelled with Armstrong – is an unlabelled plan in which the subject matter of each bay is described in Dewey terms, beginning with 010–099, General Works, beside the entrance, and completing the circuit with 900–999, History, with the back door falling between Science and Useful Arts. This illustrates the perceived nexus between the new Dewey system and modern centralised planning, both favoured by Armstrong, as opposed to the traditional library organisation and rectangular plan, both favoured by E. Morris Miller.

Miller, then a junior assistant in the Library, was also travelling from February 1908 on unpaid leave. He met up with Armstrong in Edinburgh, and unsuccessfully argued against the polygonal scheme and tried to persuade him to visit what he considered to be the more advanced rectangular library buildings in Germany[24] – a rectangular plan probably implying a non-Dewey system. Armstrong, undeterred, showed Peebles's initial polygonal design to various librarians, including Sir Edward Maunde-Thompson, head of the British Museum, who expressed great interest, and queried only the adequacy of the ventilation and natural lighting. The outcome was that the skylights were enlarged beyond what Peebles thought strictly necessary,[25] perhaps sowing the seeds of future troubles with leakage. Miller's contrary report, received on 28 May 1909,[26] sank without



The Monier beam design. Signed J. A. L. [J. A. Laing], 2.3.09, from the John Thomas collection, per Trevor Huggard, 1984. This was after the Monier Company had submitted its original price, but before the controversy over open tendering, when it was still assumed that Monier would have the contract.

trace, and the Dewey system was adopted at Melbourne, as it was at other major Australian libraries.[27]

By now Peebles envisaged a reinforced concrete dome and apparently proposed, or assumed, that this would be built by the Reinforced Concrete and Monier Pipe Construction Co. Its principal was John Monash, whose position in the matter may have been enhanced by the fact that he had been a contemporary of Armstrong at Scotch College. And this was not all they had in common, for Monash himself had been seized with enthusiasm for the Dewey system while on a visit to the United States.[28] In May 1908 Monash submitted a price of £18,692 for the whole concrete work of the Reading Room. Later, when the architects queried the price, he argued for it by comparison with steel, and quoted costs per square for other concrete roofs he had constructed.[29] This prime cost sum of £20,769 for the concrete work was incorporated as a condition of tendering.[30]

Monash had been at pains to foster the general impression that the Monier Company had in effect the sole rights to build in reinforced concrete, and it seems, from a later report, that his position was enhanced by his close relationship with the Portland cement manufacturer, David Mitchell.[31] It would have been quite natural at the time to assume that the Monier Company must do the work. However, this was a monopolistic

proposal which would remove about 30% of the job from competition, and it attracted the wrath of the building trade, of G. A. Taylor (editor of *Building),* and of competing concrete interests.

There had already been concerns amongst Melbourne builders about the increasing use of prime costing within contracts, that is, naming sections of the work which would be done by another party, whether named or yet to be named, upon which the main contractor would charge a percentage fee for his management. A report in 1906 suggested that this 'objectionable practice' was open to abuse, though reinforced concrete would not have been the issue at this stage, because it had hardly entered the field of conventional building (as opposed to engineering) works. In fact the example cited related to steelwork and bricklaying:

> one contractor who had the contract for the erection of extensive buildings well in hand had to dismiss his bricklayers and cease operations simply because the architects made their own arrangements for dealing with the steelwork, instead of leaving it to the contractor.[32]

By 1908 the builder, J. W. Swanson was active in the issue.[33] The practice was seen to remove significant elements of the building from competition, hamstring builders, and presumably elevate prices. So far as the Monier Company goes, the issue had arisen specifically over the construction of the Preston No. 2 Reservoir.[34] The Monier Pipe Construction Co's tender of £26,480 for the reservoir was the lowest, but this was to be expected when the design had been prepared on the Monier system. According to the Master Builders' Association, there were half a dozen methods of reinforcement, and by specifying one the Board would be awarding the tender to the particular firm using the method.[35]

A correspondent of the Melbourne *Age,* under the name 'Contractor', claimed that in the contract for the new Library building, £42,000 out of about £70,000 was 'tied up' to private firms at their own prices. The librarian, Armstrong, asked the architects, Bates, Peebles and Smart, for an explanation, and Bates admitted to amounts totalling about £37,500:

Provision (unforseen contingencies)	500
Circular iron stair cases	832
Electric lift	450
455 galvanised iron, pivot hung casement and double hung windows glazed complete	4,050
Mechanical ventilation	1,763
Reinforced concrete girders and lintels and dome of roof	20,769
Locks and fittings to doors	40
Models, external cementing	50
Electric light and fittings	500
Luxfer prism glazing of dome	5,000

On 12 February 1909 George Taylor fulminated:

> The specification for the Melbourne Public library, to cost about £70,000, has the amount of £44,255 included for a number of prime cost items, . . . no less a sum than £20,769 has to be included for reinforced concrete work . . . Reinforced concrete is a construction which any intelligent builder can carry out provided proper specifications were prepared. There is no patent that can tie the best methods of reinforced concrete to any one firm.

Taylor argued that the proceedings in this case 'lends colour to the allegations . . . that a monopoly in reinforced concrete is being conserved in the interests of a certain firm'. But he prudently – or perhaps sarcastically – continued 'we do not for one moment consider the architects in charge of the Public Library would countenance an allegiance to any particular firm'.[36] For it would be hard to come to any other conclusion, and Peebles, when interviewed by *Building*, did little to refute it:

> 'Not one single firm has been "tied up". Regarding reinforced concrete that was open. There were only three firms who could do the work'.
> 'Who are they?' asked our representative
> Mr Peebles replied: 'The Reinforced Company, the Expanded Steel people.'
> 'And the third?' asked our representative.
> Mr Peebles replied that at the moment the name had slipped his memory.[37]

'Not a single one of these items', said Bates, 'has been fixed for any firm or firms'. As soon as the main contract was let tenders would be called for these items, and in cases where the item was made by only two or three firms, each sub-contract could if necessary be advertised separately. The galvanised iron windows were 'on the latest American fireproof plan' and it seemed that only one firm in Sydney [probably Wormwalds] could produce them.[38] 'The big item is the reinforced concrete dome, and that can be advertised too'. The Luxfer prism glazing specified for the dome was patented, but 'it will be open to anyone to offer us something better.'[39] All this was very disingenuous, for it does not appear that there had been any intention before now of opening all these contracts to separate tender – as is apparent from the panic which was to ensue as the architects rushed to produce independent drawings for the reinforced concrete work.

A letter to the *Age* from 'Master Builder' added to Bates's list:

marble facings to walls	4000
tile paving	277
asphalt to floors, &c	1853
fibrous plaster	170
iron balustrade	70
granolithic coring	435

which, added to the previous amount, made a total of, £44,255 in a contract estimated at £70,000. Although the architects claimed no names were mentioned in relation to these items, the brand specified for the asphalt amounted to the same thing, and

> a much favoured individual is given the monopoly of asphalte paving by the naming of his trade mark . . . It may be that this is done out of prejudice or pure friendship for the party favoured . . . The practice at any rate affords foundation for the suspicion that in the case of unscrupulous firms corrupt practices may exist.[40]

Farr, the President of the Master Builders Association in Melbourne confirmed

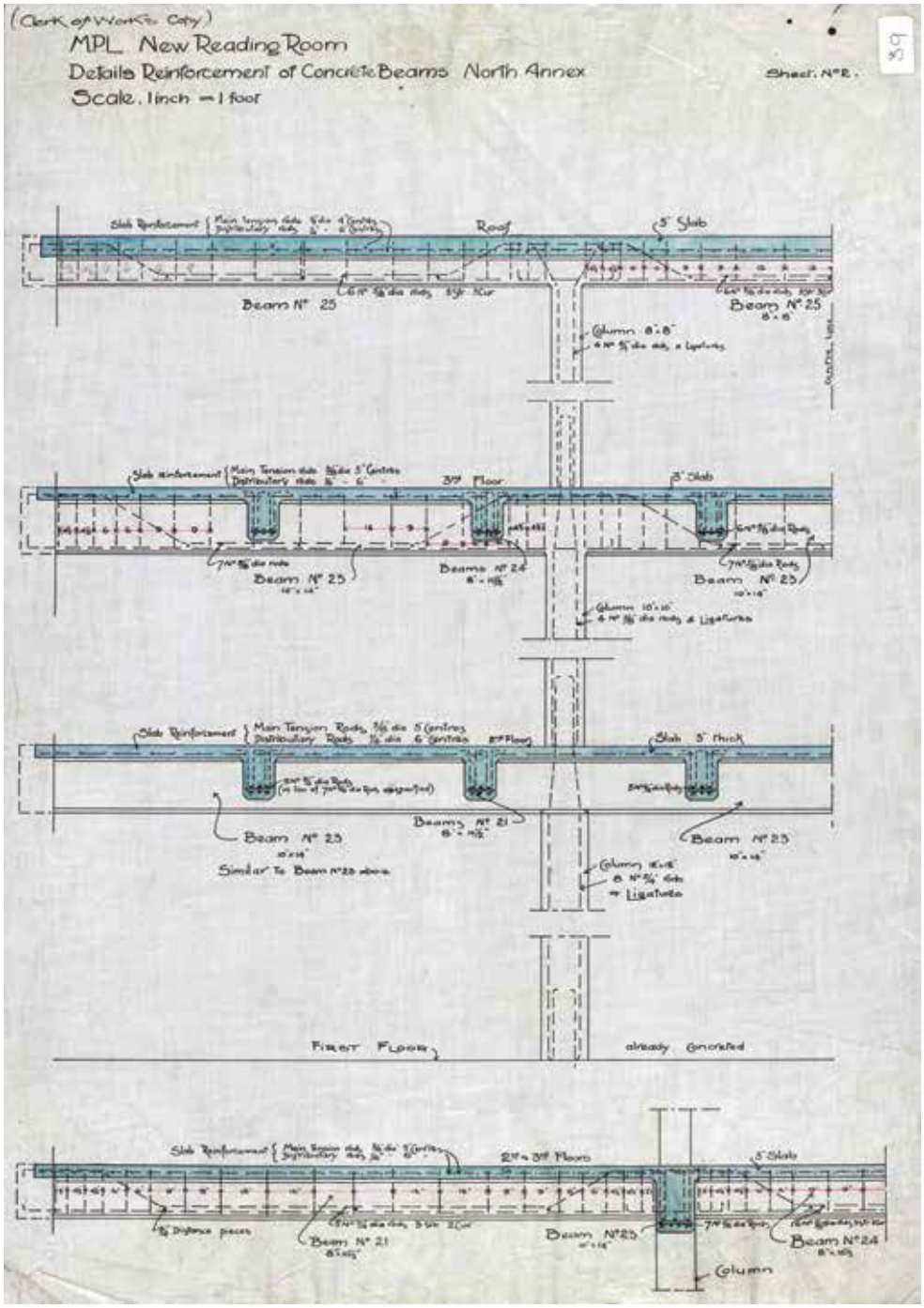
that the body had been concerned about excessive prime costing, and cited 'the Cheltenham Home' as another public project at issue. On the other hand he was himself carrying out all the reinforced concrete on the Women's Hospital project, to the satisfaction of the architects, J. J. & E. J. Clark.[41]

On 10 February 1909 the Master Builders Association wrote to the Library Trustees asking them to receive a deputation,[42] and also wrote to the Royal Victorian Institute of Architects about the general principle. They asked members of the RVIA to restrict prime cost items to cases where it was absolutely necessary, and never for constructional work. In the case of reinforced concrete, iron or steelwork, they demanded that the architects should provide complete specifications, so that any builder could tender for them. The MBA subsequently blackballed contracts in which this condition was not satisfied.[43] The matter was also brought up in the Legislative Assembly, and it is clear that the trustees felt the political pressure. They agreed to receive the Master Builders' deputation, but the letter went astray and the deputation was deferred for a week. Nevertheless the trustees, meeting in camera, decided that for every separate item in the contract (subject to slight exceptions) tenders were to be called openly by public advertisement. Among these would be the large tender for reinforced concrete girders, lintels and dome of roof. The only exception Armstrong could think of would be where patent rights were involved, as in the case of the glass contract.[44]

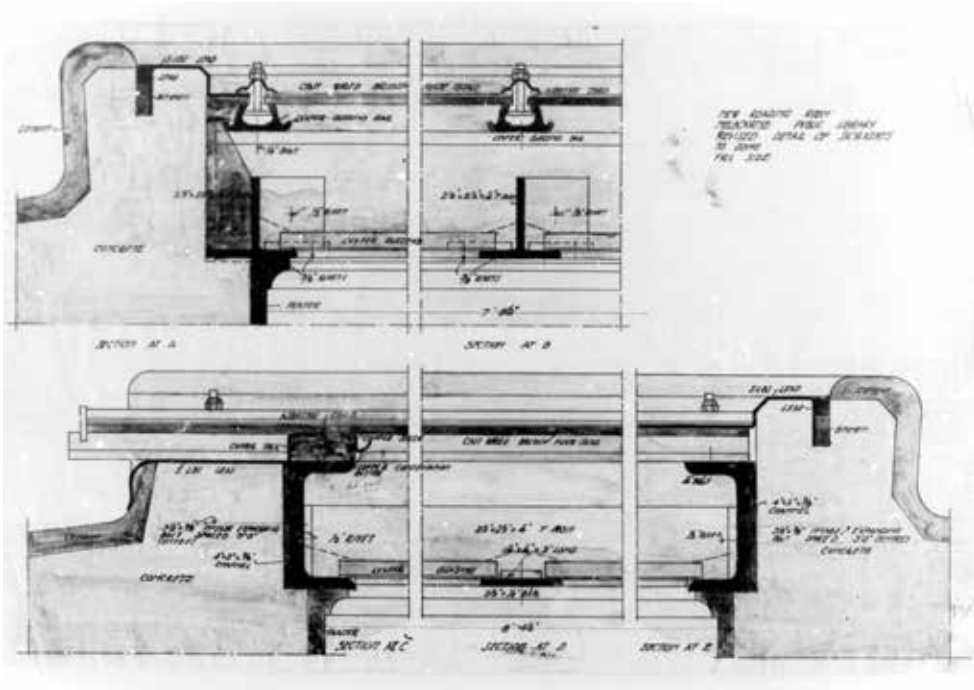
On 17 February 1909 the Trustees received the deputation from the Master Builders Association. One of the Trustees was Sir Thomas Bent (no longer Premier of the state), and he successfully moved 'That tenders be called for the whole building in one contract, the architect to submit specifications, as might be necessary, to safeguard the interests of the Trustees'.[45] The required specifications were provided by the architects on 25 March 1909.[46]

Monash apparently felt personally slighted, as well as concerned about the implications for his business of this further erosion of the Monier monopoly, and he wrote a petulant letter to Peebles, who responded unctuously:

> The idea of a man of your vast intellect and attainments, unimpeachable honor and social standing, being in any way affected or disturbed by fancied humiliations and the puerile calumnies of a few of the members of the Master Builders Association is simply preposterous, as is also your anxiety with regard to the future of your business affairs. I am confident that your business instead of decreasing will increase ten fold as a result of what you term the 'recent crisis'. I am very sensible of the great amount of time and energy you have expended in connection with the library job, and deeply regret that your efforts were not rewarded with the success they merited. You have at least however the consolation slight though it be of knowing that you will receive an adequate fee for your consultations. I will take this opportunity of tendering you my sincere and heartfelt thanks for the very valuable hints on re-inforced work and the very great assistance you have given me in the preparation of the contract. I keenly appreciate the invariable courtesy and patience you have extended to me throughout and you may rest assured that I shall ever do my very utmost on your behalf.[47]



'M. P. L. [i.e. Melbourne Public Library] New Reading Room. Details of Reinforcement of Concrete Beams North Annex,' by Bates Peebles & Smart. State Library of Victoria, H2010.69/70. Presumably one of the drawings done by Peebles in May-June 1909.



