

Paper No: 319 Influences on lighting performance: the case of the 1908 Carnegie Public Library at Wednesbury, Birmingham, UK

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Abstract

Towards the end of the nineteenth century, during a period of technological change, design guidance and standards for lighting in early public libraries were formulated at a rapid pace. With the aid of philanthropy, libraries began to proliferate across Britain and America. The emergence of this new typology within polluted industrialised towns exacerbated the requirements of daylight design and increased the desire for electric light as it became more widely available. These functional buildings, as “free libraries,” were also required to invent precedents for new kinds of publicly accessible interiors. A detailed case study of Wednesbury Library, by Crouch, Butler and Savage, 1908, examines how contemporary theory, formulated in response to economic and environmental constraints, affected the delivery of this new form of public light in practice.

Keywords: library philanthropy daylight artificial illumination smoke

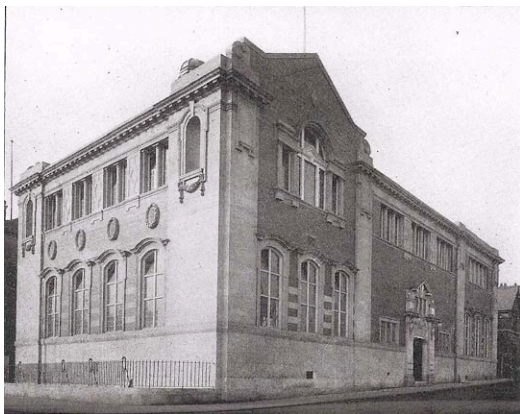


Fig 1. Wednesbury Library 1909 [1]

1. Introduction and methodology

Designers were required to provide “perfect lighting” [2] in early public libraries despite having limited economical, physical and technological possibilities available to them, in comparison with today. Furthermore, lighting performance was often directly linked to a requirement to mitigate against the effects of pollution. Public libraries had initially proliferated as philanthropic gifts. The industrialist, Andrew Carnegie, supported the building of 2094 public libraries across Britain and America between 1881 and 1910 [3]. Both the transatlantic link and also the engagement of a single organisation in the procurement of one building type were unprecedented developments in modern building practice. Safe artificial lighting, in the form of electric light, had become widely available for the first time between 1880 and 1890. The initial beneficiaries of Carnegie’s philanthropic gifts were largely heavily polluted industrial towns. It was from these heightened environmental contexts that the emblematic significance of artificial lighting and the challenge

of designing economic natural lighting rapidly developed into architectural precedents for the identity of public light within libraries in Britain and America.

In evidence of these influences, both design strategies for light and its performance in Wednesbury Library are assessed at a series of architectural scales. At each scale, the design responses to local environmental factors, contemporary architectural guidance as well as the influence of experience built up by the Carnegie Corporation are examined. The study correlates contemporary theory with evidence of its observation in practice and models its performance in relation to its historic environmental context.

2. Design Strategy Issues at 1:10,000

2.1 The elevation, orientation, latitude and sunshine hours at the site

Elevation = 143m

Orientation = East and South

Latitude = 52°33'13.61" N (2°01'00.56" W)

Prevailing wind direction: SW-NE

Average Annual Sunshine Hours: 1379.2 [4]

2.2 The level of pollutants in the air; visibility, corrosion, staining

A 1905 report estimated the average loss of light for the year in the “smokiest towns” to be 45% and comments on the consequent additional cost of illumination [5]. Wednesbury was at “the very heart and centre of the South Staffordshire Black Country” [6], a region identified by a description of its pollution [7]. The immediate presence of the iron and steel industry, the general domestic burning of coal and the location of the library, in receipt of the prevailing wind across the entire

Birmingham conurbation would concentrate the airborne products of combustion there. This effect is self-evident in the sulphuric erosion of the limestone south facade of the library and its granite plaque, which is completely illegible less than 100 years after it was set. Wednesbury librarian, Thomas Stanley, had appealed to Andrew Carnegie in 1903 for a replacement of the previous library as: "The chemical action of the atmosphere arising from (the adjoining works) is proving most detrimental to the books in the library" [8].

