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A Note on the Display Initials
Drawn by Adrien Vasquez of the John Morgan studio, and featured in the twin texts on or by Colin Rowe, the display initials in this issue are an adaptation of a slab-serif typeface developed in the first half of the nineteenth century by the English punch-cutters Bower & Bacon and by the Fann Street Foundry, bought in 1820 by William Thorowgood with a large sum of money he had just won in the lottery. Thorowgood was the first to use the term 'grotesque' to describe a sans-serif typeface. Similar letterfaces were used in the 1940s in the pages of *The Architectural Review* – the journal that first published Rowe's 'The Mathematics of the Ideal Villa' in March 1947 – whose characteristically English vernacular typography also seems fitting given Rowe's idiosyncratic, spoken and resolutely English prose. These letterfaces are printed in the antique madder lake of this issue's inside cover – which, alongside the cover colour, reference the signature pinks and apple greens of Hieronymus Bosch, whose works have recently been on display at the Noordbrabants Museum in Den Bosch, Netherlands.

The Lost (First) Chamber of the House of Commons

Henrik Schoenefeldt

Aerial view of the Palace of Westminster,
showing the Central Tower
and square ventilation shaft, *c* 1905
© Parliamentary Archives / FAR/4/24

On 28 October 1943, two years after a Heinkel bomber from the Luftwaffe destroyed the House of Commons, parliament held a debate on its debating chamber. The issue was whether the new House of Commons should adhere to the Victorian model or base itself on an entirely new plan. Prime Minister Winston Churchill spoke passionately about retaining the 'traditional character' of the original chamber, but at the same time pushed his fellow MPs to agree on updates to its ventilation system. George Duckworth, MP for Shrewsbury, backed the argument, stating that 'although we may greatly regret the old chamber, with all its associations, it is my view that its destruction has presented us with a great opportunity. Now that it no longer exists, we may as well face the fact that it had many serious defects... It suffered from a system of ventilation which was antiquated and calculated to give everyone cold feet and a hot head.'[1] No doubt in agreement, Churchill promptly appointed an exploratory select committee, which would release a report the following year recommending a 'thoroughly up-to-date system of heating, ventilation and lighting', with mechanical ventilation and air-conditioning approaches proposed by the engineer Oscar Faber as the 'best which modern science can devise'.[2]

Conceptually, if not technically, Faber's idea for an air-conditioned space was not unlike the first environmental system installed inside the original Victorian chamber by the Scottish physician David Boswell Reid (1805–1863). Brought into being by a similar catastrophic act of destruction (in this instance, the Great Fire of 1834), a special committee had invited Reid to testify on possible arrangements for a new chamber. Reid, who had been testing various heating and ventilation approaches in his purpose-built laboratory in Edinburgh, proposed a sealed debating chamber, with controlled lighting, climatic and atmospheric conditions and an early non-mechanical approach to air-conditioning.[3] This was initially tested inside a model debating chamber, erected in Edinburgh in 1836. He was then invited to further test and refine his principles under real-life conditions, first in the Temporary House of Commons and then the Temporary House of Lords.[4]

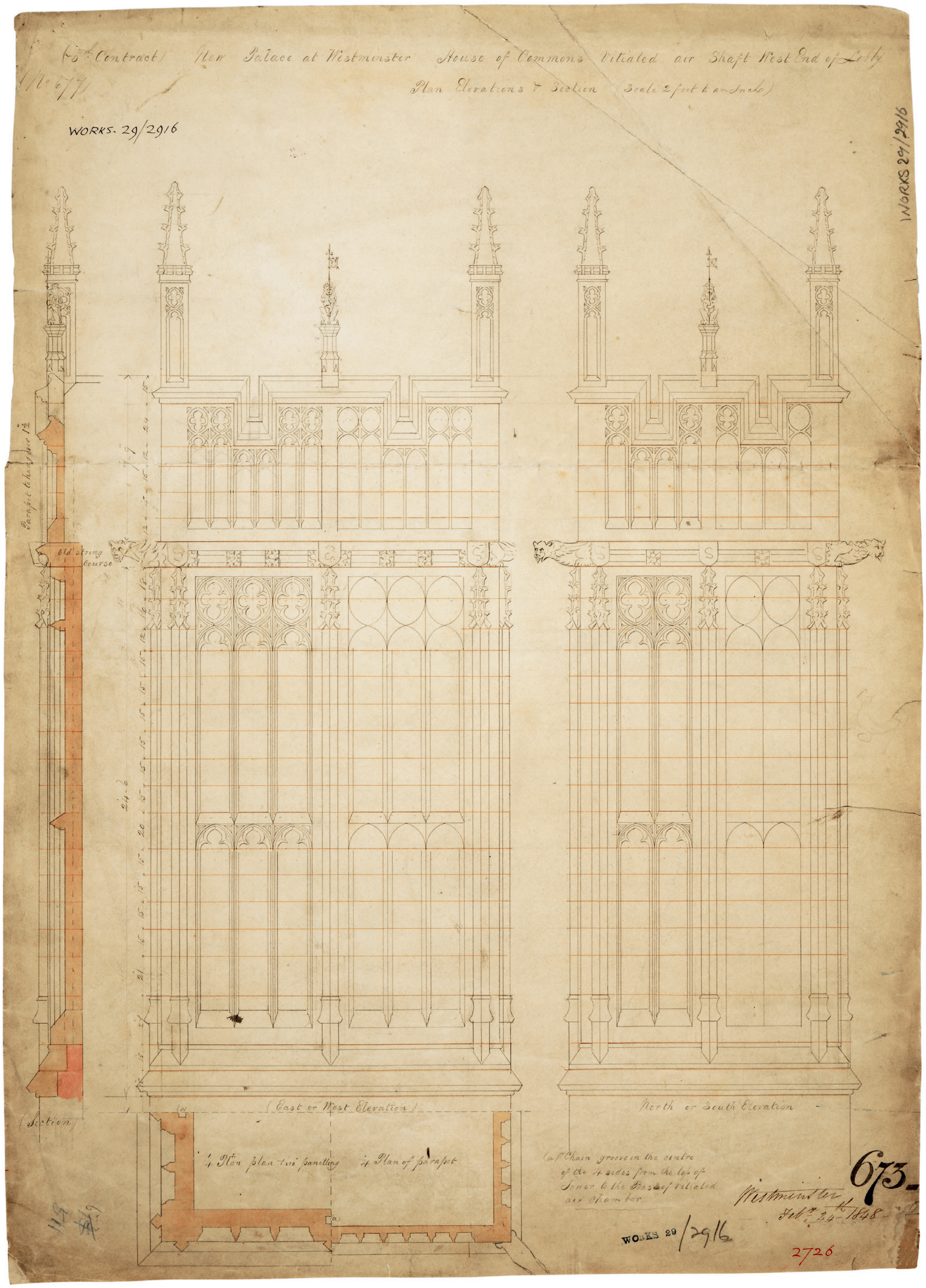
In 1839, following the success of these tests, Reid was appointed ventilation engineer of the new Houses of Parliament – one of the very first instances of the appointment of an expert consultant to advise on the design and construction of a building (pre-empting the modern tripartite division of labours between the architect, engineer and hired consultant). It was in this capacity (as 'ventilator', as he was referred)[5] that Reid was invited to collaborate with Charles Barry, architect of the Palace of Westminster, who by then had already completed his design of the building, which he had worked on since winning the competition three years earlier. It was not long, however, before tensions began to emerge between architect and ventilator. Reid, whose training was in medicine not architecture, insisted that Barry and his team adapt their architectural plans to accommodate his system – an assertion he defended through the immutability of his research, citing several textbooks he had written which illustrated the science behind the natural movement of air induced by atmospheric pressure, gravity or thermal buoyancy, or what modern science now calls fluid dynamics.[6]

Various scholars have used these differing skill sets – between architecture and science – to explain the souring of Reid's relationship with Barry. [7] This critique, however, detracts from the discernible influence that Reid's medical background had on his working method – not just in terms of the ventilation system he was advocating, but more fundamentally through the empirical methods he employed in its development. For example, letters and drawings exchanged between the two offices show how Reid drew on research methods pioneered in the fields of chemistry and medicine to evaluate the performance of environmental technologies from the perspective of human physiology and perception. In this sense, Reid was responsible for the conceptual design of a system – providing drawings and descriptions to Barry that were schematic and largely scientific, and which therefore required Barry's engineers to implement them at a required technical level.