'New Reading Room / Melbourne Public Library / Revised detail of skylights to dome / Full size' [undated]. Public Record of Victoria, LM 1.161.

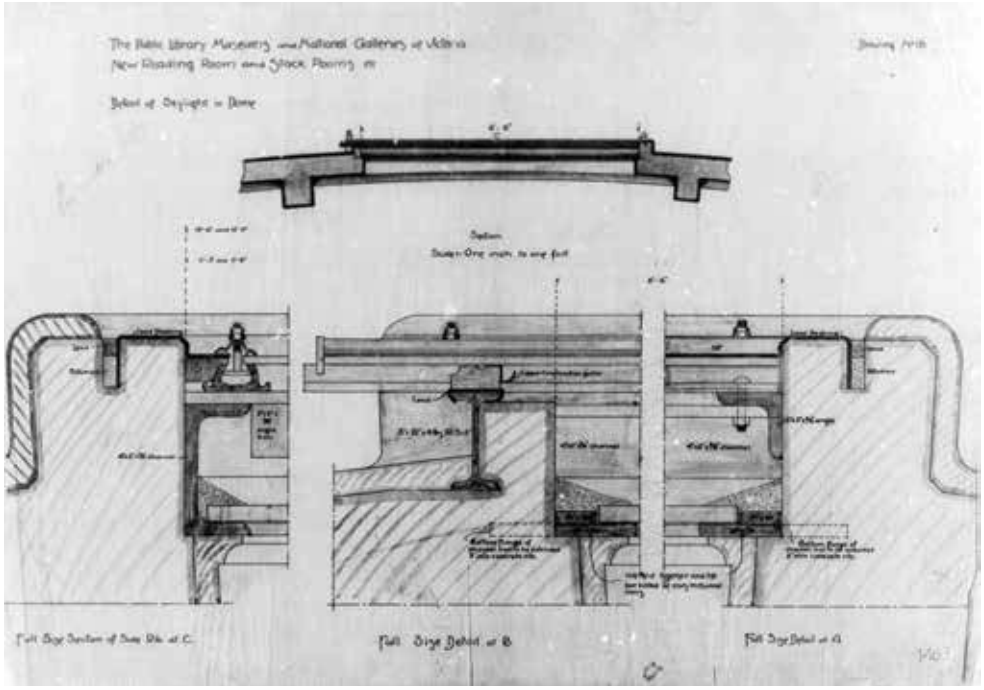
This did not prevent Peebles from becoming friendly with the successful tenderers, the Swanson Brothers, who subsequently commissioned architectural work from him.

The tender date was 10 May 1909,[48] and on 13 May the Trustees opened the eight tenders received and agreed to accept that of Swanson Brothers, for £66,914.[49] This was presumably the lowest, and perhaps embarrassingly so, for there is no worse thing for a government body than failing to fully expend any funds allocated to it. The trustees quickly added:

> This provides for the entire edifices [*sic*], but is not inclusive of certain fittings, such as electric lifts, &c., that are contemplated. The contractors will be allowed to install these and other fixtures as extras, and it is anticipated the additional charges thus incurred will exhaust the Parliamentary vote of £70,000 set aside for the building.

The contract with J W & D A Swanson was signed in June.[50] The delay was probably due to the unanticipated need to provide documentation for tendering on the reinforced concrete. As the Melbourne *Herald* reported:

> It was originally intended to get the plans out piecemeal during the progress of the work, extending over a period of two or three years. As the construction of the re-inforced concrete stone [sic] was to have been reserved from the contract and



'The Public Library Museum and National Galleries [*sic*] of Victoria / New Reading Room and Stack Rooms etc / Detail of Skylight in Dome' [undated], attributed to N. G. Peebles, annotated in ms 'Contactor's copy'. Public Record of Victoria, LM 1.163.

> entrusted to a constructional company in the first instance, there was thought to be no necessity for preparing all the plans at once.
>
> The trustees, however, decided that tenders should be invited for the whole work, including the dome, and the contractors who wished to tender asked to be furnished with detailed plans and calculations of weights and strains. The architect, Mr Peebles, immediately set about the arduous task of compressing into two months work which was to have [been] spread out over three years. By working late into the nights he succeeded in submitting all his drawings, and a volume of minute calculations in time to permit of tendering before Thursday last.

The Library trustees congratulated Peebles warmly, and the now conciliatory Master Builders Association wrote to express their appreciation.[51] But this may have been misplaced, for Peebles could not have designed the reinforced concrete himself. No engineer is named, but Peebles's acknowledgement of Monash's 'valuable assistance'; and 'hints on re-inforced work' indicate that Monash was the effective designer, and that the old collusion was still in operation behind the scenes. But what were they attempting to do? Peebles's drawings show something resembling Monier concrete but with elements from at least two other patent systems, as will be discussed below. This might have been a

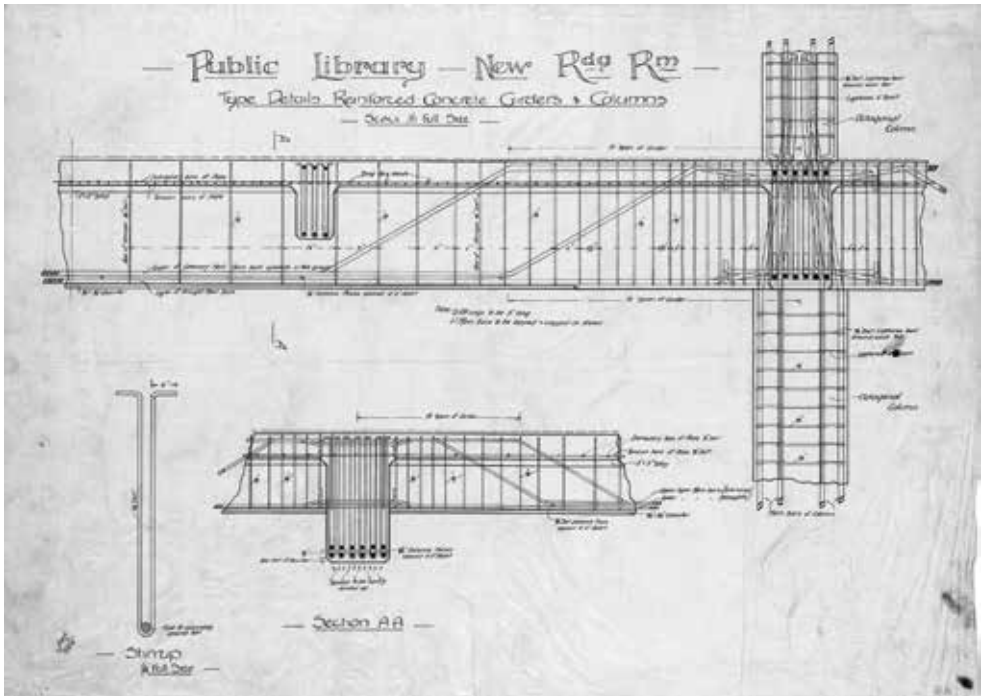
genuine attempt to produce a generic design, independent of any patent, though it looks as much like a deliberate attempt to infringe patents, and thus force any tenderer back into the waiting arms of the Monier company. But the Monier patent was actually due to expire on 11 February 1910,[52] so Monash could not have hoped to retain his quasi-monopoly, though he might have thought the date could pass unnoticed for a time.

The situation is illuminated by the drawings for the skylights, which went through the same process. The Luxfer glazing was the one item which Armstrong had thought problematic for tendering, because the system was patented. Luxfer made prismatic glass designed to deflect light in the required direction, as for example in a pavement light set in a footpath, and required to throw the light sideways into the depths of a basement,[53] but there is no obvious reason why this capacity should have been required in the dome. The company made other glazing products, but these could have been matched by other manufacturers.

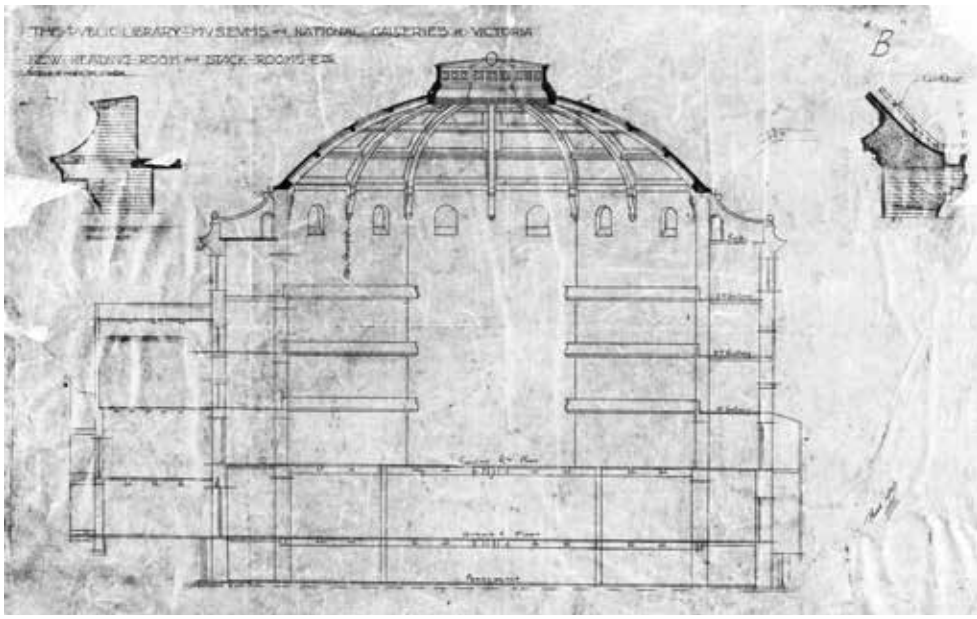
The first drawing for the dome lighting shows the underside to be Luxfer glazing (though not specifically identified as prismatic), and the upper face as cast wired British plate glass set in Luxfer glazing bars. The revised drawing names none of these materials, though the glazing bars are still of the characteristic Luxfer pattern. Presumably a tenderer would be allowed to propose an equivalent product, in spite of the detail shown in the drawing. We can also learn something from the lettering on these drawings. Those prepared by Peebles after the decision of February 1910 are captioned in slightly ornate lettering of a Snugglepot and Cuddlepie style – a useful indicator given the fact that they are unsigned and undated.

Details on the subcontractors' tenders for what had been the prime cost items are not available, but the contract for the reinforced concrete work was gained by the Trussed Concrete Steel Company (Truscon). In fact it represented something of a pyrrhic victory for the builders, for the Monier company had simply been replaced by a comparable one. It tended to show that a builder could not in fact undertake the reinforced concrete work himself, as George Taylor had claimed, if only because he could not do so without infringing somebody's patent. But if a builder's tender was in future to include the reinforced concrete, as the Master Builders had sought, then it might succeed or fail according to the price obtained for one of the patent systems, quite beyond the tenderer's control. This would be much worse than having a prime cost sum allocated to a particular firm. Luckily this was never to become a serious issue, because over the period of the Great War many of the patents lapsed, or in the case of the German ones, were voided. By the 1920s reinforced concrete was indeed a field open to builders in general.