Metallurgical furnace smoke was identified as the highest contributor to smoke "nuisance" of all [9]. The local reliance on the source of pollution as the main source of employment for the town's inhabitants ensured that people were not motivated to complain about its environmental effects. Notably, the Sanitary Authority of Wednesbury failed to respond to a questionnaire on smoke prosecutions by The London Coal Smoke Abatement Society in preparation for a report for the Smoke Conference Report to be delivered at the South Kensington Smoke Abatement Exhibition, 1905. [10] The sole recorded voice publicly complaining about smoke was from nearby Coseley Hall, overlooking the railway line between Wednesbury and Dudley. He wrote: "the smoke is absolutely poisonous and is held in a close atmosphere for a long period. It permeates every room in my house and is doing damage in every possible way. In addition to this the annoyance is personally unendurable, particularly when the wind is in the east." [11]

2.3 The catchment area of the library; its industrial and residential neighbours

In order to judge the significance of the new library building and its internally illuminated environment, it is important to identify the environmental context against which its contemporary customers would experience it. The population of Wednesbury had multiplied by 6.5 times between 1801 and 1901. Coal mining had declined from 16 open pits in 1889 to none by 1915. [12] By 1907, the council's Town Guide states: "The town is purely industrial". [13] The physical transformation of the landscape of the town was thus recently vastly altered from a largely exposed external working world of open black fields to a built up enclosed working world of maximum scale factories.

The 1907 guide describes the new residential area extending to the north east from the library site as "breezy". [14] However, maps reveal that the majority of the residential neighbourhoods consisted of older, densely integrated terraces which remained centrally located between mammoth new industrial buildings. The Crown Tube works being the largest and most central of these, covering an area of 6.5 acres in the centre of the town. The difference in scale between the internal working world and the private recreational realm was vast. Behind the factory's

masonry façade with its monotonous fenestration, detailed with the same proportions as an upscaled terrace, an array of steel framed sheds made use of the most economic building systems of the day.

2.4 The aspect and prospect of the building

The Carnegie grant had stipulated that the town must provide a site for the library [15]. Contemporary design guidance described the necessity of direct light for its "purifying properties" despite issues of annoyance and degradation to books, it emphasised the importance of direct light for rooms "to which the public are admitted" [16]. Public correspondence on the issue emphasized the need for a "clean and public position" [17]. Associated with the aim of cleanliness was a more general attitude to the purity of daylight.

The library's elevated location and south-eastern corner plot combine to maximise the sky view from its street-side windows, as advised in the first, 1897 manual of library construction [18]. The rights to "ancient lights" were secured in the brief, which stated that passages to the west and north should be left to be "used for light" [19]. In addition, minutes of the Library Committee record a decision to paint the walls of the neighbouring Conservative Club white in order to increase reflected light into the lending library [20].

Specifically in accordance with contemporary recommendation, the library faces south and east. Champneys, who claimed to write the first book on Public Library design in 1907, noted that west light, "which admits the almost horizontal rays of sun at the time of day when public libraries are often much frequented, should be as far as possible avoided" and that with an easterly aspect the sun is "to a large extent off the windows before its rays have attained their full power, and generally before the library is much used; while with a south aspect, the rays, at the time of year when their power is most considerable, fall at a steep angle and do not penetrate far into the room" [21].

2.5 The guidance or instruction to the architect

It is evident that great efforts were made in the briefing process to benefit from recent developments in library design. The Library committee visited newly constructed Carnegie libraries at Wolverhampton, Walsall and West Bromwich, then under construction, noting of the latter: "The building is admirably lighted and is said to contain the latest improvements and requirements in Library building which the great experience of the last ten years has found to be necessary and desirable." At Wolverhampton they noted that the library was "not well lighted" whereas at Walsall, they commented "the lighting of the whole building is admirable" [22]. The Librarian stated: "the lighting should be a matter of grave consideration to prevent disappointment in the future." The brief, subsequently phrased a

requirement that: "Daylight should be abundant, and carefully arranged to fall upon the fronts of the bookcases, and particularly both sides of the indicators. All rooms should be well lit, it being essential that as much light as possible shall be secured in every department" [23].