This process of translation in turn prompted Barry, ten years Reid's senior, to question his new colleague, suggesting that Reid did not 'profess to be thoroughly acquainted with the practical details of building and machinery'.[8] Nevertheless, the design of the Palace of Westminster had become a cross-disciplinary endeavour, and between 1840 and 1846 'miles of pipe and thousands of valves and stopcocks were installed', with new heating and cooling shafts designed to fit inside the existing Clock and Victoria Towers.[9] At the same time, Reid's lack of design expertise did not stop him from proposing a new central tower to contain huge volumes of hot smoke and exhaust gases – a £50,000 expense to which parliament eventually agreed, with even Barry conceding that a third tower actually improved the original design.[10]

By 1846, however, the already strained working relations between architect and ventilator had become recalcitrant – Reid's involvement, Barry argued, was slowing down construction and pushing the project significantly over budget.[11] He went on to complain that all of the new shafts were compromising not just the building's fireproofing but its very solidity.[12] In an effort to regain design control, Barry therefore enlisted the help of the chemist Michael Faraday to develop an alternative system using a steam jet. As a result the original ventilation project was discarded in the autumn of 1846 following a full parliamentary enquiry into difficulties arising from the collaboration between Reid and Barry's office. To further minimise Reid's involvement, all ventilation projects, including the scheme for the House of Lords, were transferred to Barry and his engineers, Faraday, William Jeakes and Alfred Meeson, with Reid's area of responsibility now restricted to the boundary of the House of Commons. With this change in personnel, the concept of a single up-cast shaft was abandoned and replaced by a centralised system, composed of an array of local shafts for different sections of parliament, including a stone shaft for the House of Commons. A scaled-down version of Reid's central tower was eventually built, but the structure never fulfilled its intended purpose, functioning merely as a local outlet for air from the central lobby.[13]

And yet this reassignment of control did little to prevent the slowing of any decision making. Because parliament's ventilation was now based on Barry's system, Reid had to adapt his own system (by this stage, at least six years in the making) to function independently and with no access to the central air supply and exhaust outlined in his original plans. Accordingly, in April 1847 Reid submitted a new set of drawings to Barry's office outlining his adapted scheme, even if the detailed design of a number of its important features, including the fresh air supply, was not agreed upon until after several months of often intense negotiation.[14] In some way attesting to its dual authorship, the resulting arrangement featured two air inlets. The main vent constituted manually adjustable cast-iron louvres,[15] built inside the roof facing the river, which could be closed



Elevation of the House of Commons
square ventilation shaft, 1848
© National Archives

when the air pollution or stench of sewage became too severe.[16] A second inlet functioned as a backup and was placed on the opposite end of the site, inside one of the corner turrets of St Stephen's porch – an architectural feature previously introduced by Barry but lacking any obvious practical function. This reserve supply comprised part of the ceiling system, which was equipped with its own up-cast shaft, steam-powered fan, heating and humidification.[17]

Drawings show that fresh air was conveyed into the House of Commons through passages under the roof. On the north side of the central tower air passed through a fan and was then warmed inside a passage lined with steam pipes, terminating in the fresh air chamber above the central row of ceiling panels. Next, the air filtered into the debating chamber through gaps between panels and openings inside hollow ornamental beams that were manually regulated by sliding valves.[18] The vitiated air chamber situated above the side panels was connected to the new up-cast shaft on the west side of the Commons Lobby. Air came up through the base of the shaft and was exhausted through cast-iron valves at the top, which could be adjusted with the aid of pulleys. The current produced by the buoyancy of the hot air, boosted with the aid of coke fires, drove the vitiated air out of the debating chamber. But because the shaft was not strong enough to ventilate all spaces simultaneously, valves were used to switch between individual spaces, such as the Commons Lobby, the Ladies' Gallery and the Strangers' Gallery.[19] During votes, for instance, when the debating chamber was busier and therefore in need of more ventilation, the pull could be redirected from the house to the division corridors.[20]

The reasons for building two simultaneous air supplies, and parliament's approval of such a project, belie a purely functionalist analysis. Instead, the arrangements of the inlets can be seen as the outward expression of a political process that resulted in a physical, political artefact, and one that Reid considered a serious compromise to his original plans: inside the Central Tower was a diagonal wall, which not only served to isolate the fresh reserve of air for the House of Commons from the vitiated air entering the tower from the House of Lords, but also physically represented a contested border between Reid's and Barry's spheres of influence. This border was mirrored by another wall introduced by the architect inside the central air chamber at basement level, which physically isolated the air supply passages within the two territories.

Reid would actually challenge Barry's intervention, arguing that it compromised the effectiveness of his air supply. In fact, the House of Commons already had two pairs of inlets. Apart from the pair that served the downward supply through the ceiling, another set was provided for the upward supply through the floor of the debating chamber. The Central Chamber, which was connected to four courtyards, was intended as a spare inlet for the floor-level supply and could be deployed whenever the atmosphere around the main inlet at the top of the Clock Tower was polluted. Barry's partition, however, cut off the two courts on the south side of the Central Chamber and prevented Reid from using it as an effective backup supply.[21]

Yet Reid's concerns about air pollution entering into the chamber were not entirely unjustified. His earlier observational studies had given him an understanding of how wind conditions affected the movement of atmospheric pollutants around the site. The use of switchable inlets was therefore part of Reid's plan to enable the building to better respond to the level of external atmospheric pollution.[22] The use of windows was not viable due to the severity of local atmospheric pollution; inside the Temporary House of Commons the supply air had to be filtered in through canvas screens and water sprays.[23] Reid's earlier experiments had led him to determine that air was purer when pulled in from a higher elevation. His plans developed between 1840 and 1846 show air being taken in via inlets built high up in the Clock and Victoria Towers, whose positioning on opposite ends of the site allowed the fresh supply to be switched when pollution levels on one side were too severe.[24] In a letter dated 7 July 1840, Reid wrote that these high-level inlets gave access to 'an atmosphere at least equal to that of Hyde Park, and often one as pure as it is possible to obtain within some miles of London for the dull, lifeless, languid and heavy air which I have so often experienced around the present house particularly on the side towards the penitentiary'.[25] In the mid-nineteenth century, however, Hyde Park was on the edge of London, and so its atmosphere was considerably less polluted that Westminster, in the centre of the city – a geographical detail that enabled Joseph Paxton to utilise direct natural ventilation in his glasshouse for the Great Exhibition in 1851.[26] In contrast, parliamentary staff logbooks kept during this period mention several instances when attendants were unable to protect the interior from smoke pollution, even with access to multiple inlets in different locations. On 6 March 1854, for instance, staff reported the atmosphere as 'very foggy and charged with smoke' and that air was 'taken from central hall as that from the Clock Tower very smoky'. One week later it was reported that switching the supply from the Clock Tower to the Central Chamber made the air 'better but not good'. On 18 March, a 'foggy atmosphere loaded with smoke of the neighbourhood penetrated the building', and in early April, attendants wrote 'the supply from the tower feeling close and unwholesome'.[27]

Such unwholesome feelings were largely due to the detrimental effect coal-fired technologies were having on the atmosphere immediately outside the Houses of Parliament, which the system relied on as a source of fresh air. At the same time, the same system was also greatly influenced by the impact of internal sources of heat and air pollution, such as the radiant heat generated by the interior gas lighting, or even the body heat of all the MPs in the chamber and the public in the galleries above (a figure that reached as high as 800 for particularly popular debates). Anticipating these problems, Reid envisaged a fully integrated system capable of filtering in clean air from outside while alleviating the various pollutants within the chamber – a concept he had first demonstrated with his model debating chamber. This was a completely sealed space, without natural light, in which air was supplied and extracted entirely through the perforated surfaces of the floor and ceiling. Temperature, humidity and velocity of the supply air were tightly regulated. Diagrammatic cross-sections published in *Ventilation in American Dwellings* and *Brief Outlines Illustrative of the Alternations in the House of Commons* show the level of detail involved, with gaslights concealed behind sloping glass panels that ran along the edges of the ceiling, so as to isolate the bulbs from the atmosphere of the chamber.[28] The use of coal gaslights in a sealed chamber was a particular challenge – only 0.04 per cent of the energy they produced was visible light. The solution was to contain this unwanted heat and noxious fumes inside cavities above the ceiling, behind walls and under the raised floor before extracting it through the central ventilation shaft of the laboratory.

Overleaf: Sketch plan and section of the House of Commons ceiling system air supply, 1848 © National Archives

For the Permanent House, Reid proposed a different lighting system compatible with the downward air supply provided through the ceiling. A set of drawings submitted to Barry on 1 March 1848 shows the insertion of conical light reflectors covering the whole of the ceiling panels, which were also designed to function as hoods for the extraction of gas fumes. Each cone terminated in a flue connected to the up-cast shaft. Fresh air was supplied downwards, through gaps around the edges of the ceiling panels, and fumes were instantly expelled before they could contaminate or overheat the incoming air. Although it followed the same extraction principles Reid had used inside his private laboratory for extracting fumes released during chemistry experiments, Barry rejected the proposal on aesthetic grounds. And so while the architect, assisted by Faraday, was embracing current gas-lighting technology, fittings in the House of Commons and Lords were designed as medieval chandeliers to harmonise with the gothic character of the interior.