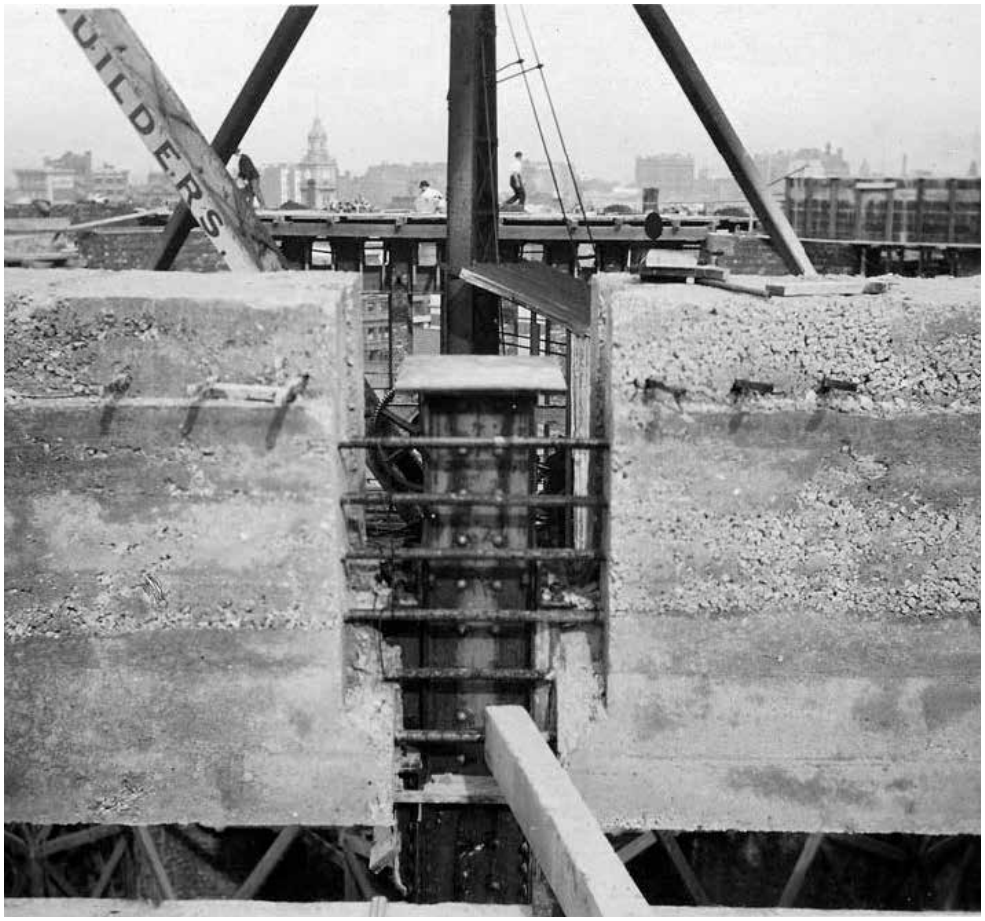
The Truscon company was in a good position to tender because it was at about this time constructing a dome-like structure almost as large over the auditorium of the Villa Marina Kursaal, Douglas, Isle of Man.[54] Although this was in the form of an octagonal cone, it was referred to as a dome, and it would have had some relevance to the Melbourne structure.



The Peebles design for the ground floor beams. 'Type Details Reinforced Concrete Girders & Columns'. Bates Smart Collection, University of Melbourne Archives.



The Public Library - Museums and National Galleries of Victoria. New Reading Room and stack-rooms etc [Unfinished section A B of the Domed Reading Room] Initialled and dated in ink l.r.: Recd 6/4/10 / WWH. SLV, H2010.69/57.

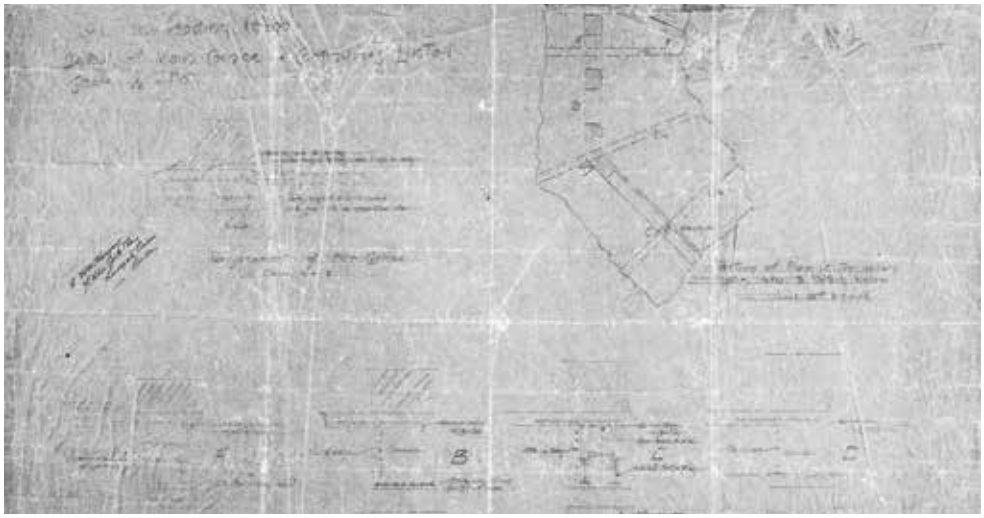


Lintel at top of stanchion, [and] pocket for rib of dome [picture] 1910. Clark photos, SLV, H93.39/25.

The Engineering Concept

Most of the reinforced concrete drawings of 1909, other than those attributable to Peebles, are anonymous or are signed 'J A L', and look as though they must be of local origin, and in fact it seems that these are the original Monier Company drawings, and, 'J A L' is the Monier employee John Albert Laing.[54] One gets the general impression that in most of the substructure, the members as constructed are in accord with these Monier forms and dimensions, and that it is only the reinforcement which has been changed.

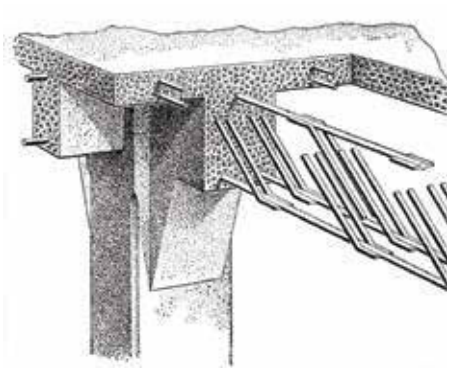
But in fact it is not so simple, because three processes have taken place. Firstly the whole of the reinforced concrete appears to have been redesigned by Peebles under Monash's guidance, as discussed above. Secondly a proportion of the Peebles-designed reinforcement was apparently replaced by Truscon bars. Thirdly the dome itself was



M. P. L. New Reading Room. Detail of main cornice & continuous lintol / Bates Peebles & Smart. Reinforcement of main cornice; and portion of plan of top gallery (i.e. open walkway around the dome) and details: at A: section at Lintol No. 3; at B section at Lintol No 2; at C Section through lintol carried by stanchions; at D Section at angles of octagon. SLV H2010.69/77.

completely redesigned by Truscon in London. In the first stage the forms and dimensions of members were in at least some cases changed from Monash's original designs, as in the case of the octagonal column heads at ground floor level. In the second stage the Peebles forms and dimensions seem to have been retained, and only the reinforcement changed. Indeed, given the speed with which construction began, something like this might be seen as inevitable. In the dome the changes were more substantial. Confusingly, drawings issued by the architects, even after Truscon were engaged, continue to show the Peebles/Monier reinforcement.

The engineering drawings for the dome itself are different in format, date mainly from the second half of 1910, and bear the signature of Nic K. Fougner, chief engineer of the Trussed Concrete Steel Co. of Westminster. The historian David Saunders has noted a drawing of 30 June 1910 which is endorsed 'Rec'd & forwarded 1st July 1910. W.W. Harvey', and he surmises that Harvey, then in London, was the 'engineer acting on behalf of the architects', referred to in a later report. This is supported by a letter from Harvey to Bates, Peebles and Smart of 25 October 1910 in which he says 'I have pointed out that this [arrangement of the ring bars] is very well suited for the intermediate ribs it brings the bars inside the line of thrust at the angular rib . . .'[56] Harvey was a former Monash employee, having joined him as an assistant engineer in 1905 and then in about 1907 became resident engineer in the Adelaide office (the South Australian Reinforced Concrete Co.), where he remained until about November 1909.[57]

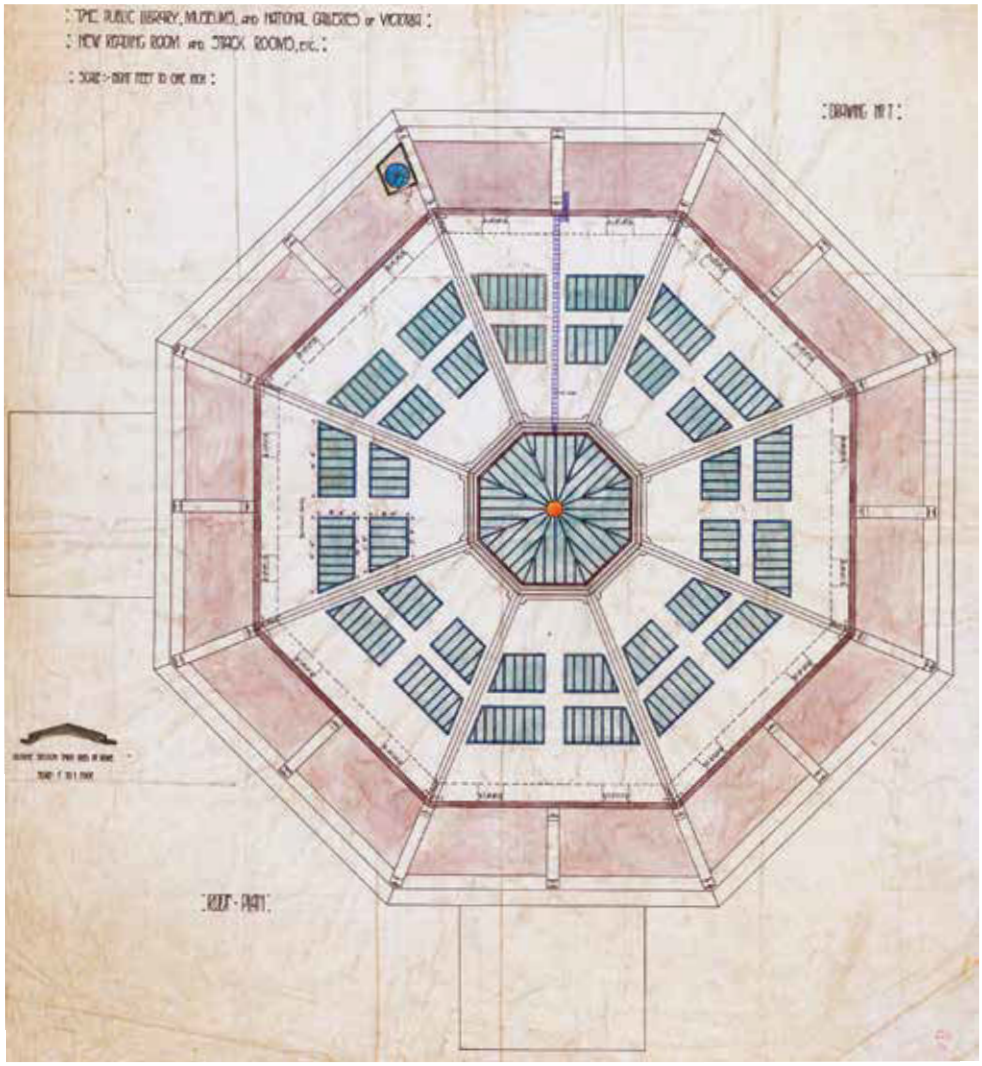


The Kahn system. International Library of Technology, vol 34D, *Stone and Brick, &c* (Scranton [Pennsylvania] 1922 [1906-1912]) §45, p. 15.

The Kahn reinforcement in place in the main floor beams. *Truscon: the First Fifty Years: a short history of The Trussed Concrete Steel Company Limited, 1907-1957* (London: Truscon House, 1957), p 7.

The Kahn bar, used by Truscon, was an odd conception, consisting of a basic rolled bar of T-section, with slits run along the flanges so that strips could be bent out from them and wrapped around the adjoining reinforcement. The reinforcement is said to have been imported from the USA,[58] but this may be a misconception, for though the Kahn system was American in origin, it was marketed by a separate British company which, as was common at the time, would have had rights throughout the British Empire. Whether the reinforcement was actually made in Britain or in America is in fact unclear (and unimportant). Saunders devotes some thought to the reason why Bates, Peebles and Smart decided to use the Kahn system, but the evidence shows that it was not their decision, nor even that of Swanson Brothers, but the result of separate tenders being called for the work.

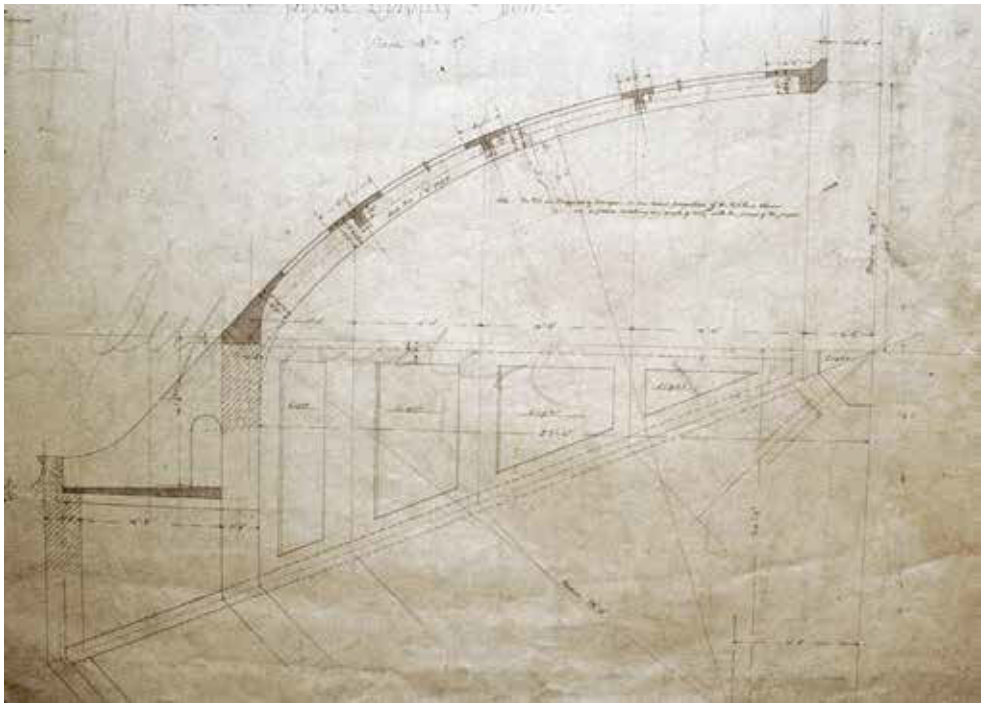
A comparison with Monash's original drawings shows that even in the dome his dimensions for the concrete were kept virtually unchanged, but the Monier reinforcement was replaced by Truscon's Kahn bars. However in some parts, such as the ring beam around the base of the dome, photographs taken during construction show that conventional bars were still used, though whether they adhered to Monash's original design is unclear. Alan Holgate has identified the changes in design between the original Monash drawings and the structure as built, though some may have been revisions by Monash himself before he was displaced. Some time before the dome was built, the width of the oculus increased from 10 to 32 feet [3 to 9.6 m], the amount of glazing on the slopes was reduced from four bands to two, and the profile of the ribs was altered. The profile of the dome was altered. In the initial scheme of 1908 Monash had seen opposing pairs of ribs as forming an arch like a Monier bridge, spanning the full width of the Reading Room. The full arch was to be composed of three circular segments, the central