Significantly, the brief also demanded that architects submit and commit themselves to proposed costs for both the procurement and the running costs of the building, indicating that energy costs were considered as a responsibility of the designer. The procurement process was also influenced directly by Carnegie's secretary, James Bertram. He had corrected what he saw as an extravagant designation of space for staff in the initial brief, stating that: "a large community like Wednesbury requires all the accommodation that can be got for the money" [24], demonstrating his energetic influence in promoting his aim for more "effective" and economic library buildings. The competition was advertised locally and nationally, 43 applications were received [25]. The winning architects' recent experience of a building Carnegie library in Lancashire was perceived as an advantage [26].

3. Design Strategy Issues 1:1000

3.1 The significance and status of the new illuminated public rooms to the locality

The town clerk, Thomas Jones pleaded to Carnegie in 1903 referring to the fact that he had first seen and bought the steel making patent that made his fortune in Wednesbury: "We are an entirely working class town. Fifty years ago many of our best men went to the US where they assisted to build up the great industries of that great country" [27]. When the grant was finally given, Bertram formally acknowledged the reciprocity between Carnegie and the town: "Mr Carnegie will be glad to give £5000 stg. For the erection of a free public library building in Wednesbury to which he is indebted for it was there that his firm first saw the experiment in the basic open hearth process." [28]

At its opening, Councillor Beardmore "trusted that the beautiful building opened that day would be an object lesson to the youths and the young men of Wednesbury" [29]. The Library's position and appearance, contrasting stone and brick, tall windows, cupola and flagstaff, indicate that in civic terms, the library service was to be viewed as a source of illumination, a public periscope within which natural light and clean air might be understood to be captured and redistributed for the enjoyment of the individual within.

The use of Monks Park Stone from Wiltshire and Welsh Ruabon bricks [30], belonged to the fashionable "English Renaissance Style" [31], derived from the re-kindling of a specifically English domestic precedent of 16th century palaces, including Smythson's lavishly fenestrated Hardwick Hall (*More glass than wall*). The masonry mullions, leaded lights and

contrasting brick was used by many of the 660 Carnegie libraries in England as well as other schools, hospitals and colleges of the period. The alternating pale stones served as a daytime signifier of the library, whilst artificial light would point it out at night.

3.2 Reading at night: The timetable of work, and leisure in relation to hours of daylight

In 1900, an average 54 hour week for engineering workers in Wednesbury was recorded [32]. The working day, from 6am to 5pm during the week and from 6 am to 1pm on Saturdays [33], left little recreational time within daylight hours. It should be noted that the contemporary campaign to introduce Daylight Saving Time was not successful until 1917 [34], reducing this period of daylight leisure time further still.

In correlating opening hours of the library with hours of daylight, it is evident that the library would have been reliant upon artificial lighting for at least half of its opening time. Furthermore, the majority of its customers would not have the opportunity to experience the library during daylight hours during the week between September and April, as a result the library was open until 10pm, 19-22 days per month [35]. To compound this further, a report on smoke in Birmingham between 1905-1909 gives a figure of "1167 average yearly sunshine hours or 29% of its possible duration" [36].

4. Design Strategy Issues 1:100

4.1 Light for navigation; the entry sequence

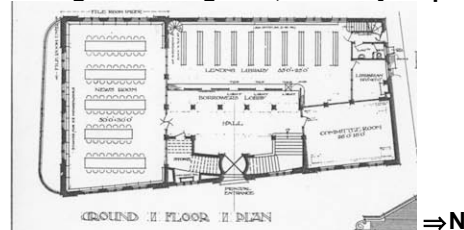


Fig 2. Ground Floor Plan: [37].

It was said that Wednesbury library "cannot fail to impress its visitors and is also easily accessible for the inhabitants." [38] The issues of lighting and public access within libraries are inextricably linked. The competition brief stated "the public should be able to reach any department of the library without passing through any other department" [39]. To this end, the entry sequence is made navigable by clear architectural signals. The primary move is the placement of the entrance in the side street. In practical terms, the judgement ensures that it need not occupy valuable south facing daylight space.