Reid, on the other hand, had proposed a radically different approach, which bore a closer resemblance to the lighting of twentieth-century office buildings – such as Eero Saarinen's 1950 General Motors Technical Centre in Warren, Michigan – than a candlelit hall. Just as the fluorescent ceiling fixtures of the Technical Centre cast a perfectly even light over GM's drawing studios, Reid's intention was to create a more 'equal' and 'homogeneous light'. He therefore proposed covering the entire ceiling of the chamber with 336 small 'burners' in order to cast a soft and uniform light throughout the space, 'imitating the equal and diffuse light of day', and protecting the eye from the intense glare of strong lamps.[29] Direct light was then diffused by placing these gas burners inside white cone-shaped reflectors, thus illuminating the chamber using only the 'mild luminous surface' of the ceiling. External fixtures were also proposed to make stained glass windows visible after sunset, creating a daylight effect.

Despite its modernity, Reid's proposed lighting scheme was rejected on aesthetic grounds because it interfered with Barry's own more ostensibly gothic plans. Yet in implementing his own lighting model, without any involvement from Reid, Barry in turn sabotaged Reid's ventilation system – in particular, the ceiling air supply that Reid had built into the system, which was rarely used at night because it pushed hot air around Barry's beloved chandeliers and into the depths of the house. In order to achieve better acoustics, the architect also lowered and remodelled his own ceiling design (an original scheme that had formed the basis for Reid's design). These obstacles meant that Reid's system could not address the myriad of environmental problems of the house (temperature, circulation, visibility, humidity, pollution, acoustics) in an integrated way, and prompted Reid to exclaim, in his 1852 interview with the select committee, that 'it is utterly impossible ... to carry out a perfect system of ventilation whilst [Barry] was liable to have it deranged by violent cold currents'. He went on to argue that the 'existing evils in the ventilation' could not be remedied without inspecting the architectural drawings, and which Barry consistently refused to supply.

Certainly the souring of his relationship with Barry was one of the reasons Reid found himself constantly trying to solve the 'evils' of the house. Another was that, compared to the straightforward ventilation system developed for the Temporary House, the Permanent House was far more complex. Here, ventilation followed a mixed model, combining a stack-driven 'vacuum' model for the extraction of hot air with fan-powered 'plenum' ventilation for the air supply. From the basement air rose through adjustable shutter valves inside the vaults and up into the heating chamber on the ground floor. It then passed over the pipes of a hot-water apparatus before continuing its ascent through another set of valves and into an equalising chamber. The heating chamber was also surrounded by a cool-air compartment, through which unheated air could be conveyed directly from the basement using a set of circular valves, meaning that the chamber could respond quickly to fast fluctuations in temperature (essential for a space that would quickly alternate between heavy and light occupancy, as one debate ended and another began). Fresh air was monitored using a hygrometer and 20 separate thermometers before it was admitted into the same chamber.[30] Once inside, temperature and humidity could be adjusted using a non-mechanical form of air-conditioning that involved running cold water through the heating pipes (ice, which was used for brief trials in the Temporary House, was not deployed). In addition to his attempts to lower the actual temperature, Reid also sought to lower the perceived temperature by exploiting the cooling sensation of air currents as they passed over human skin. At the same time humidity was raised with the aid of steam or by evaporating water and lowered by unspecified 'absorbents of moisture'.

In order to facilitate the workings of this system the floor in the Temporary House of Commons had been completely perforated, allowing conditioned air to be uniformly supplied across the entire space, but in the Permanent House Reid introduced a more elaborate arrangement, which permitted a greater degree of local control over the climate and air supply. This was because in cases where there was a uniform supply of air, attendants reported difficulty getting MPs, who all sat in different areas, to agree on a set temperature. There was 'scarcely a meeting of the house at which there are not some members who would like the temperature to be at 55°F, and others at 70°F or 72°F', Reid reported.[31] The new concept of personal control was first trialled in the Temporary House of Lords from 1838 to 1847 in order to investigate whether user satisfaction could be increased by providing microclimates in different parts of the chamber and by responding to differences in the number of people per zone. But data collected during this time revealed that the new approach did not increase the level of satisfaction.[32] However, the problem was not the system, Reid argued, but that the lords did not provide attendants with enough personal feedback. These difficulties notwithstanding, Reid continued to develop the concept for the Permanent House, dividing the chamber into different climatic zones and increasing the level of control by allowing climate and air supplies around each bench to be individually adjusted.

Reid had first outlined his concepts for the permanent chamber during interviews with the select committee between 1844 and 1846. His aim, he said, was to 'give all who are tied down to official seats a ventilation in unison with their own feelings to a certain extent, while the general ventilation is arranged for the house'.[33] Such a system was an attempt to reconcile the tension between central control strategies, in which environmental systems are managed anonymously following a set range of climactic conditions, and personal control strategies, where users are able to adjust the environment to suit their needs. As if anticipating the modern concept of cybernetics, Reid then designed a system that responded not only to internal and external environmental conditions, but also to personal preference.

Original working drawings show that the attendants inside the equalising chamber used over 60 sliding valves to individually

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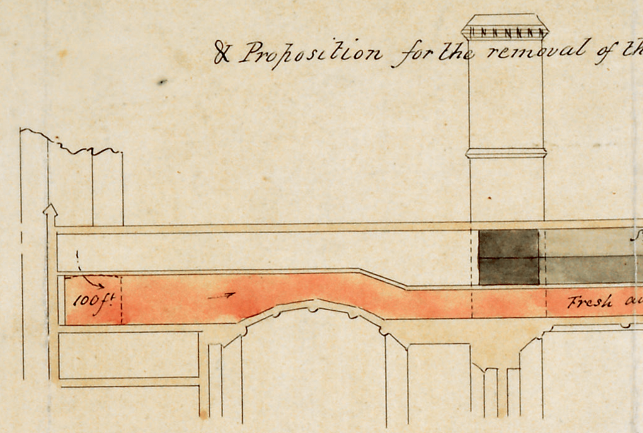

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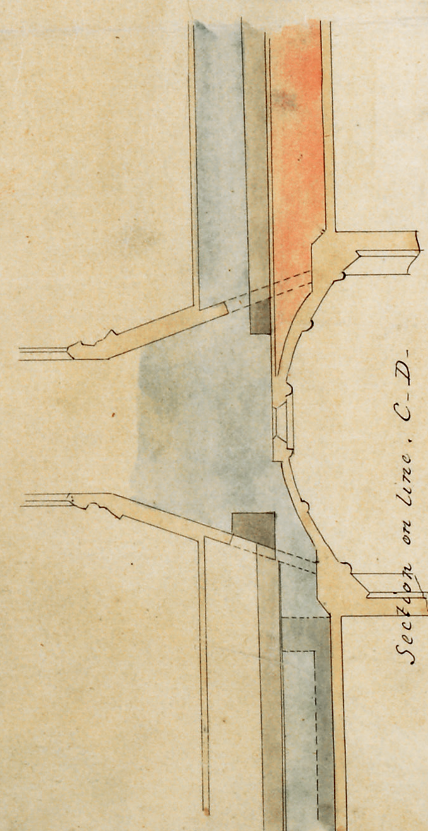