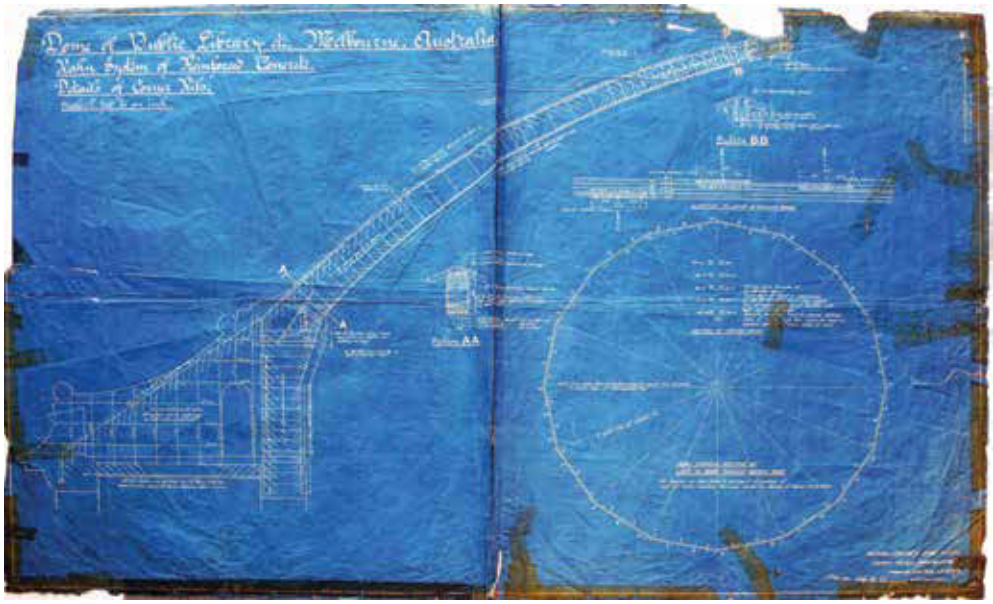
The roof plan. Bates Smart Collection, University of Melbourne Archives.

portion having a radius of 98 ft 8 in [29.6 m] and the outer portions, 58ft 6in [17.55m].

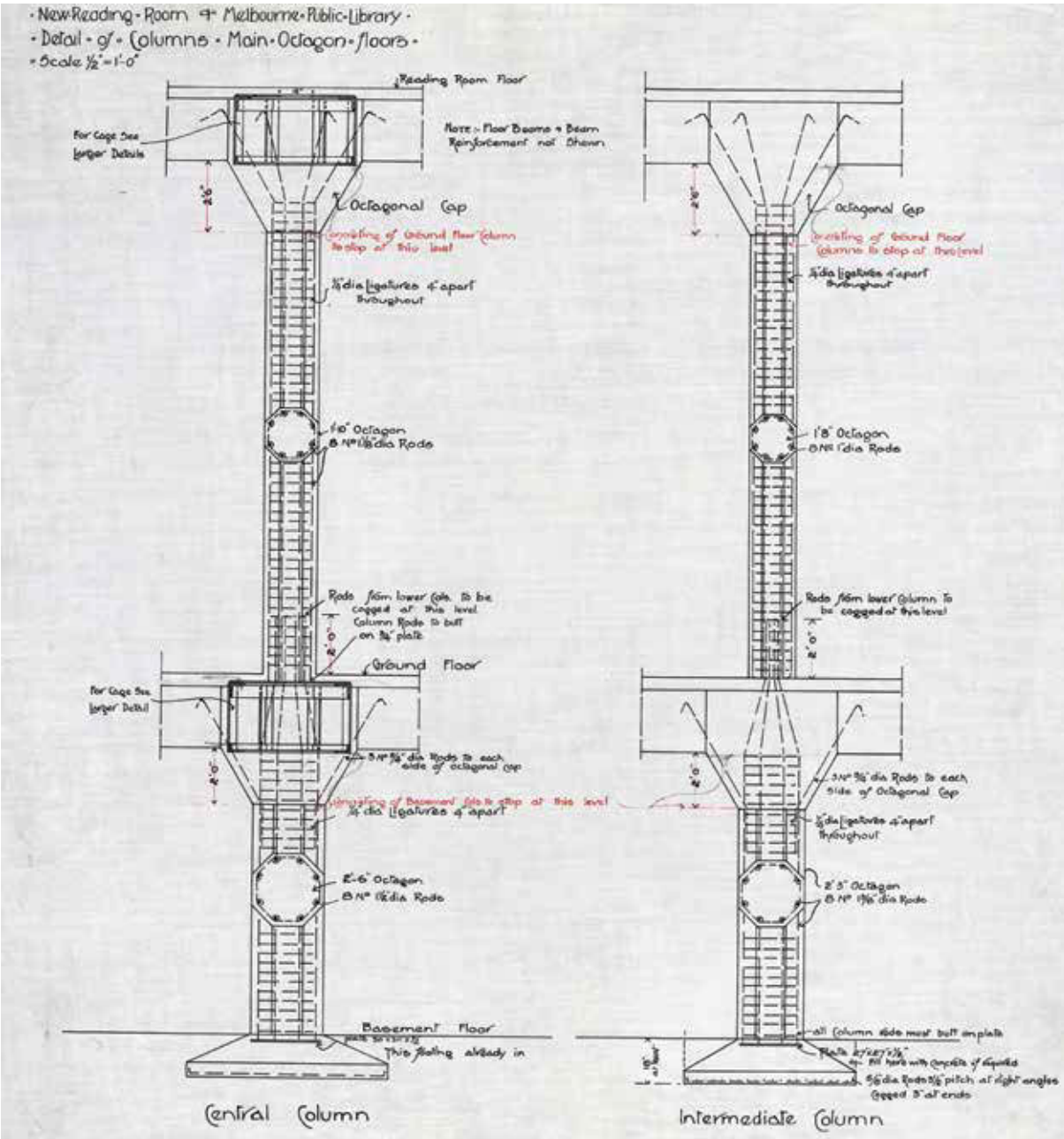
On 2 July 1909, Truscon prepared a drawing entitled 'Details Shewing Dome Reinforced on the Kahn System' which was modified on 7 January 1910. The rib profile is very close to Monash's original, but incorporates the enlarged oculus and reduced glazing panels of the final scheme. At some time on or before 27 April 1910, the architects prepared a drawing of yet another profile for the intermediate rib to be sent to Truscon. The extrados or top surface lies on a single circular arc of radius 79 feet [23.7 m]. The intrados was also a single arc. A note on the drawing (which provides the only means of



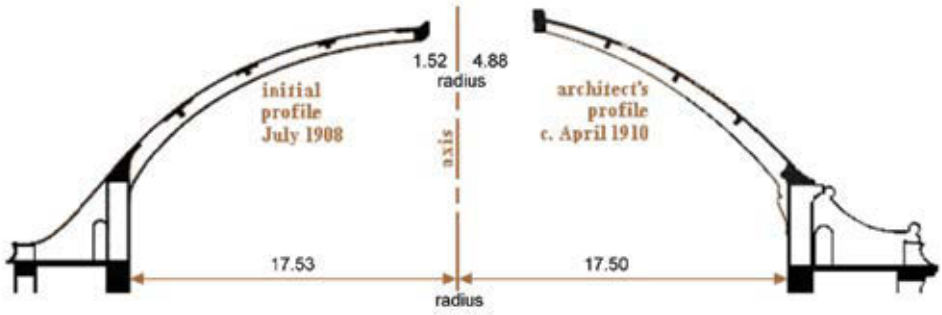
The Monier dome design. part-section as designed by John Monash, 1908. Labelled as designed J. M. [Monash], 4.7.08, traced J. A. L. 6.7.08, and marked 'superseded', from the John Thomas collection, per Trevor Huggard, 1984.



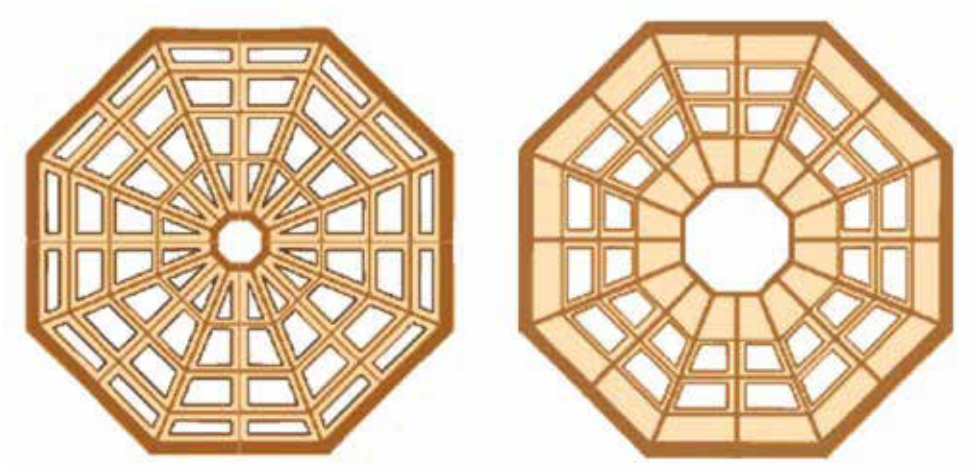
The Truscon dome design. Bates Smart Collection, University of Melbourne Archives.



'New Reading Room M. P. L. Detail of Junction of Main Octagon Beams & Columns' by Bates Peebles & Smart [1910]. SLV, H2010.69/68.



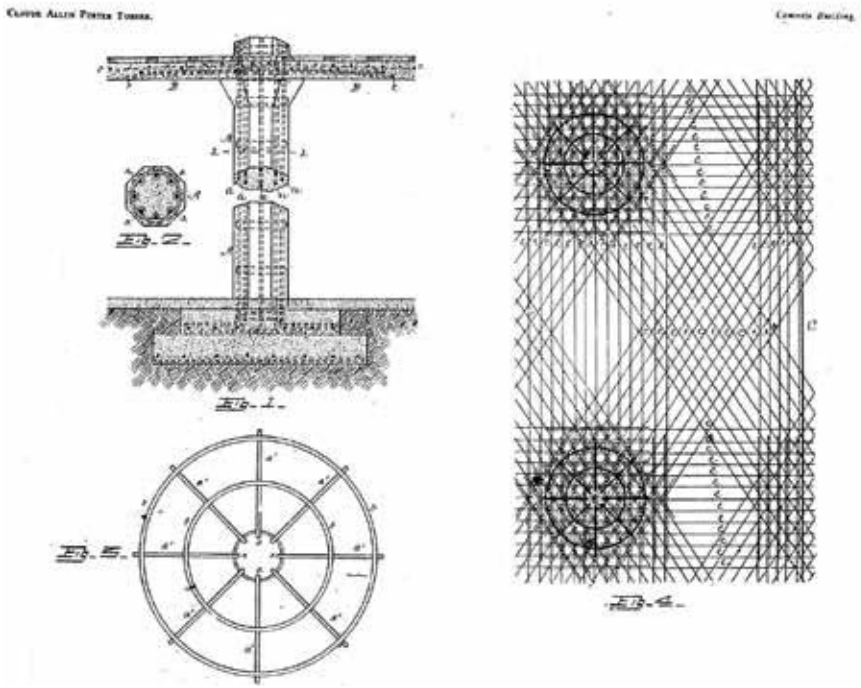
Alan Holgate's diagram of changes in the dome design (whether before or after the Truscon contract is unclear). Holgate, Monash web site [modified].



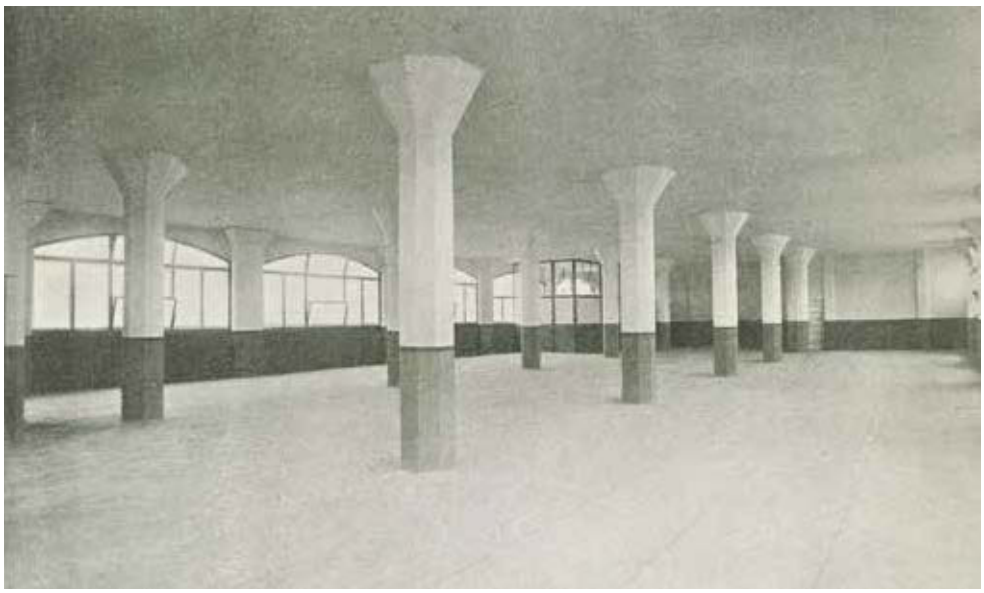
Alan Holgate's comparison of the dome plan as shown in a schematic plan of the dome as conceived by John Monash, Reinforced Concrete and Monier Pipe Construction.

dating) gave Truscon permission to make a slight modification if necessary but required them to maintain the rise of the soffit at 26 ft 10 in [8.05 m], a small increase upon the original profile.[59]