In accordance with Bertram's demand for "minimum waste for passage space between entrance and delivery desk" [40], the stair is neatly returned behind the sight of the new arrival. Its central landing wedges the entrance door in place beneath it. The double height

volume of the stairwell, leading to the reference room and magazine room above, has east facing windows at high level, and acts as a light periscope, to benefit the foyer below.



Figs. 3&4 Views: stair and lending desk: 1909 [41]

4.2 Observation and control

The drenching with north light of the centre of the ground floor plan is achieved by the use of a single storey, steel framed, flat roofed back area. Just visible in the photographs are single suspended bare electric lamps behind each column that would attempt to perform the same job at night. The customers viewed the lending stacks obliquely and faced high-level windows with obscured glass offering externally reflected west light from the walls of the neighbouring club. This high level reflected light illuminated the spaces between the perpendicular stacks without glare in order that the titles on the spines of the books were legible to the librarian who could then retrieve them for the borrower. The customer, in turn, could study them under the maximised top light that is afforded to the counter.

4.3 People and activities with respect to their aspect and prospect

The resourceful device of a two storey masonry public face concealing a single storey deep top lit steel framed plan to the rear was in common with all the two storey fronted Carnegie libraries in the area; Walsall, Stirchley, Selly Oak, West Bromwich and Dudley. The lean, shed-like “back of house” with its maximised structural spans and open plan, displays awareness of the evolving technology of industrial buildings.

The newsroom and reference room above it occupied the prime location with respect to daylight, facing south but also with exposed east and west facades. The Lending library, as described above, relied upon top light and reflected light. Glazed screens recommended for the “diffusion of light” [42] were used to allow light to be shared between spaces on the ground floor. More significantly, the spartan structure encouraged views within the building, helping to make it more legible and navigable as a public space.

4.4 The quantity of daylight; areas of intensity

Moving towards guidance for a daylight factor for libraries, Burgoyne had recommended in 1897 that, “if not overshadowed by tall neighbouring buildings,” libraries “should allow for windows of 8ft² (0.74m²) to each 500ft³ (14.16m³) room space, slightly less on upper floors and south

facing rooms” [43]. In accordance with this, the south facing Wednesbury newsroom, has 5.1ft² (0.46m²) of glazing to each 500ft³ (14.16m³) of space, whereas the reference room above it, has an area that is further reduced to 3.2ft² (0.29m²) per 500m³ (14.16m³).

Less precisely, in 1907 Champneys advised that “the relation of glass to floor space should not be less than 1:6 and 1:4 if possible” [44]. In Wednesbury, whilst the newsroom achieves a ratio of 1:5, in the reference room, the relationship is only 1:9. Modern convention dictates that an average daylight factor of at least 2% is required for a room to be entirely naturally lit [45]. Including a reduction in the transmittance of glass 0.7 to account for the polluted atmosphere, the average daylight factor in the newsroom would have been 2.42% but only 1.73% in the reference room.

5. Design Strategy Issues 1:20

5.1 Furniture and fittings

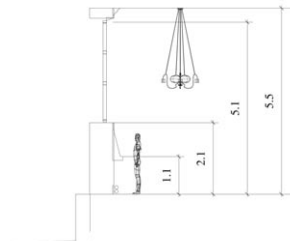


Fig. 5 Section through Wednesbury Library Newsroom

The requirement for fixed furniture, limited by anthropomorphic dimensions within libraries encouraged writers to extrapolate proportional guidance from those dimensions. Champneys stated that the ratio of two to five for the minimum height for windows above desks in relation to the depth of the room in classrooms should be applied to determine the height of reading rooms. He noted that newspaper slopes dictated the height of sills to be 6ft+ (1.8m+) whereas reading tables would require sills of only 3’6”-4’ (0.9-1.2m) above the floor [46]. The height of the ceilings “not less than about 20 feet” (6m) and sills “7ft from the floor” (2.1m), were specified to the architects in the competition brief [47]. Pre-empting modernist architectural ideals, the functional disposition of library furniture and fittings dictated the scale, proportion and quantity of fenestration on its façade.