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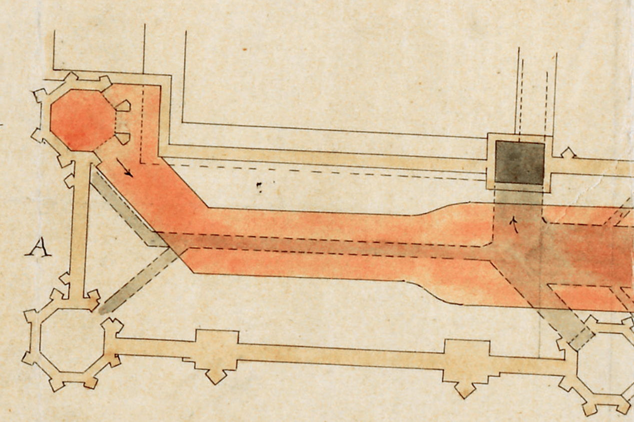
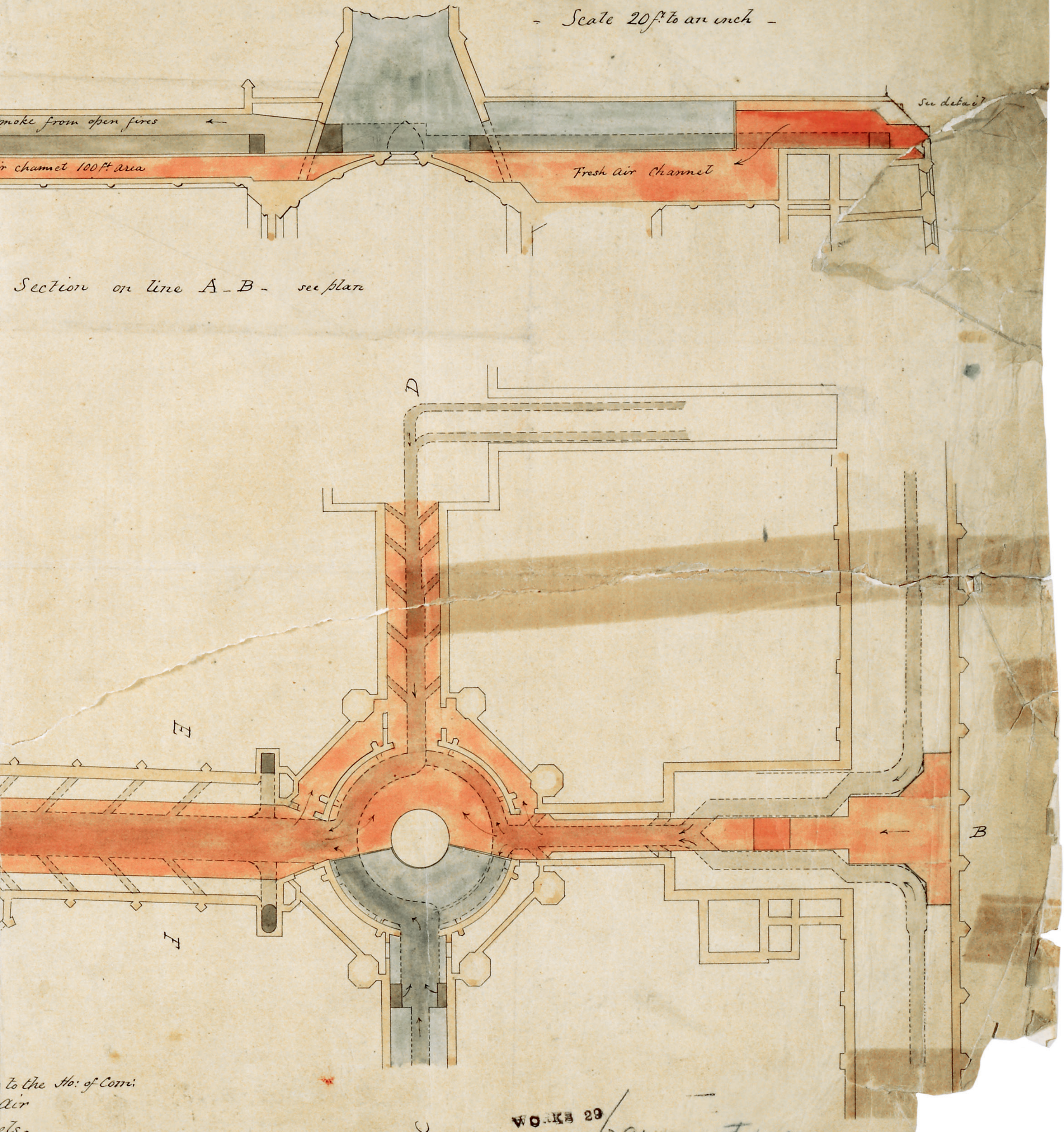


The pink Tint indicates supply of Fresh air
The blue Tint indicates disch: of Vitiated
The black Tint indicates the Smoke Chann

...Fresh air to Ho: Com: from the N. W. Turret of St. Stephens Porch and also f...
the East face of the Roof over the Centre portion of River Front.

...e Smoke Shaft from the E. end of St. Stephens Hall to the S. E. angle of Westmr. Hall.

- Scale 20 ft. to an inch -



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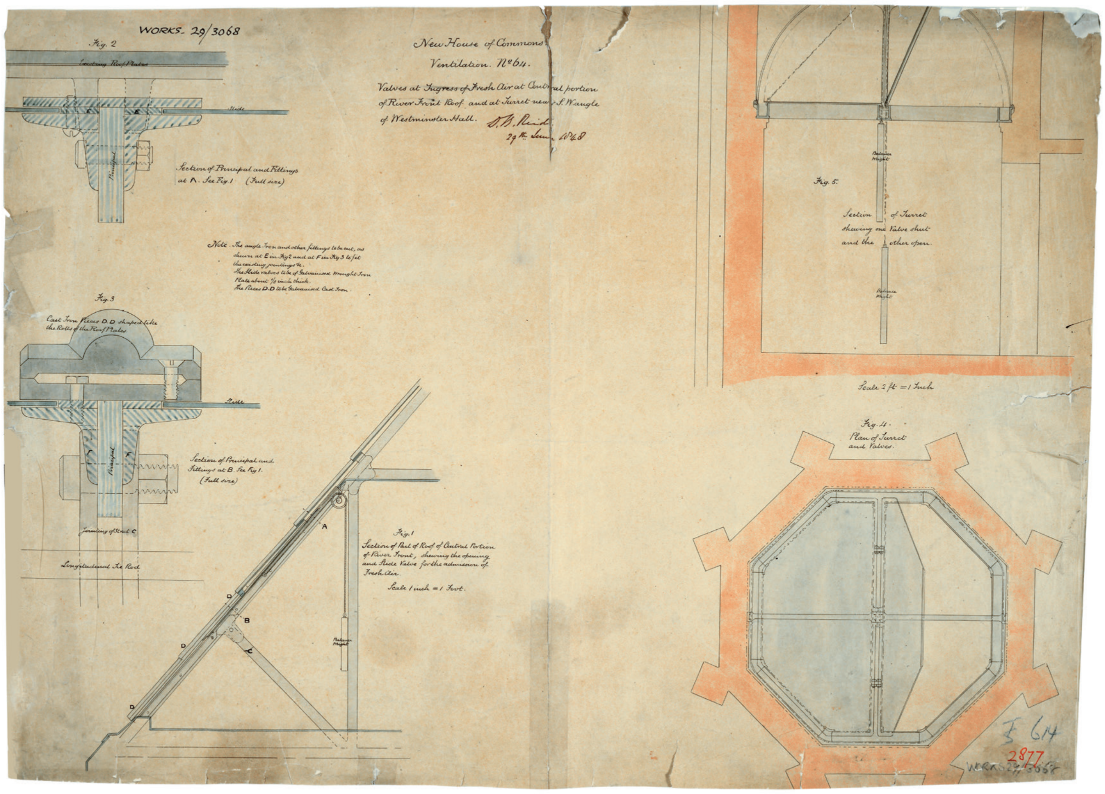
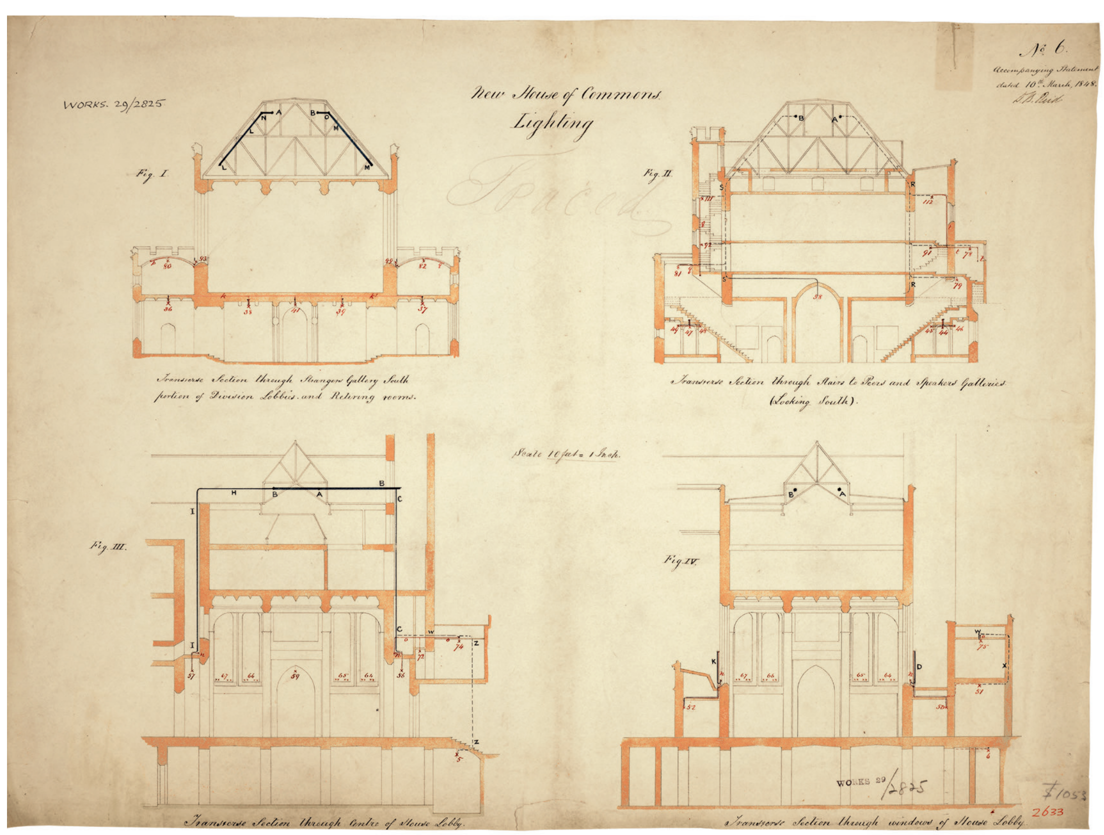
Approved ...22 ...