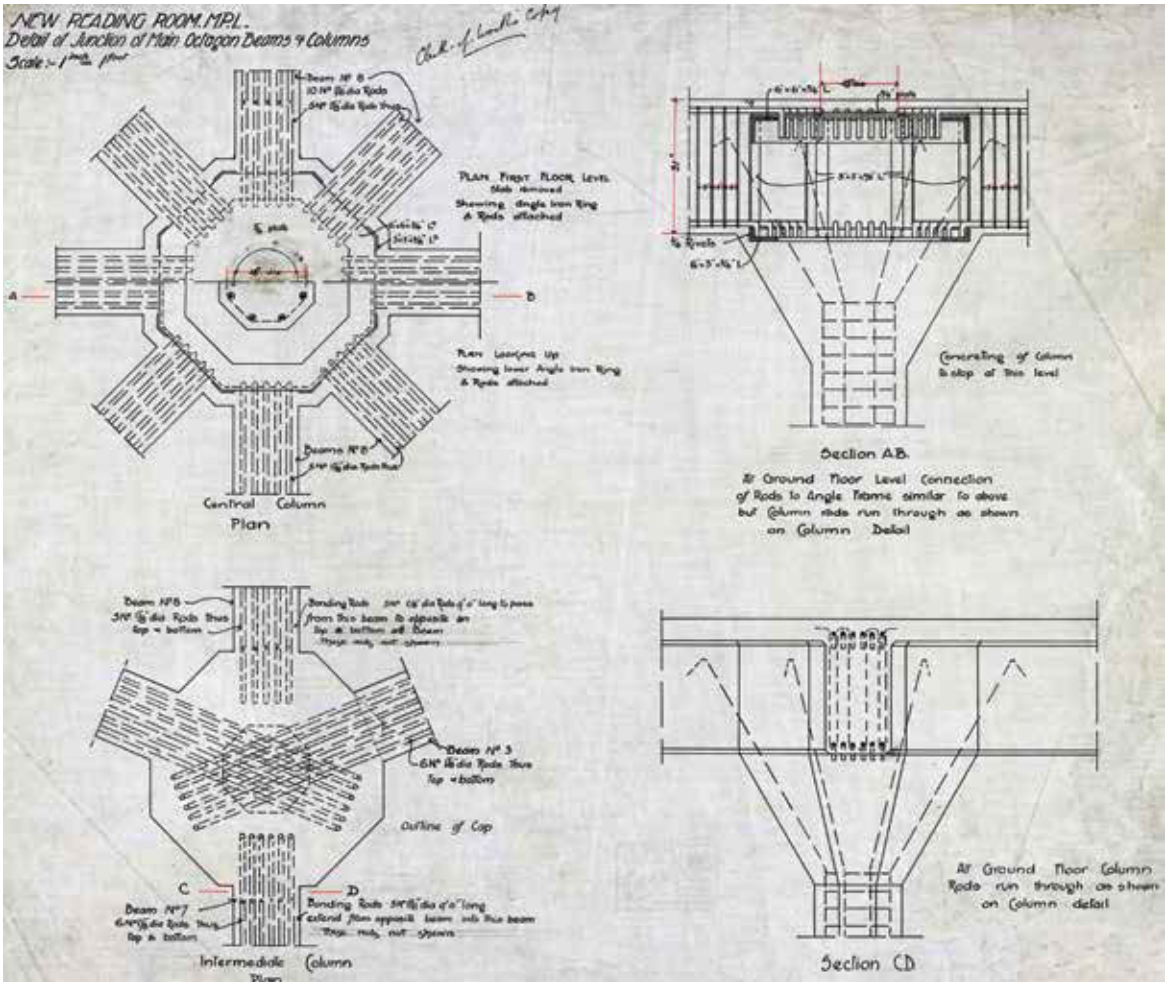
Monier construction in Melbourne was generally of a very standardised type. The columns were square, the bays were square or as near square as the plan conveniently allowed, and each bay was bounded by a pair of primary beams along the column alignment in one direction, and had three secondary beams in the other direction. Neither the square columns nor the standard grid were suitable for the polygonal plan of the reading room, in which the columns supported beams coming in from different directions.



Australian Patent no. 7296/06 to C. A. P. Turner, 7 November 1906, detail.

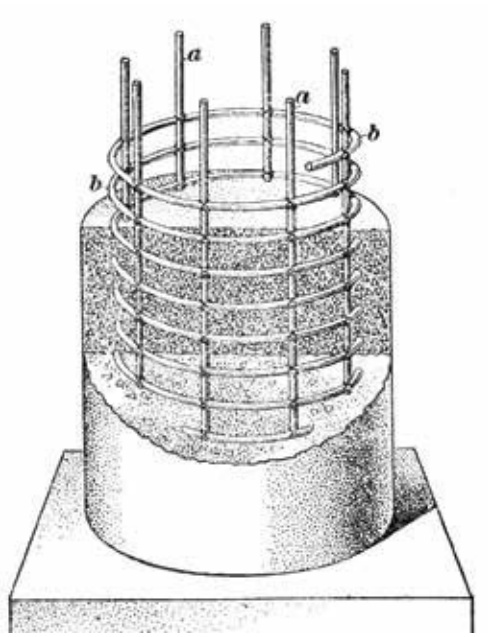


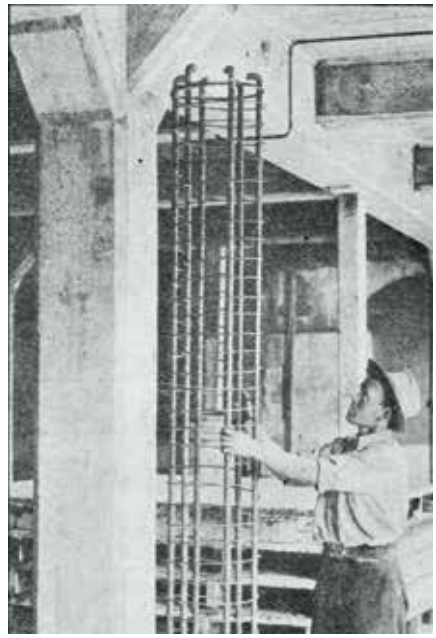
Sniders & Abrahams building, Drewery Lane, by H R Crawford, 1909-10. interior view of the top floor showing Turner system octagonal columns and heads. *Building,* 11 June 1910, p. 60.



'New Reading Room M. P. L. Detail of Junction of Main Octagon Beams & Columns' by Bates Peebles & Smart [1910]. SLV, H2010.69/68.

The solution, which probably originated with Monash and was then carried through in the Truscon version, was to copy the columns and column heads used in the Sniders & Abrahams building, Drewery Lane, off Swanston Street, almost opposite the library. This is a notable example of flat plate construction according to the American system of C. A. P. Turner, somewhat modified in Turner's Australian patent. The resemblance in form is cosmetic, because the structural and design issues were quite different from those applying in the library building. A cylinder is a more efficient form than a square pier for use in a solid column, and Turner's columns in the United States are indeed cylindrical. But forming a cylindrical column (in the days before cardboard tubes) is problematic, and for a carpenter using flat boards an octagon is a very fair approximation.





The Considère system as used in columns: International Library of Technology, *Stone &c,* §45, p. 22. Dennys Lascelles Austin Building, Geelong, by E. G. Stone, 1910-11, reinforcing bars for a column: *News of the Week,* 321 (2 November 1911), p. 16.

In the flat plate system there is a great concentration of reinforcement around and above the column head, and a high level of punching shear, both of which Turner dealt with by flaring the column head out to a larger diameter. However, this was a particularly complex form to create, and in his Australian patent Turner simplified it into a polygonal cone, within the capacity of an ordinary carpenter. This was possibly the work of the Australian agent Hugh Ralston Crawford, rather than of Turner himself. This form as used at the library entirely lacks the structural rationale which applies in the flat plate system, and in fact appears rather clumsy when placed below the beams.

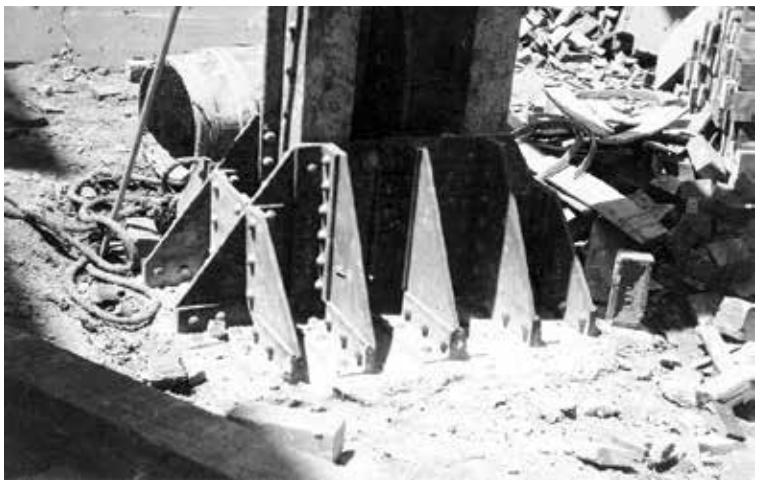
This was not the end of Peebles's borrowing from other systems. The drawings for the octagonal columns show the vertical reinforcing rods contained in circular 'ligatures' of 1/4 inch [6.5 mm] diameter steel at four inch [100 mm] spacing. Now true ligatures are merely wires to hold the rods in the correct position, and have no structural function. They need not be as large as 6.5 mm diameter, and certainly not spaced as closely as 400 mm. The scheme here seems to reflect the influence of Armand Considère's 'hooped concrete', or *béton fretté,* in which the vertical rods are surrounded by a spiral of reinforcement. This had a structural effect, in increasing the compressive capability of the concrete within the spiral. Considère's system was introduced to Australia at about this time by the engineer E. G. Stone, in his Dennys Lascelles Austin warehouse, Geelong.

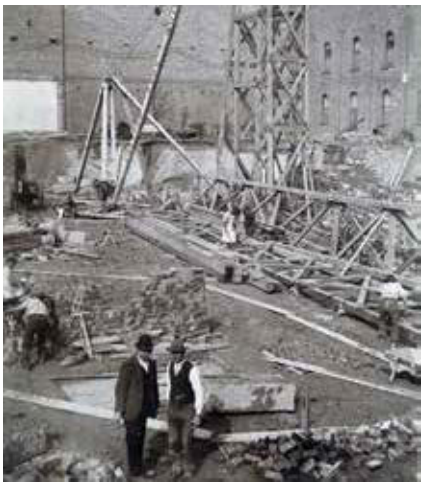
Construction

On 26 October 1909 the foundation stone was laid by the Governor of Victoria, Sir Thomas Gibson-Carmichael. The progress of the concrete work is unusually well documented by a series of thirty-five gelatine silver photographic prints which survived in the papers of John Richard Thorpe Clark, foreman in charge of the concreting. Clark was a carpenter and joiner by trade born in England, who emigrated to Australia in 1887 and later worked in South Africa for six years. After returning to Melbourne, he was employed by the contractors Swanson Brothers from July 1909 as foreman in charge

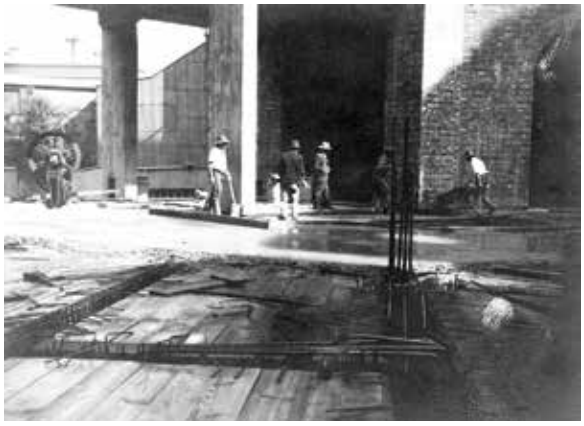
Laying concrete on the roof of the annulus corridor, c. 1910. J. R. T. Clark, foreman in charge of the concreting, standing at centre in waistcoat and bowler hat. Clark photos, SLV, H93.39/27

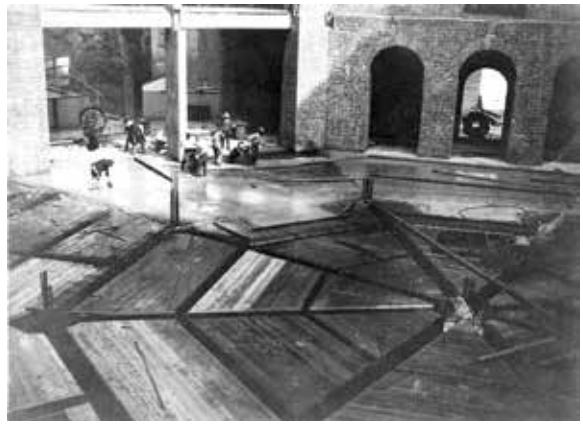
Above: Brick footings at for the octagon wall, c. 1909. Clark photos, SLV, H93.39/2; H93.39/4.
Top: Excavations at basement level, prepared for the pad footings of the stanchions. c. 1909. Clark photos, SLV, H93.39/1; H93.39/5.





Base of what is probably one of the steel columns of the annulus. Excavations for footings and scaffolding tower at basement level. Clark photos, SLV, H93.39/6; H93.39/3.





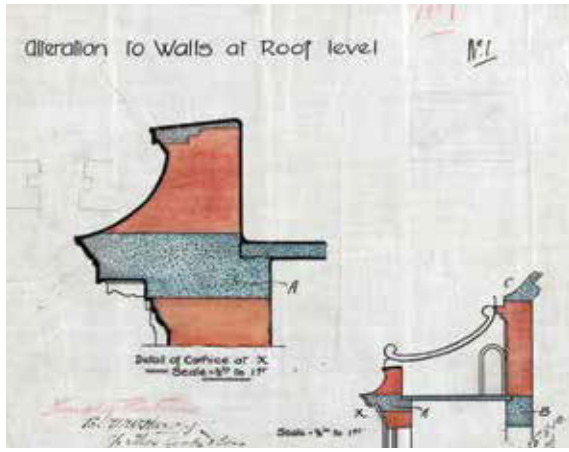
Construction at ground floor level, 1910: looking south along beam no 3; concreting the floor slab. Clark photos, SLV, H93.39/9; H93.39/10.