5.2 The economic control of artificial light and potential adaptive responses to natural light

Champneys noted that windows above reading slopes required blinds which roll upwards from the sill “and can be adjusted to keep the glare out of reader’s eyes on bright days” [48]. There is no evidence of this in the library. It appears likely that the requirement to control glare was rare because sunshine hours were so low. Although seemingly evident in the competition design, there are no visible signs of permanently installed shading devices or sunlight moderators in the photographs of the library when it opened

(although today blinds are used as permanent fixtures to eclipse glare, forcing the library to be artificially lit at all times).

The town's annual report proudly described the library lighting: "The building is lighted by Electric Light with specially designed bronze fittings" [49]. The provision of Electricity to Wednesbury had begun in 1904 with 1180 lamp connections. By 1908 12,484 were in operation [50]. The power of lamps recommended in library lighting guidance had increased also, from 8cp in 1897 [51] to advice that "16 candle-power lamps should be arranged so that no reader will be more than 6ft distant from one" (1.8m) in 1907 [52]. In evidence of cost consciousness, the librarian had proposed to close the library an hour earlier, "the whole building to close down at 9 O'clock a saving of one hours current of electricity per day for the year." [53].

The individual switching of artificial light was clearly intended to be economical as had been recommended by Burgoyne, [54] however, it was also a hugely significant "gift" to the people of the town and was the first subject to be described in the "Full Report" on the opening of the library "Over each paper on the stand round the room there is an electric light, which the reader may switch on and off as he desires" [55]. From this description we know that "in the majority of cases the new metallic filament lamps are used." An electrical contractor's advertisement in the town annual of 1909 advertises the availability and performance of the new kind of filament lamp: "35 hours light, 30 candle power, for one unit" [56] indicating that, at 377 lumens, each of the lamps used would have an equivalent output of a 25w [57] incandescent lamp today, or, that the whole background illumination of the newsroom was provided by the equivalent of four 100w incandescent lamps. Using this information, the general artificial illuminance of the newspaper slopes in the newsroom would only have been 36.554 lux, until an individual reading lamp was switched on. In contrast to this, current standards propose illuminance levels for general library areas are maintained to provide a minimum level of 300 lux for the purposes of accessibility. [58]



Fig. 6 Newsroom: Ray traced model illustrating artificial illumination (NB light sources not depicted)

5.3 Filtered lights: diffusion of light

Sir David Brewster, inventor of the kaleidoscope [59] had advocated the use of prismatic glass in 1866, "from every point of this luminous surface light will radiate into all parts of the room". A contemporary advertisement recommended use of Pilkington's "Patent prismatic Rolled Glass for Lighting Up Dark Interiors" [60]. Its specification in Wednesbury on the windows facing the alley of the Conservative club, is therefore likely more for faith in these reasons rather than for privacy, as it would be to day.

Contemporary research on "smoke" had noted that architects should avoid the use of skylights because "the collection of soot soon renders them useless" [61]. Champneys recommended "horizontal frosted panels" [62] beneath rooflights presumably with an aim to mitigate the effects of soot collected on the sloped external glazing above them. This device is employed at Wednesbury in common with other Carnegie libraries both locally as well as in America.

6. Design Strategy Issues 1:1

6.1 Touching light; the choice of materials.

At the threshold from the street, a bright terrazzo floor reflects light up from below, encouraging the eyes to squint, the head to lift up and survey the room before proceeding towards the desk. Burgoyne had recommended pale floors in entrances, as they were often the "worst lighted" spaces [63]. In reading areas, the densely packed pitch pine parquet floors provide a darker ground, absorbing sound, as suggested by the librarian in his notes for the brief [64].