Thos. Greene

Signed by me in unison with a letter to be addressed this day to the Commissioners of H. M. New Palace ... 22 June 1848

Signed - Charles Barry
22 June ...





Detail of House of Commons
roof-level inlets, 1848 (*above*), and
Reid's proposed lighting system, 1848 (*below*)

adjust the air supplied to each bench. The conditioned air passed through the valves into a horizontal duct under the bench and entered the house through the perforated floor.[34] Separate supplies were provided for the speaker and sergeant-at-arms, the floor area between the table and bar, and the risers of the steps between the benches.[35] Air was extracted through the ceiling and downwards through different sections of the floor, including the area immediately in front of the benches,[36] before being drawn into a vitiated air chamber below the floor and exhausted through the boiler chimney, which terminated in the octagonal turrets in the northwest corner of the Central Tower.[37]

Such an elaborate ventilation scheme required a monitoring system of equal calibre. From February 1852 to April 1854 climatic conditions inside the chamber were routinely checked and recorded in logbooks that in many ways resembled proto-Excel spreadsheets. Each log sheet contained columns for readings from four thermometers on the main floor. These were located near the speaker's chair, at the bar end and on the government and opposition sides of the central floor. A fifth thermometer, for which there was no separate column, was placed on the table. Additional columns showed readings from four other thermometers located inside the galleries. Humidity was measured inside the equalising chamber before the fresh air was admitted into the house, but not in the debating chamber itself.

Yet the continuous recording of temperature in logbooks was neither new nor unique to Westminster, as it was a practice then widely used in horticultural and public buildings. For example, temperatures were systematically recorded inside Smithfield meat market, several galleries in the Victoria & Albert Museum and the Royal Albert Hall, and twice-hourly readings were taken inside the Crystal Palace over the entire duration of the 1851 Great Exhibition.[38] But according to reports by doctors Neil Arnott, John Leslie and Goldsworthy Gurney, these measurements could not account for the full range of environmental factors – such as radiant heat, air currents, humidity, etc – known to affect perceived thermal comfort.[39] Therefore in the Houses of Parliament, along with aggregating column after column of quantitative data, the messenger of the sergeant-at-arms, Lord Charles Russell, gathered personal feedback from MPs, which Russell reviewed before passing it on to the office of the ventilator. Russell saw himself as the 'usual medium of communication, as respects the ventilation, between Dr Reid and the members'. He was, however, not passively transmitting data but actively moderating the subjective feedback process and engaging with conflicting views – what he called 'the war of lowering or raising the temperature'.

Though all of this predated computerised building systems by more than a century, and incorporated some of the biggest technological advances of its time (steam-powered fans, warm-air central heating, etc), the day-to-day management of the ventilation in the House of Commons was more akin to the honing of a craft than the operating of a well-oiled machine. Reflecting in 1846 on the system Reid trialled in the Temporary House, the engineer Morrill Wyman wrote:

The changes in the various circumstances in and out of the house are so frequent and so extensive, that the attendants must be constantly upon the watch to detect them; indeed, it is said that the same attention is required to give a good atmosphere, as is required of 'the sailor in steering a ship'.[40]

Unlike today's systems, characterised by their automated, anonymous processes and limited human involvement, the environmental control of the House of Commons was a question of human organisation. Its success relied on tight coordination, and the 'steering' of large quantities of environmental data was extremely labour- and time-intensive. In addition to various monitoring procedures, attendants were responsible for adjusting clocks to regulate the temperature of the hot water and steam pipes and managing the 60 individual air valves that regulated the air supply in different sections of the chamber.

The monitoring of personal comfort was another matter, since this was impossible to define using only quantitative climatic parameters. Comfort is a fluid, ever-changing state of being. Because of this, the direct involvement of people and the documentation of self-reported experience had been integral to the methodology Reid used in his early laboratory experiments, which used sealed rooms with controlled environmental conditions to investigate how climate and air purity affected everything from levels of concentration and a physical sense of well-being to appetite.[41] And in demonstrating a methodology by which the perceived reality could be continually 'metered' alongside the measurement of physical stimuli, this monitoring system can be seen to represent an early example of psychophysical principles when applied to architecture. Indeed, Reid's approach closely resembled what the German physicist Gustav Fechner later described as *äussere psychophysik* (outer psychophysics), a scientific field concerned with the correlation between physical stimuli (*äusserer reiz*) in the environment and the sensations (*innere empfindung*) they produce.[42] While his approach was more informal and less systematic than Fechner's method, Reid saw this type of feedback loop – between scientist and occupant – as a central part of his design of the House of Commons.

Like Russell, Reid was aware of the war over the thermostat and saw MPs functioning as the 'instruments' needed to qualitatively measure perception, allowing him to gather 'information as to the ever-changing feelings of members, of which no one can possibly judge but themselves'.[43]At the same time he knew that satisfying every individual in the chamber was impossible. He did, however, set basic parameters for temperature and humidity, if only so as to minimise disgruntlement. 'As far as I have been able to observe', he stated, 'a temperature of 65ºF, with an atmosphere moving in a very gentle stream, so as not to be perceptible, is most agreeable in rooms that are not overcrowded'. In 1852 he added that 'when there is a difference of 5ºF between the dry thermometer and wet-bulb thermometer next to it, I have the least number of complaints'.[44]

Yet between February and March of that same year Reid and his team fielded continuous complaints from unhappy MPs, and the issue of universal comfort became the subject of several 'heated' parliamentary debates.[45] For example, on 4 February, Joseph Hume, MP for Montrose Burghs, reported having to leave the chamber because he could no longer stand what he considered its sweltering temperature. Captain Fitzroy added that the situation was more complex, stating that MPs were exposed 'to puffs of alternate hot and cold air'. In another debate on 10 February it was suggested that the atmosphere felt too hot but also suffered from 'tremendous draughts'. The gallery was particularly warm due to rising hot air and the strong radiant heat of Barry's gas chandeliers, which produced 'a burning sensation, such as if I were exposed to a red-hot iron', stated Denham Jephson Norreys. Spot measurements taken by the physician Goldsworthy Gurney during a sitting on 19 March confirmed the discrepancy – the temperature on the main floor reached as low as 61.5ºF then rose to 68ºF on the gallery and 73ºF above the seats. While maximum temperatures of 73ºF do not appear exceptionally high, the perceived temperature would have also been affected by the heavy clothing worn during parliamentary sessions as much as by the heat generated by a particularly argumentative debate. As house physician John Leslie noted, 'thermometers tell one tale, the body another'.