Three scaffolding towers supporting a crane, 1909; the wall from the outside, with the crane support visible through the opening. Clark photos, SLV, H93.39/18, H93.39/1.

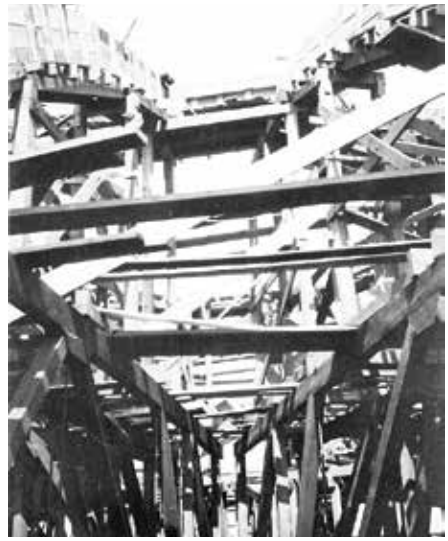
of the reinforced concrete work for the domed reading room. (He was the father of the noted children's author Mavis Thorpe Clark). The photos were given to the Library by Ms Susan Thorpe Clark in 1992. The architectural supervision of the construction was not by Peebles, but by his partner C. P. Smart.[60]

Timber scaffolding and hoist, c. 1910. Clark photos, SLV, H93.39/26.

Above: Looking east at first gallery level 1909. Clark photos, SLV, H93.39/15.
Below: Completing the drum in 1910: looking south-west at a rolled steel joist and the base of the continuous (reinforced concrete) lintel; looking south-east from the top of the continuous lintel. Clark photos, SLV, H93.39/17; H93.39/11.

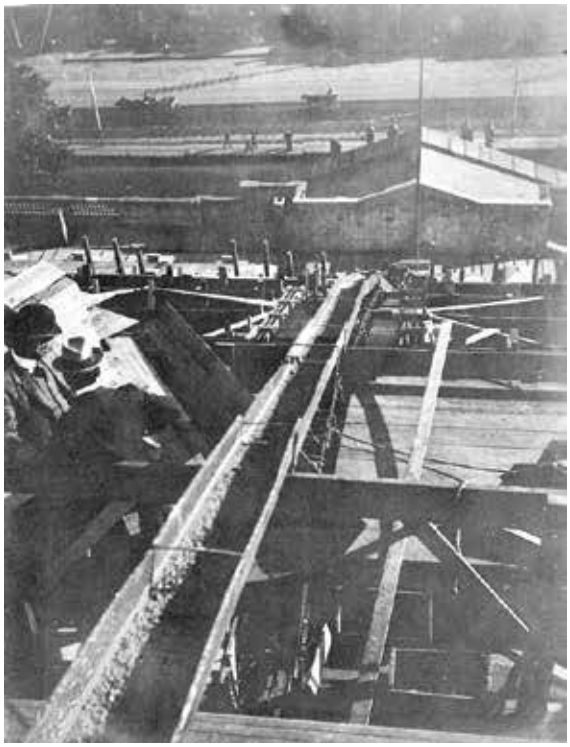


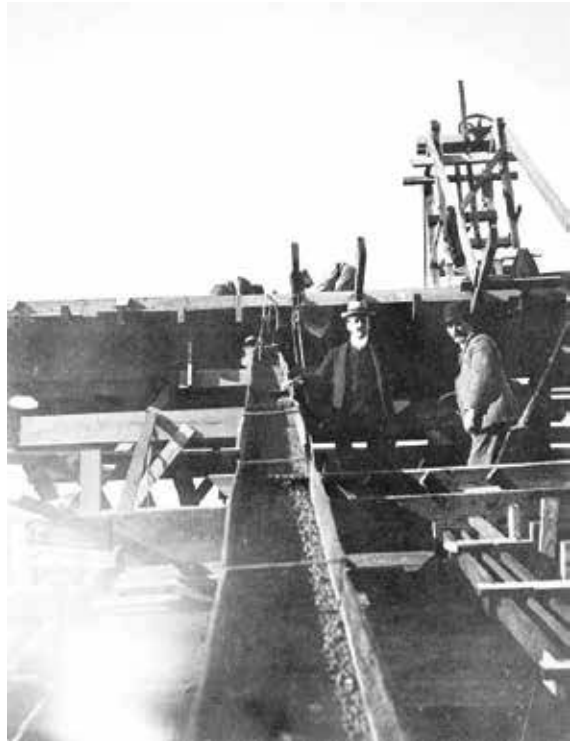
Above: View along the south-east side of the annulus roof, with projecting rods designed to tie into the brick buttresses: Clark photos, State Library of Victoria, H93.39/33. The altered buttress design, 'Alteration to walls at roof level [Domed Reading Room, Melbourne Public Library] / Bates Peebles & Smart. Annotated in red crayon and black ink l.l.: Kindly Return / to W W Harvey / c/- Thos Cook & Son / Ludgate Circus / London. Annotated in black ink l.r.: Recd 25.5.10 / WWH. SLV, H2010.69/78. Below: Concreting a 21 x 24 inch [525 x 600 mm] beam under a roof buttress. Clark photos, SLV, H93.39/126.



Above: Timber formwork for the arched reinforced concrete ribs of the dome, with scaffolding below; both 1911. Clark photos, SLV, H93.39/19; H93.39/21.
Below: 'Towers etc. [and] dome centering', 1911. Clark photos, SLV, H93.39/23.

The dome decorated for the completion of the formwork. *Building,* 12 June 1911, p. 53.



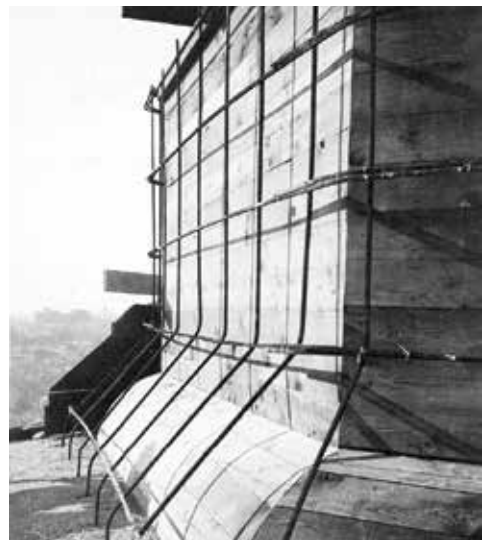


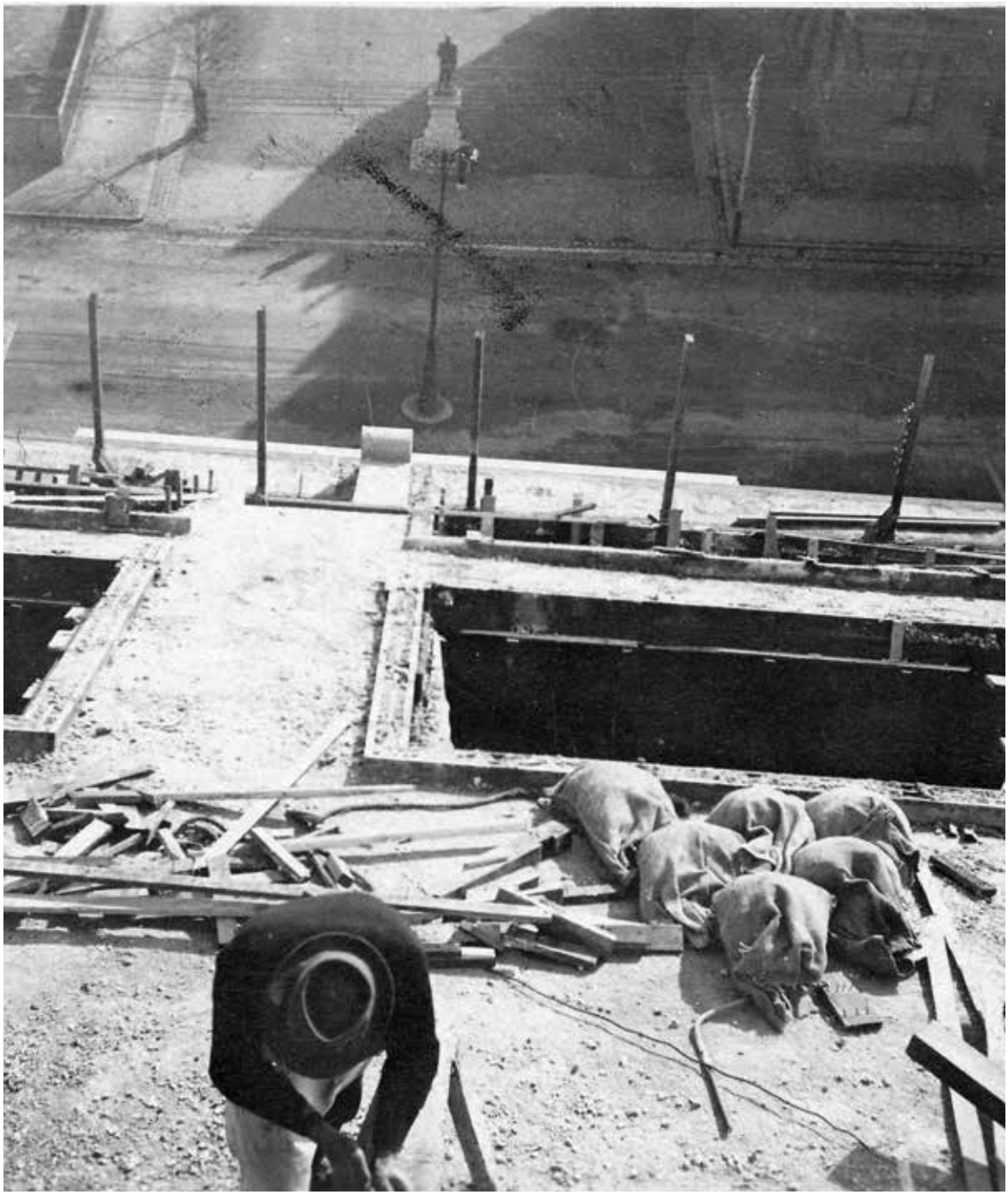
View down a concrete chute towards the library forecourt; view up the chute towards the crown of the dome. Clark photos, SLV, H93.39/3, H93.39/24.

The concrete for the dome was hand mixed in the basement by a crew of twenty men[61] in the ratio 1:2:3 of cement, sand, and ¾ inch [19.5 mm] bluestone screenings, and shovelled into trucks. A platform about six metres square was constructed above the central lantern light, supported by the centering below, and an electrical hoist raised the trucks of concrete up to this platform where it was dumped, and immediately shovelled by hand through hoppers in the floor of the platform, which discharged it into the heads of chutes which conveyed it by gravity to the points required on the dome. An article in *Building* of 12 June 1911 described the process as follows:

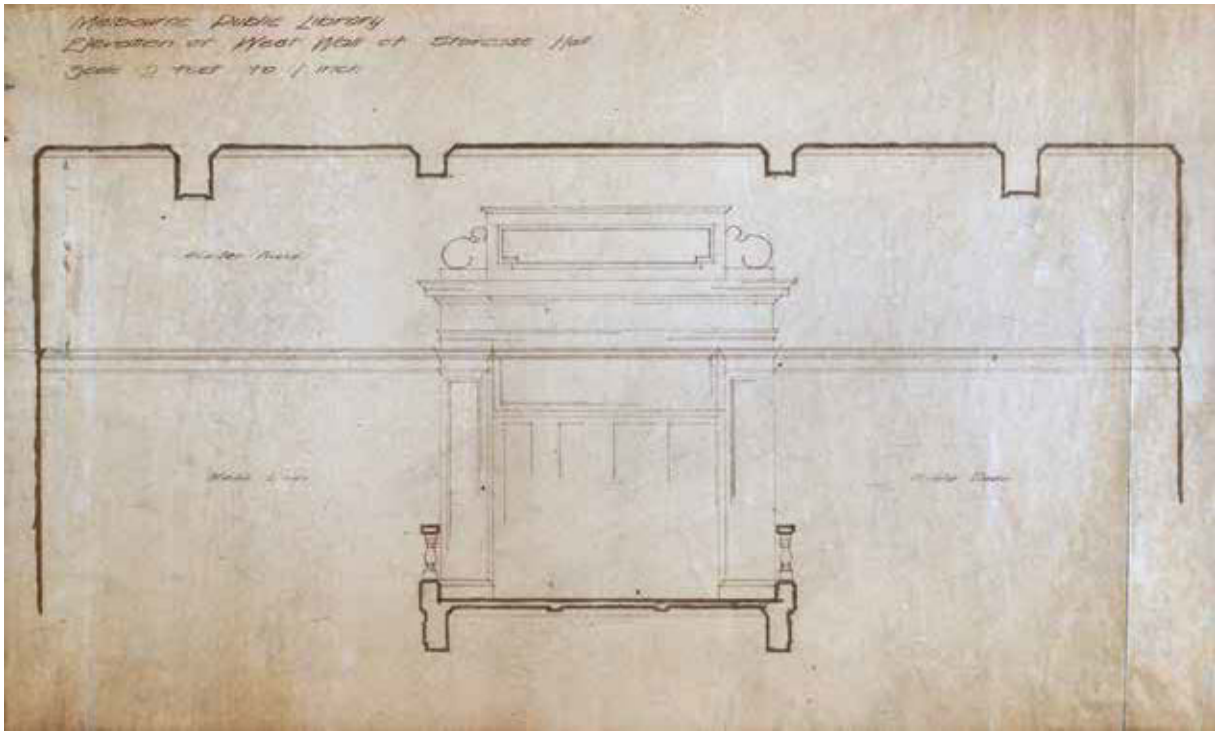
> every half minute with a roar and rattle a ton of concrete is shot up from below, and a gang of men fall on it, and as quickly throw it into chutes conveying it into the great steel-laced ribs.
>
> Down the concrete flows in a never-ending stream, covering the spider web of steel and locking it from mortal gaze for perhaps ages to come.

Above: Constructing the base of the dome c. 1911, with the Kahn reinforcing bars visible, Clark photos, SLV, H93.39/28, H93.39/30.
Below: Completing the monitor lantern at the crown of the dome c. 1912. Clark photos, SLV, H93.39/29, H93.39/32.