The brief requested that the surface below the dado on the walls should be tiled in green glazed bricks as recommended by Burgoyne both for hygiene as well as "helping to diffuse the light" [65]. Champneys added: "A very important consideration connected with the question of lighting is the colouring of the walls and ceilings. The latter should, of course, be whitened, while for the walls, or at any rate for a tile or glazed brick dado such as has been recommended, some shade of green or grey is the least trying to the eyes and absorbs very little light." [66] Accordingly, at Wednesbury, "The woodwork generally is of canary wood, stained green and varnished, and the walls have been coloured in quiet tones to match." [67]

6.3 The Newsroom: light for reading small print, large format material, standing in a row

Champneys commented that newspaper reading rooms were more important in Britain than elsewhere and that "their cost is often nearly a third of the whole cost of the library" [68]. In 1909-10 averages of 314 visitors per day were recorded to the Lending Library, only 50 to the reference room but 700 to the newsroom. The librarian confirmed that the newsroom "maintains its popularity as is evidenced by the undiminished patronage it enjoys" [69]. Within the newsroom,

newsstands surround the East, South and West walls of the room. Aligned beneath window sills, their surfaces are fixed at 14 degrees from vertical, ensuring that a maximum quantity of internally reflected light and a minimum amount of direct sunlight would have reached the readers field of view. As an indication of this, the internal reflected component of daylight upon a news slope under the window is 150 times greater than either the sky component or the externally reflected component.

Champneys points out that “isolated points of light and dark in a room are very trying to most people, owing to the dilation and contraction of the pupil which takes place each time the eyes may glance up from the well illuminated paper to the dark surroundings and back to the paper again” [70]. It is clear from observation of the daylight design that the intention was to rely upon the use of reflected light. The activity as it was designed to take place was entirely ordered by the furniture. Collectively, the windows acted as a giant lantern following the same principle as traditional collegiate and monastic libraries. For people standing at the slopes below them, the shape of the reveal allowed no direct light from the sky or sun, save from the sides. Individual lights economically assisted customers reading the 6pt newspaper text before them after dark.

6.2 The Reference Room: Private environment; reading at desks

The first floor reference room, from its elevated site and disposition, overlooks the town and literally provides the reader with perspective, the long view, to alternate with close inspection of text. It was admired as “certainly the finest room in the library” [71]. (Currently, the room is used for computers, with blinds that are permanently shut). The use of newly available pre-stressed concrete beams to create a barrel vault is in common with libraries at West Bromwich, Walsall and Dudley. Its foliate decoration with bows and swags indicating that the room should be regarded as a grand drawing room, an idea that is maintained in guidance for library design today. [72] CABE’s report declares that the modern public library should be conceived as the ‘living room of the city’.

The path to a reader’s seat at a shared table in the reference room is marked by the approach towards the view over the town. The subsequent activity of reading once seated, is side-lit together with reflected light from above. The daylight illumination of tables in the reference room does benefit from some direct “sky view,” however, at a table in the centre of the room this is still 8.5 times less than the internally reflected component. Library reports note that the reference room was far less frequented than the news room. [73] It is likely that its customers predominantly used the room during daylight hours. The artificial illuminance of a table surface in evening would have been only 27.06 lux beneath an electrolier. By contrast, today’s

guidance proposes that a minimum level of 500lux be maintained for a counter top in a public library. [74]



Fig. 7 Ray traced model illustrating artificial illumination of Reference Room (NB light sources not depicted)



Fig. 8 View: Reference Room 1909 [75]

7. Conclusion

The proliferation across industrialised Britain and America of an entirely new form of public interior proffered the possibility of deriving models and standards from experience at a great pace. The experience gleaned by a common funding body had a widespread influence which evidently percolated into forming early standards for the quality and economy of the functional and environmental design of public library buildings.

Current standards aim to secure accessible environments within public libraries by setting lighting levels well above those provided within earlier precedents, however, the study illustrates that very modern aims for openness were achieved at Wednesbury using devices at every scale in order to maximise the benefits of natural illumination.

The example reveals how the patent challenges of realising a predominantly daylit building within a polluted environment coupled with the economic constraints of providing limited artificial lighting ensured that the achievement of good daylighting was at the forefront of the design agenda. The ambition to achieve “perfect lighting” was shared by everyone involved in the funding, design, procurement and maintenance of the building. This affected the location, orientation and briefing of the building in addition to its architectural design.

8. Acknowledgements

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