Driven by the discontent of many MPs, a select committee was appointed in March 1852 and Gurney was commissioned to examine the internal conditions. The committee also conducted interviews with the speaker, sergeant-at-arms and several MPs on their experiences. In an effort to quantify the physical conditions described, Gurney, with engineers James Mather, James Hann and John Hutchinson, measured air speed, atmospheric pressure and humidity inside the chamber.[46] They found that internal currents arose when the volume of hot air extracted through the up-cast shaft was greater than the quantity of fresh air rising through the floor. In order to regain equilibrium, gusts of air were then forced into the chamber via open doors and unsealed air valves below the floor and above the ceiling. Reid's inability to satisfactorily address these currents, he told the select committee, was less a matter of technicalities than politics: neither architect nor ventilator had communicated directly with the other since 1846, and six years later Reid found himself in a long and drawn-out embroilment over who ultimately controlled the climate of the House of Commons. Although on paper he had free reign to apply his principles to the chamber, Reid's design was not self-contained and was therefore left, by and large, at the mercy of Barry. The architect, Reid told the committee, had built doors that greatly impacted on the air currents in the house, had installed glass chandeliers that undermined his own integrated system and refused, throughout the entirety of the project, to furnish Reid with plans.[47]

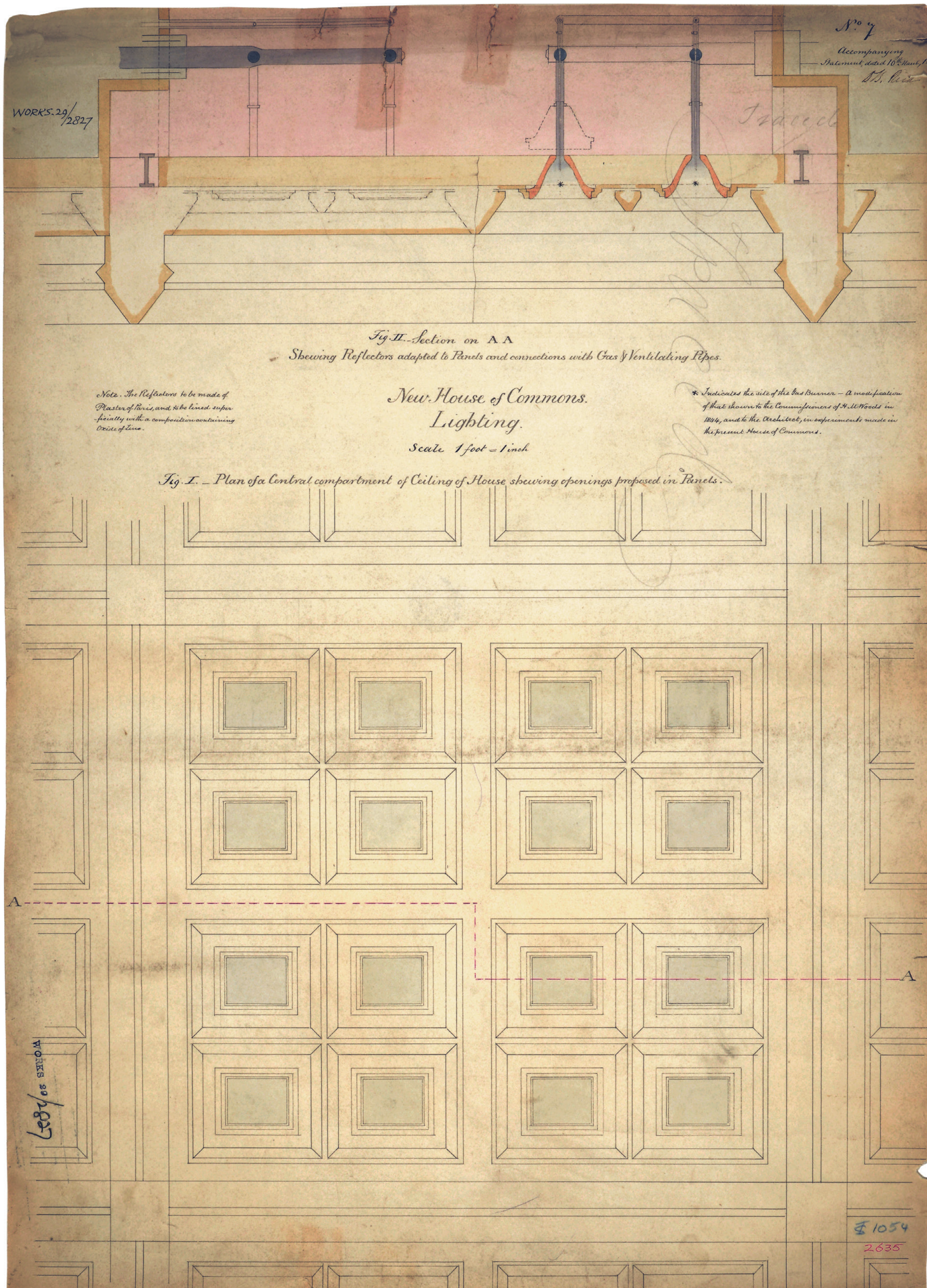
Nevertheless, between April and May 1852 Reid made a series of technical alterations in a final attempt to improve comfort.[48] Foremost among these was his introduction of a new lighting system, to reduce the perceived temperature inside the gallery, and the reorganisation of the ventilation arrangements above the ceiling to allow cool air directly into the gallery. However, recorded figures suggest that the maximum temperature difference between the floor and gallery was only marginally reduced, from 6ºF to 3ºF.[49] A steam-driven fan was then installed to counteract the low air pressure and boost the air supply, but logbooks covering this time report that currents remained an issue, largely due to the difficulties of synchronising the fan-powered supply with the stack-driven extract.

In November 1852, following the failure of these corrective measures, Reid was dismissed from his post. Day-to-day operations were transferred to the engineer Alfred Meeson, who, with Gurney, administered further tests to try to alleviate the rising currents, but to no avail. After a brief operational life of two years, the house then commissioned Gurney to remodel the entire system. Perhaps more of a politician, and distancing himself from his predecessor, Gurney promptly assured members that he did not require any drawings of the chamber to develop a successful system. The solution he came up with adopted a purely stack-driven approach with local inlets that allowed the equilibrium between the quantity of incoming and outgoing air to be naturally maintained without mechanical aids.[50] Logbooks do not give any readings for this period, but interviews with MPs between May and July 1854 suggest significant improvements in climate. The sergeant-at-arms also reported that temperatures were more tightly managed and draughts markedly reduced.[51] According to Robert Smith, MP for Northampton, the atmosphere was fresher and did not become oppressively hot. The MP for North Riding noted that draughts occurred only occasionally and Edward Bouverie, MP for Kilmarnock Burghs, found that the attendants were able to adjust the temperature with more efficiency. In its second report, dated 26 May, the commons committee formally concluded that Gurney's interventions had been successful in improving thermal comfort and recommended the permanent adoption of his system.

Over the next 90 years the system became the subject of a continual process of technical fine-tuning, incrementally erasing Reid's original design. Except for the fragments of the air supply channels in the roof and basement of the Palace of Westminster, none of the original physical features have survived – the last remaining traces were lost during the air raids of 1941. Reid, too, faded from London. In 1856, following his hostile and public dismissal, he moved to the United States where he taught for a year at the University of Wisconsin-Madison and served as a medical inspector for the national sanitary commission before his death in 1863.

Despite his fall from grace, and the dismantling of a system for which he had made his name, Reid had still developed something radical – although not so much in terms of the mechanics of his invention, but in his pioneering of the idea that an architectural environment should respond to individual perceptions of reality. Yet the irony of his successes is that in exposing himself to an especially modern concept of comfort, he left himself vulnerable to an equally modern concept of peer review. As a succession of MPs complained of differing degrees of discomfort, Reid was ultimately derailed by the same system he originated. This in turn exposed certain character flaws when he came to defend himself. Indeed, the physicist was known for his difficult personality, and many times throughout the select committee's 1852 transcript he seems to crumble under pressure, skirting the blame for his failed invention in the House of Commons, evading questions and even disregarding the on-going nature of his own scientific method, claiming over and over the impossibility of improving the ventilation system and exhibiting a predilection towards melodrama: 'I have always stated that the difficulties which a ventilator has to labour under are between the Scylla and Charybdis of the dust below and the products of combustion above'.[52]

Ultimately, however, it is not the struggle between dust and smoke that can be seen to define the rise and fall of David Boswell Reid, but the other, and even more fearsome Scylla and Charybdis of the architect and the consultant. Reid, in these terms, is not victim to monstrosity but *is* one of the monsters himself. Having been hired to provide an environment and a system, he soon found himself battling Charles Barry who in many ways had been tasked with the same thing. That their ensuing rivalry played itself out in the middle of the world's most famous debating chamber only enhances its mythology, as much as the control they were fighting over – not just over ownership and representation, but for the science or artfulness of their discipline – shows Reid and Barry as progenitors of the most modern kind of architectural practice.