View from the top of the dome looking down at the statue of Sir Redmond Barry in the Library forecourt, showing two of the dome lights, c. 1912. Clark photos, SLV, H93.39/34.



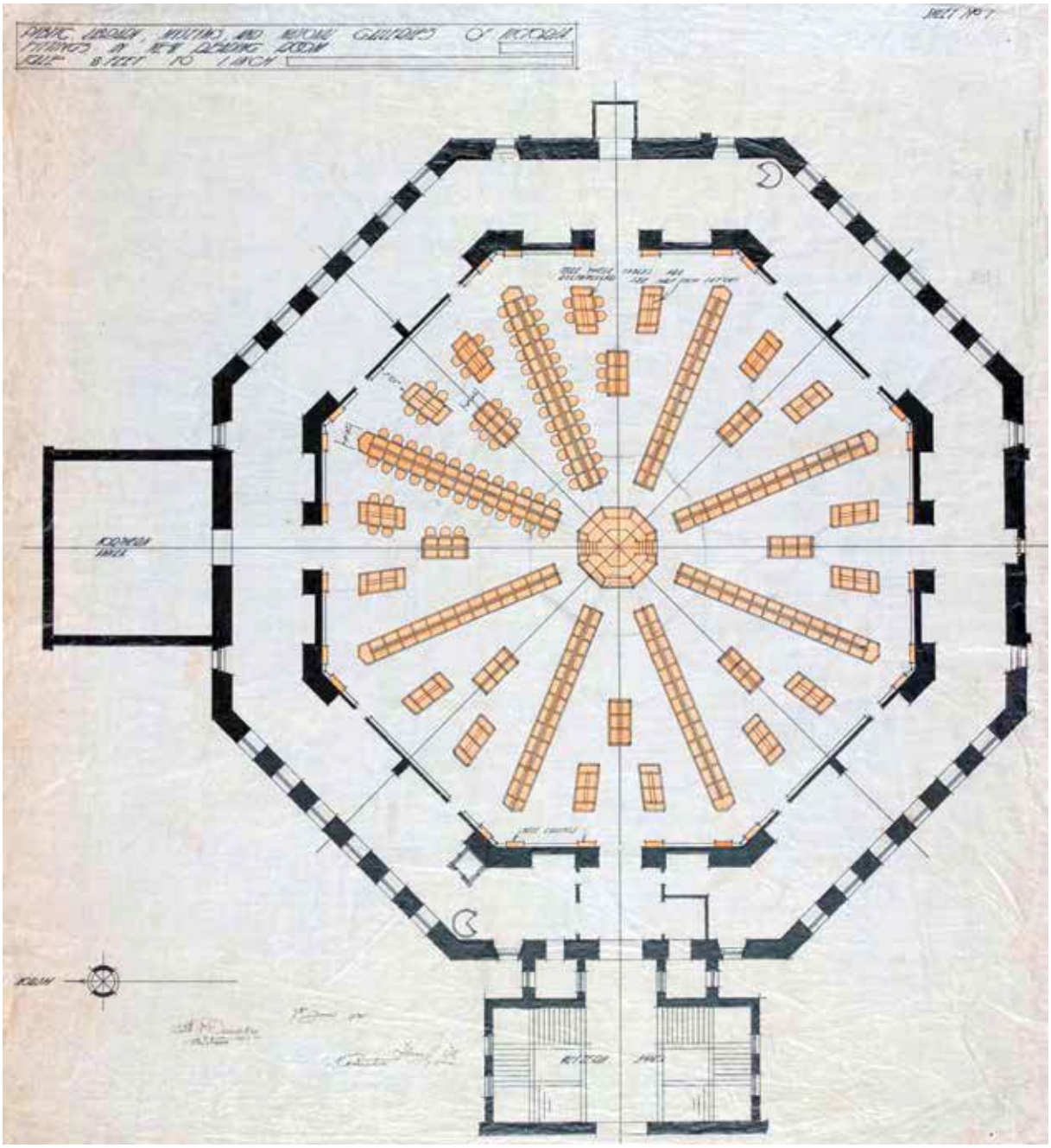
'Melbourne Public Library, Elevation of West Wall of Staircase Hall' [West Annex of Domed Reading Room] Bates Peebles & Smart [1910]]. SLV, H2010.69/86.

The work began with the buttresses, then the heavy circumferential ring, and then the dome structure itself.[62]

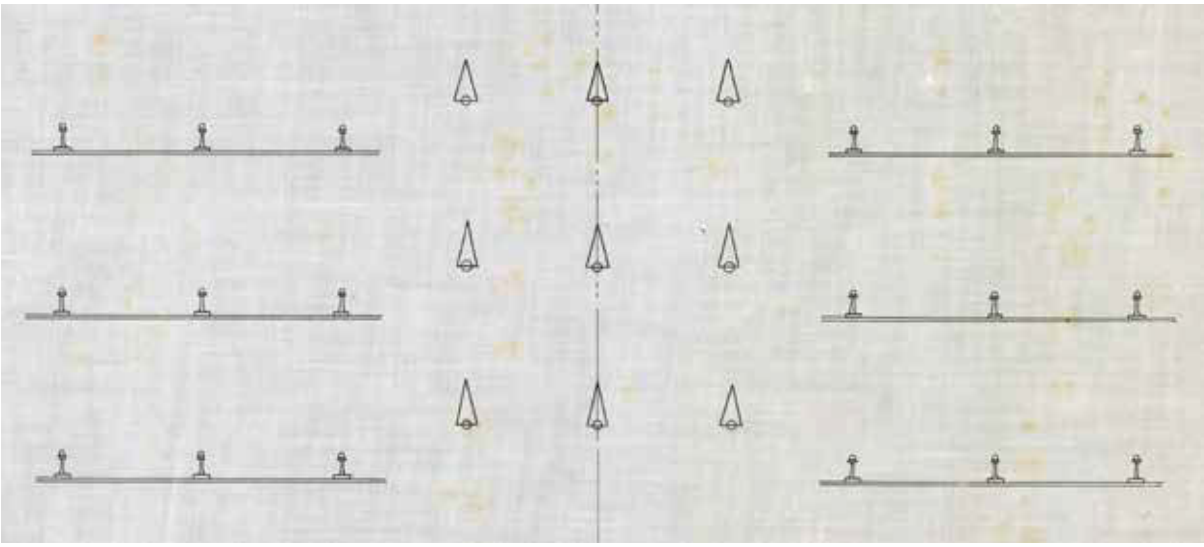
On completion the timber centering was left in place for four months, then gradually eased off by slackening wedges on top of the timber trusses, after which the dome deflected just under five millimetres.[63]

Another controversy flared during the course of the contract, for the state government wished Victorian marble to be used for the entrance and staircase, specifically the Buchan marble from near Orbost. But because of uncertainty about the viability of the as yet untried quarry, and the quantity available, 'Australian' marble was specified. Swanson Brothers now proposed to use marble from New South Wales, not because of any practical problem at Buchan, but because they thought the cost 'unreasonably high'.[64] Ultimately the Victorian stone from the Buchan quarries was used[65] and Swanson Brothers were allowed an extra shilling per cubic yard.[66] In 1912 the closing phases of construction were entered, and tenders were accepted for the electric light installation, lifts, and the chairs and fittings.[67]

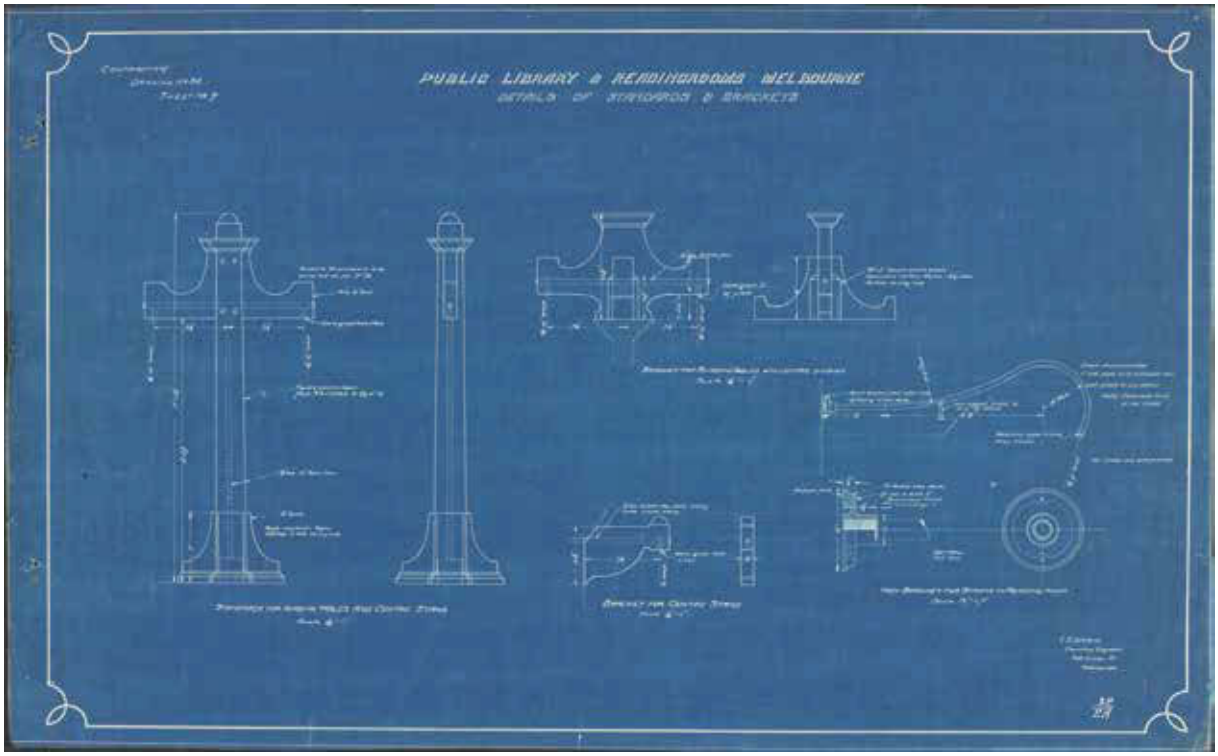
The initial plan for furnishing the reading room shows the layout of the desks and tables as it eventuated except that the outer tables are parallelograms rather than



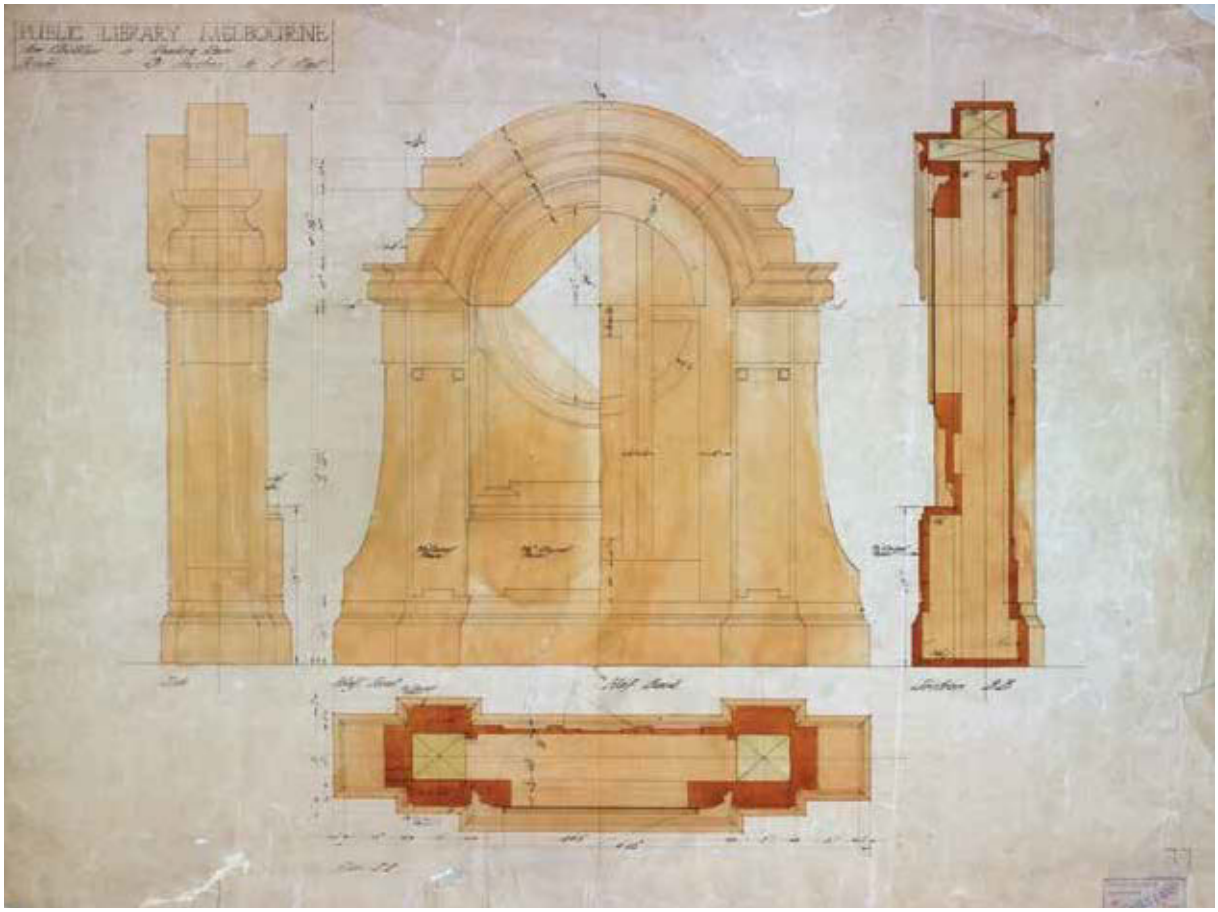
Public Library, Museums, and National Galleries of Victoria. Fittings in New Reading Room, by Bates, Peebles & Smart, contract signature 7 January 1912. SLV, H2010.69/64.



'Suggested general lighting for Reading Room' [1912]. Stamp of the City Electrical Engineer's Office initialled in ink l.r.: H. R. H. / per C. S. D. [Herbert R. Harper, C. S. Demaine]. SLV, H2010.69/88. Detail.



Details of lighting standards & brackets, by Charles S. Demaine, consulting engineer [1912]: blueprint. SLV, H2010.69/89.