Plan and section of Reid's proposed
House of Commons lighting system, 1848
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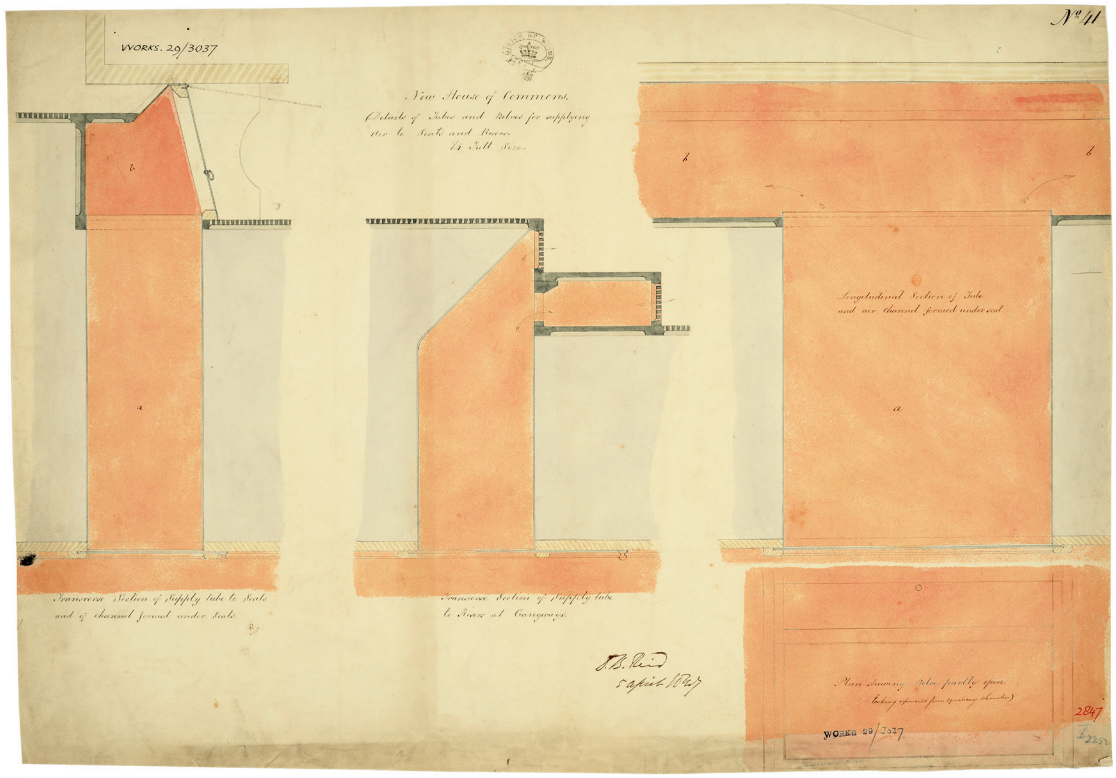

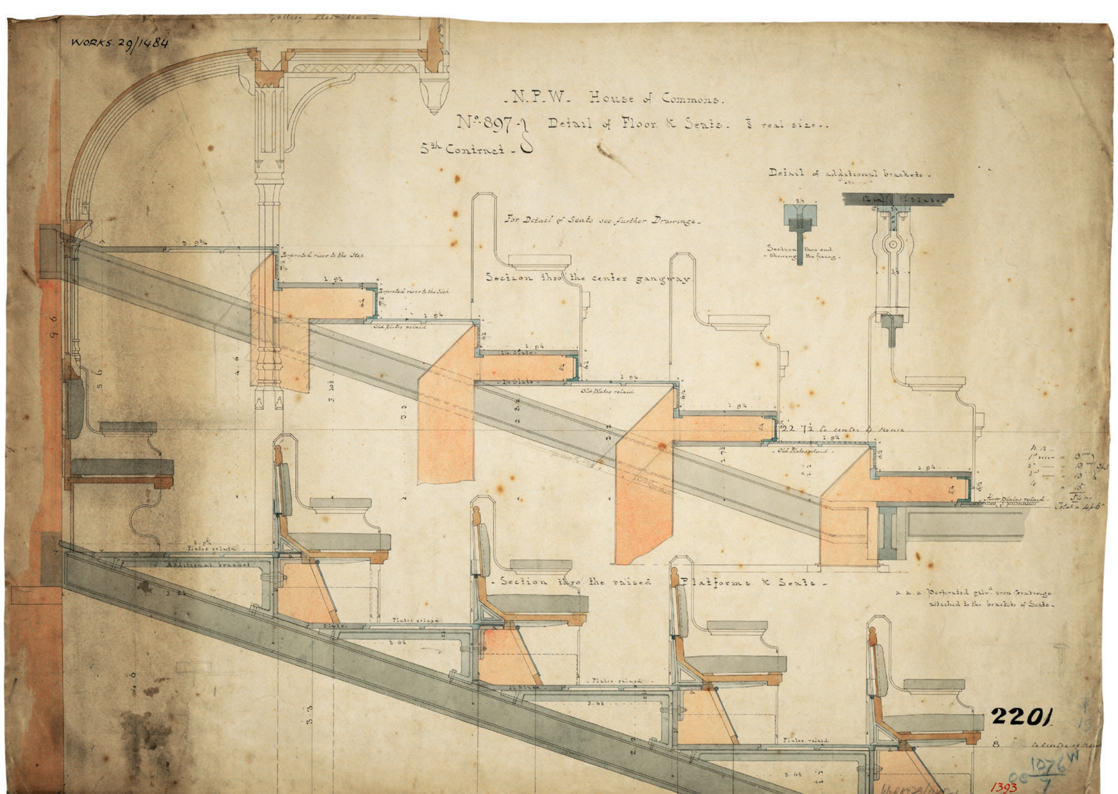

Air inlets around the bench seats
in the House of Commons, Reid's original
schematic drawing, 1847 (*above*), construction
drawings from Barry's office, 1850 (*below*)
© National Archives

1. The debate has been recorded in Winston Churchill, 'House of Commons Rebuilding', *Commons Sitting HC Deb, 1803–2005*, 28 October 1943, vol 393, pp 403–73.
2. Report from the Select Committee on House of Commons Rebuilding, HC SC 194344 (109) (London: HMSO, 1944), p 6.
3. Report of the Select Committee on the Ventilation of the Houses of Parliament, HC SC 1835, 583 (London: HMSO, 1935); David Reid, *Brief Outlines Illustrative of the Alterations in the House of Commons, in Reference to the Acoustic and Ventilating Arrangements* (Edinburgh: Neil & Company, 1837); *Illustrations of the Theory and Practice of Ventilation* (London: Brown, Green & Longmans, 1844).
4. A detailed study of these experimental studies can be found in Henrik Schoenefeldt, 'The Temporary Houses of Parliament and David Boswell Reid's Architecture of Experimentation', *Architectural History*, 57, 2014, pp 175–215.
5. Letter from Alexander Milne to David Reid, 24 January 1840 (Work 11/12 no 30–32).
6. David Reid, *Rudiments of Chemistry: With Illustrations of the Chemical Phenomena of Daily Life* (Edinburgh: William & Robert Chambers, 1836), pp 184–85; *Elements of Practical Chemistry* (Edinburgh: MacLachlan & Stewart, 1830).
7. See Moritz Gleich, 'Architect and Service Architect: The Quarrel Between Charles Barry and David Boswell Reid', *Interdisciplinary Science Reviews*, 37/4, 2013, pp 332–44; Peter Collins, *Changing Ideals in Modern Architecture, 1750–1950* (Quebec: McGill-Queens University Press, 1998); David Cannadine, *The Houses of Parliament: History, Art, Architecture* (London: Merrell, 2000); Henry-Russell Hitchcock, *Early Victorian Architecture in Britain* (New Haven, CT: Yale University Press, 1954); Rosemary Hill, *God's Architect: Pugin and the Building of Romantic Britain* (London: Allen Lane, 2007); Barnett Cocks, *Mid-Victorian Masterpiece* (London: Hutchinson, 1977).
8. M H Port, *The Houses of Parliament* (New Haven, CT: Yale University Press, 1976), p 103.
9. Robert Brucemann and Donald Prowler, 'Nineteenth-Century Mechanical System Designs', *Journal of Architecture Education*, 30/30 (1977), p 12.
10. Robert Bruegmann, 'Central Heating and Forced Ventilation: Origins and Effects on Architectural Design', *Journal of the Society of Architectural Historians*, 37/3 (1978), p 152.
11. Report from the Select Committee of the House of Lords on the progress of the building, HL SC 1846, 719; Report from the Select Committee on Westminster Bridge and new palace, HC SC 1846, 177; Second report from the Select Committee on Westminster Bridge and new palace, HC SC 1846, 349; Third report from the Select Committee on Westminster Bridge and new palace, HC SC 1846, 574.
12. Robert Bruegmann, *op cit*, p 153.
13. Letter from Charles Barry to H M commissioners for the completion of the New Palace of Westminster, 20 February 1849, National Archives, work 11/13 no 546; letter from Meeson to J Thornborrow, 13 August 1855, National Archives, work 11/14 no 8814.
14. Set of drawings dated 5 April 1847, National Archives, work 29/2905–59.
15. Letter from David Reid to H M commissioners for the completion of the New Palace of Westminster, 29 June 1848, work 11/13 no 462; drawing modifications proposed for the supply of fresh air to the new House of Commons, 7 June 1848, National Archives, work 29/3066; valves at ingress of fresh air at central portion of River Front roof and turret near SW angle of Westminster Hall, Reid, 29 June 1848, National Archives, work 29/3068.
16. Transcript of interview with David Reid, 26 March 1852, in *Second Report of SC 1852*, Q373, 406–07.
17. Plan and section of ceiling supply with heating pipes, 5 April 1847, work 29/3046; heating apparatus in the air chamber in the roof over commons lobby, 22 January 1850, work 29/3083.
18. David Reid's statement explaining the arrangements for the warming and ventilating of the New House of Commons, 5 April 1852, in Second Report of SC 1852, pp 545–8; 'Dr Reid's Arrangement for Warming and Ventilating the New Houses of Commons', *Civil Engineer and Architect's Journal*, 222/15 (September 1852), p 292f. The valves are shown in several drawings, including 'Longitudinal Section', 1847 (undated), National Archives, work 29/2905; 'Warming and ventilation – plan of roof', David Reid, 5 April 1847, National Archives, work 29/3027.
19. David Reid's statement explaining the arrangements for the warming and ventilating of the New House of Commons, 5 April 1852, in the Second Report of SC 1852, pp 545–48.
20. Transcript of interview with David Reid, 30 April 1852, *ibid*, Q3573.
21. Letter from Charles Barry to commissioners for the completion of the new palace, 6 July 1848, National Archives, work 11/13 no 464; interview with David Reid, 26 March 1852, in Second Report of SC 1852, Q402–3.
22. Letter from David Reid to Viscount Duncannon, 7 July 1840, National Archives, work 11/12; letter from David Reid to Department of Woods and Forests, 28 April 1841, National Archives, work 11/12, no 45.
23. Report from the Select Committee on Smoke Prevention, HC SC 1843, 583.
24. Interviews with David Reid on 24 September and 1 October 1841, Report from the Select Committee on Ventilation of the New Houses of Parliament, HC SC 1841, 5, pp 22–25, 30–35.
25. Letter from David Reid to Viscount Duncannon, 7 July 1840, work 11/12, no 34.
26. See Henrik Schoenefeldt, 'Adapting Glasshouses for Human Use: Environmental Experimentation in Paxton's Designs for the 1851 Great Exhibition Building and the Crystal Palace, Sydenham', *Architectural History*, 2011, pp 233–73.
27. Registers of temperature control and ventilation for the House of Commons 1853–1854, Parliamentary Archives, OOW/5.
28. David Reid, *Ventilation in American Dwellings* (New York, NY: Wiley & Halsted, 1858); David Reid, *Brief outlines illustrative of the alterations in the House of Commons, in reference to the acoustic and ventilating arrangements* (Edinburgh: Neil & Company, 1837).
29. Statement accompanying David Reid's letter to the Commissioners of Woods, 10 March 1848, National Archives, work 11/13 no 387.
30. Interview with David Reid by the Select Committee of 1852, 20 April 1852, HC SC Second Report 1852, Q3598.
31. Transcript of interview with David Reid, 26 March 1852, in Second Report of Select Committee, 1852, Q642.
32. Letter from Lord Campbell, 11 September 1843, in *Extracts from official documents, reports* (UCL Library, Hume Tracts); the New Houses of Parliament, HL Deb 21 February 1843, vol 66 pp 1033–6; the New Houses of Parliament, HL Deb 5 June 1845, vol 81 pp 120–22; progress of the New Houses of Parliament, HL Deb 24 April 1846, vol 85 cc 970–76.
33. Third report from the Select Committee on Westminster Bridge and new palace, HC 1846, 574, Q985.
34. Ceiling above equalising chamber with supply tubes, valves and flaps, 28 June 1851, work 29/3100. Section through centre gangway, raised platforms and seats, 10 January 1851, National Archives, work 29/3093.
35. Interview with David Reid, 30 April 1852 in Second Report of Select Committee, 1852, Q354-5.
36. Report of the Select Committee on Houses of Parliament, (1844, 448), Q317-28, 387.
37. *Ibid*.
38. Henrik Schoenefeldt, 'The Crystal Palace – Environmentally Considered', *Architectural Research Quarterly*, 12, 2008, pp 283–94; Report of the Commission on Heating, Lighting, Ventilation of the South Kensington Museum (1869); Walter Thornbury, 'The Metropolitan Meat-Market', in *Old and New London* (London: Cassell, Petter & Galpin, 1878), p 495.
39. Interview with J Leslie, Second Report of Select Committee, HC SC 1852, Q3137-43.
40. Morrill Wyman, *A Practical Treatise on Ventilation* (Cambridge: Metcalf, 1846), pp 214–19.
41. David Boswell Reid, 'The Revision of Architecture in Connection with the Useful Arts', *Builder*, 5 May 1855, pp 208f; David Boswell Reid, 'Eight Lectures by David Boswell Reid on "Progress of architecture in relation to ventilation, warming, lighting, fire-proofing, acoustics, and the general preservation of health"', (*Smithsonian Annual Reports*, 1856), pp 147–86.
42. Gustav Theodor Fechner, *Elemente der Psychophysik* (Leipzig: Breitkopf & Härtel, 1860).
43. Report of Select Committee on Houses of Parliament, HC SC 1844, 448.
44. The humidity of the air was determined by taking two parallel readings, one from a dry-bulb thermometer and the other from a wet-bulb thermometer. The greater the difference between the two readings, the higher the atmospheric humidity.
45. See Ventilation of the House, HC Deb, 6 February 1852, vol 119, pp 231–34; The Queen's Speech – Report of Address, HC Deb, 4 February 1852, vol 119, pp 162–72; Imperial Parliament, *Daily News*, 5 February 1852, p 3; 'The Science of Ventilation', *The Times*, 9 February 1852, p 4; Ventilation of the House, HC Deb, 11 February 1852, vol 119, pp 400–16; Editorial, *Builder*, 14 February 1852, p 97; Ventilation of the House, HC Deb, 16 March 1852, vol 119, pp 1147–50.
46. Second report of Mr Goldsworthy Gurney on the ventilation of the new House of Commons, HC 1852, 252 (371).
47. See Second report from the Select Committee on Ventilation and Lighting of the House, HC SC 1852 (474).
48. David Boswell Reid, Report of Measures required for the health and comfort of the honourable the House of Commons, in obedience to resolution of the house, dated 11 February 1852 and 10 March 1852, work 11/14 no 711–14. For a more detailed account of the experiments see Henrik Schoenefeldt, 'Reid's Short-lived Ventilation System for the Permanent House of Commons', *Studies in the History of Construction*, 2015, pp 167–82.
49. Temperature at the House of Commons, taken by the messenger of the sergeant-at-arms, 22 March – 4 May 1852, HC 1852 (402).
50. First Report from the Select Committee on Ventilation, HC SC 1854 (149); letter from Works to Gurney, 7 April 1854, work 11/14 no 850; letter from Gurney to Works, 7 April 1854, work 11/14 no 842; letter from Gurney to Office of Works, 10 April 1854, work 11/14 no 847.
51. Report from the Select Committee of the House of Lords, appointed to enquire into the possibility of improving the ventilation and the lighting of the House, HL SC 1854, 384, Q839–81.
52. Second report from the Select Committee on Ventilation and Lighting of the House, HC SC 1852 (361). Twenty years earlier, in 1831, Reid had been involved in an equally fractious enquiry, having a very public falling out with the chemist Richard Phillips, who had pointed out a number of inaccuracies in one chapter of Reid's *The Elements of Practical Chemistry*. Reid responded by publishing a 20-page pamphlet titled *An Exposure of the Misrepresentations in the Philosophical Magazine and Annals*, denouncing Phillips' critique as that of 'an infatuated, and, unaccountably, totally and grossly ignorant person'. Phillips in turn retorted that: 'You have appealed to the public, and expressed your willingness that your book should stand or fall by their decision. I also am perfectly content that the same tribunal should determine, which of us has substituted words for facts.' See Richard Phillips, 'A letter to Dr David Boswell Reid', 1831, p 28.

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Colin Rowe was born near Bolton-on-Dearne in South Yorkshire in 1920 and studied architecture at the University of Liverpool, architectural history at the Warburg Institute and at Yale with Henry-Russell Hitchcock on a year-long Fulbright scholarship. He taught at the University of Liverpool (1950–52), the University of Texas-Austin (1954–56), the University of Cambridge (1958–62) and Cornell University (1962–92), before retiring briefly to London (1993–94) and ultimately to Washington, DC. His books include *The Mathematics of the Ideal Villa & Other Essays* (1976), *Collage City*, with Fred Koetter (1978), *The Architecture of Good Intentions* (1994), the three-volume *As I Was Saying* (1996) and, with Leon Satkowski, *Italian Architecture of the Sixteenth Century*, published posthumously in 2002. Rowe died in Washington, DC in November 1999. His ashes are scattered at the Temple of the Four Winds, Castle Howard, Yorkshire.

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