Working drawing for the clock case erected on the west gallery of the Domed Reading Room, showing a side elevation, half front and half back elevations, section B B (vertically through the centre) and plan A A (from beneath the curved surrounds of the clock face). SLV H2010.69/90.

rectangles, in an attempt to conform to the radial geometry of the layout. The problems would have been substantial - for example would the tilting reading surfaces have been made in the same shape? - and wiser counsels must have prevailed. Tenders for the fittings of the Domed Reading Room were accepted from Thomas S. Gill, at a cost of £4,113 in 1912. The overall scheme for the electric lighting seems to have been suggested by Herbert Harper, City Electrical Engineer, in a drawing which bears his stamp, but the fittings were designed by a consultant, Charles S. Demaine. The provision of sixty-three power points for vacuum cleaners[68] seems forward looking, but not as much as do the reticulated suction tubes installed in the same year at the Commercial Travellers Association clubhouse and adjoining Commerce House in Flinders Street.

Possession was taken of the completed reading room in October 1913, and on 14 November, it was opened by the Governor-General, Lord Denman.

The completed reading room. Bates Smart Collection, University of Melbourne Archives.

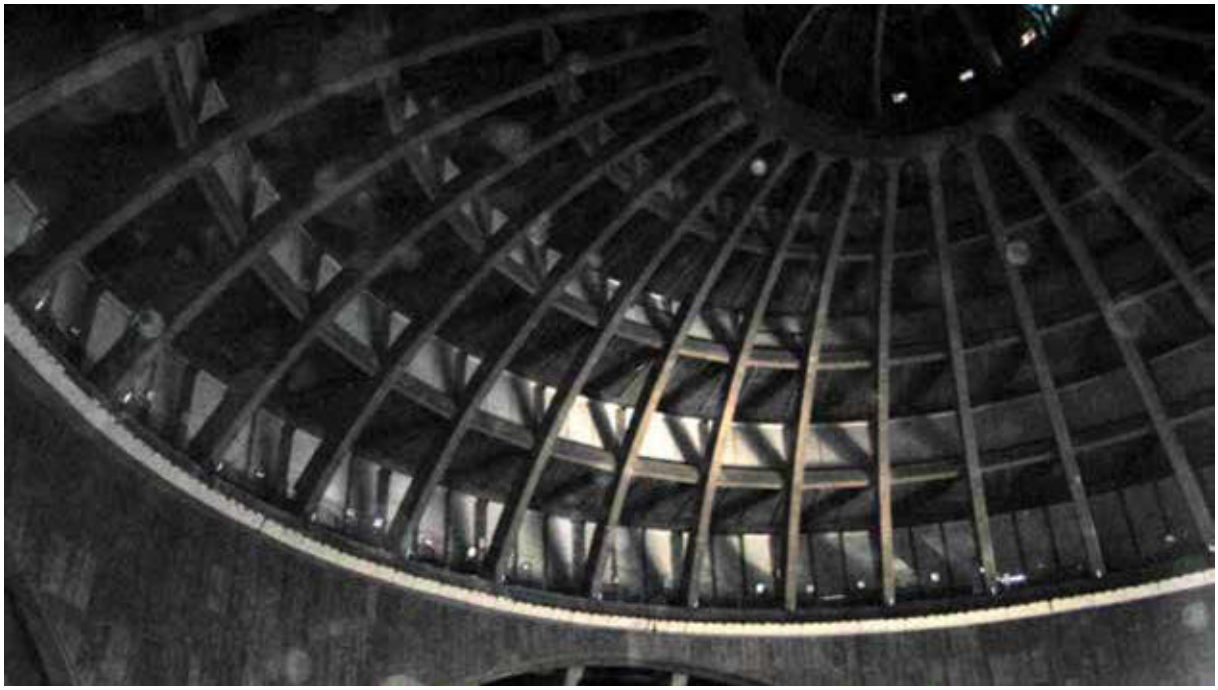
Domes and Spans

George Taylor of the magazine, *Building,* who had been so hostile when the Monier monopoly was at issue, was now full of enthusiasm, and wrote of the dome as 'The Greatest on Earth'.[69] For the dome was, arguably at least, and only for a very short time, the largest such structure of reinforced concrete in the world, 34.75 metres in diameter and the same in height, just exceeding the 33.7 metres of the saucer dome of the church of St Blasien, Germany, constructed late in 1910,[70] and the 32.7 metres of the conical 'dome' of the Villa Marina Kursaal, Isle of Man, the largest in the British Isles.[71] But this is unremarkable given that the Pantheon in Rome, which is, of course, of plain rather than reinforced concrete, has a span of 43.3 metres. The British Museum reading room of 1854-7 is almost as large as the Pantheon, 42.6 metres, but is not of concrete.[72]

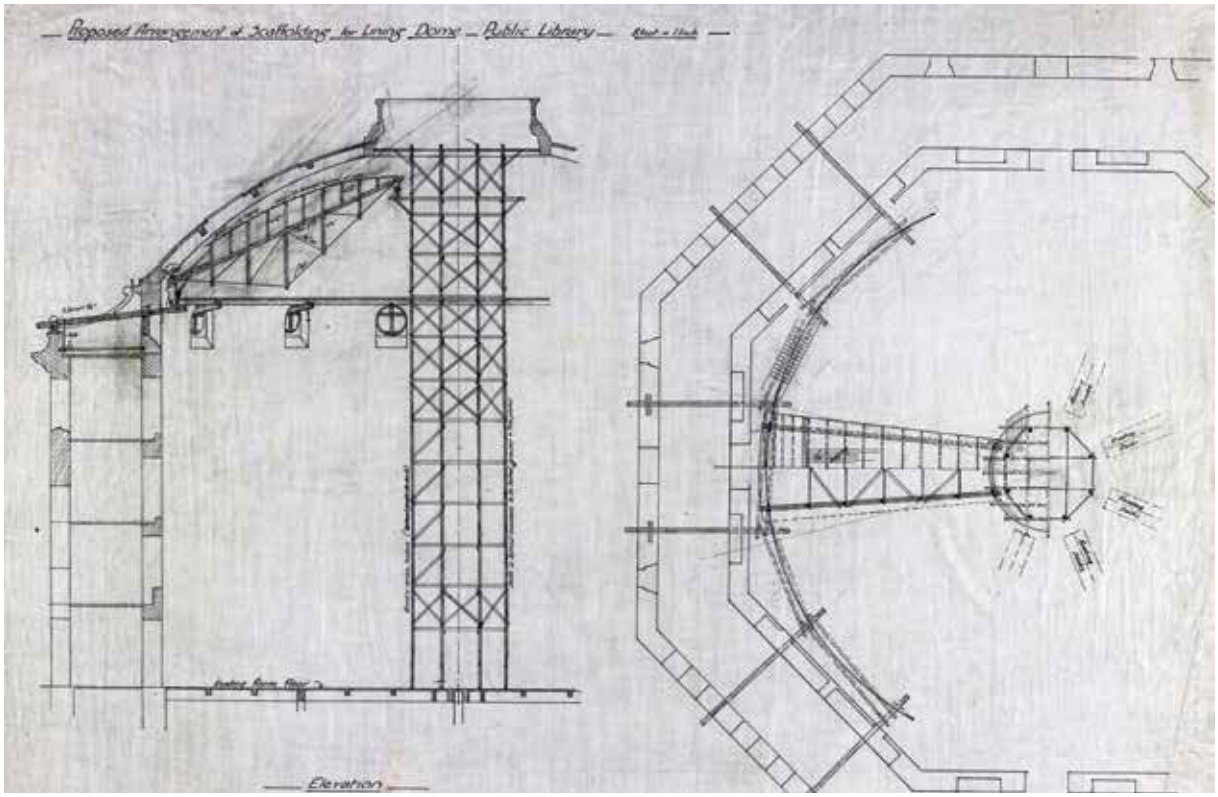
In term of span alone the Melbourne reading room was far exceeded by the 54 metre trussed concrete roof already completed at the Dennys Lascelles Austin Wool Store in Geelong in 1910-11, which is not a dome but something like three trussed bridges in parallel. Even as a dome, and indeed as an architectural concept, it was very soon completely eclipsed by Max Berg's Jahrhunderthalle or Centennial Hall at Breslau in Germany (now Wroclaw, Poland) of 1912-13, a saucer dome of 64.55 metres diameter.[73] Given that both were occupied in 1913 it could be argued that the Melbourne structure never held the record, but the Centennial Hall was started much later and seems to have reached structural completion a little later as well.

Left: The ground floor as constructed. SLV, H9217. Right: Dennys Lascelles Austin & Co Wool store, Clare, Corio & Brougham Streets, Geelong, by E. G. Stone (1909) 1910-11, with a clear span of 53 metres (the props were modern, and proved superfluous). Demolished 1990 at the instigation of the Cain Labor Government.

Jahrhunderthalle [Centennial Hall], Breslau, Germany; now People's Hall or Hala Ludowa, Wroclaw, Poland, by Max Berg, 1913. (Miles Lewis).



Jahrhunderthalle, interior. (Miles Lewis).



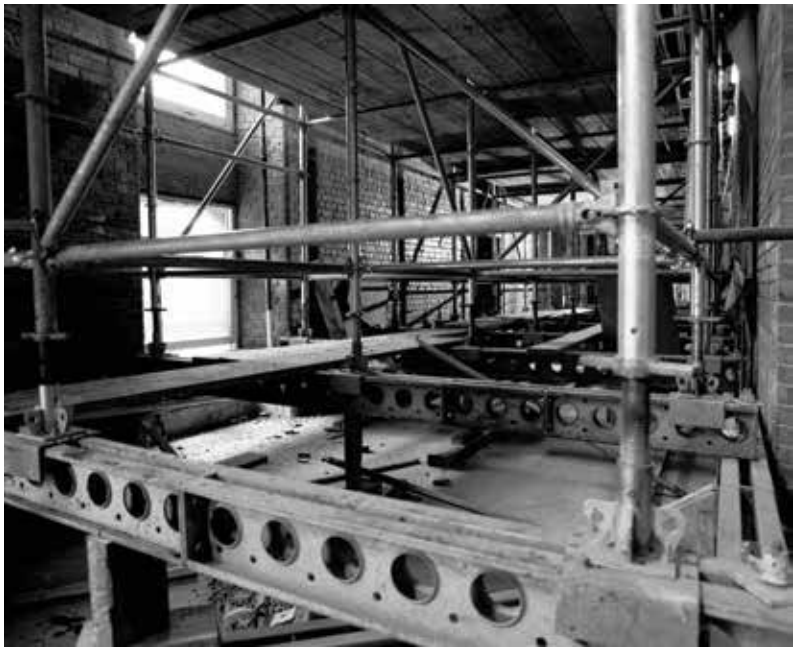
Proposed arrangement of scaffolding for lining Dome – Public Library / The Reinforced Concrete & Monier Pipe Construction Coy Propy Ltd. 4 March 1918. J. A. Laing ; Bates Peebles & Smart, architect SLV H2010.69/92. This was the relining required after the failure of the plaster.

Afterwards

The plan was less than ideal in terms of staff accommodation. The heating was by means of furnaces which warmed air drawn in by fans from the roof, and often failed to work properly. The books in the open stack were difficult for the public to reach and required ladders. On one occasion a piece of plaster fell from the roof and knocked a visitor unconscious, and when he recovered sufficiently to look for his assailant he was barely restrained from assaulting the Chief Librarian.[74] Ironically the Reinforced Concrete & Monier Pipe Construction Coy, which had been ousted from the original contract to construct the dome, seems to have been brought to reline it in 1918. That at least is the intention indicated by the company's drawing of scaffolding to be used for the purpose. In 1922 the Trustees offered prizes for a mural war memorial, to be placed on the upper portion of the wall on the west side of the staircase hall, leading into Queen's Hall. And the war artist H. Septimus Power was awarded first place. His mural was unveiled in 1924.

Above: Men on a suspended scaffold, said to be for repairs to the glass skylights, c. 1918, but more probably for the lining work. Photo by Sutcliffe Pty Ltd. SLV, H36621.
Below: Scaffolding of the Reading Room, 27 June 1958, photo by C. A. McCallum, Chief Librarian, SLV, H40298.

Copper cladding of the dome by Specialised Building Services Pty Ltd of Moreland, 1959. Photo by Wolfgang Sievers. SLV, H2001.172/1.



Work in the annulus 2001. SLV, H2013.204/137a.

The reglazed dome 2001. SLV, H2013.204/41b.

Later the dome lining seems to have been defective again, probably due to the fact that there were problems of leakage in the concrete skylight frames, and these defects resulted in drastic action by the Public Works Department, which in 1958-9 lined the inside of the dome with fibrous sheets. The exterior was covered in copper, by Specialised Building Services Pty Ltd of Moreland, blocking the lights and destroying much of the original interior character.[75] It was more than forty years before the skylights were reopened and the original character of the interior restored. Meanwhile books were stored in the basement, which had not been designed for the purpose and was not fully waterproof.

In the late 1980s there was extensive debate about the future of the site and the two remaining institutions, the State Library of Victoria and the Museum of Victoria. The issue was whether one or other should move from the site and be given a purpose-built home elsewhere (which both desired), or whether the adjacent Queen Victoria Hospital site should be used for one of them, or, just possibly, Little Lonsdale street should not be the absolute divider, and there should be some shared facilities. Complicating the issue was the question of how much of the existing building complex must be kept for heritage reasons, or because there were structures and spaces which were in fact still useful. That in turn raised questions as to how much alteration or renovation to these surviving structures would be acceptable. At one point it seemed to have been settled that the Museum would remain and the Library would have the hospital site. Proposals were floated for the Museum's use of the spaces, including a historic aeroplane to be suspended in the reading room – an idea received with hostility by admirers of the dome. Ultimately the Queen Victoria site was disposed of separately and the Museum was allocated a site on the south side of the Yarra. How it came about that the Museum was instead built in the Carlton Gardens, and the Melbourne Exhibition Centre built on the foundations intended for the Museum, is another story not to be pursued here. The outcome was that the State Library was left in undisputed possession of its site, the voids surrounding the octagonal structure were filled, and the whole complex was renovated successfully, with the domed reading room remaining as its focus.