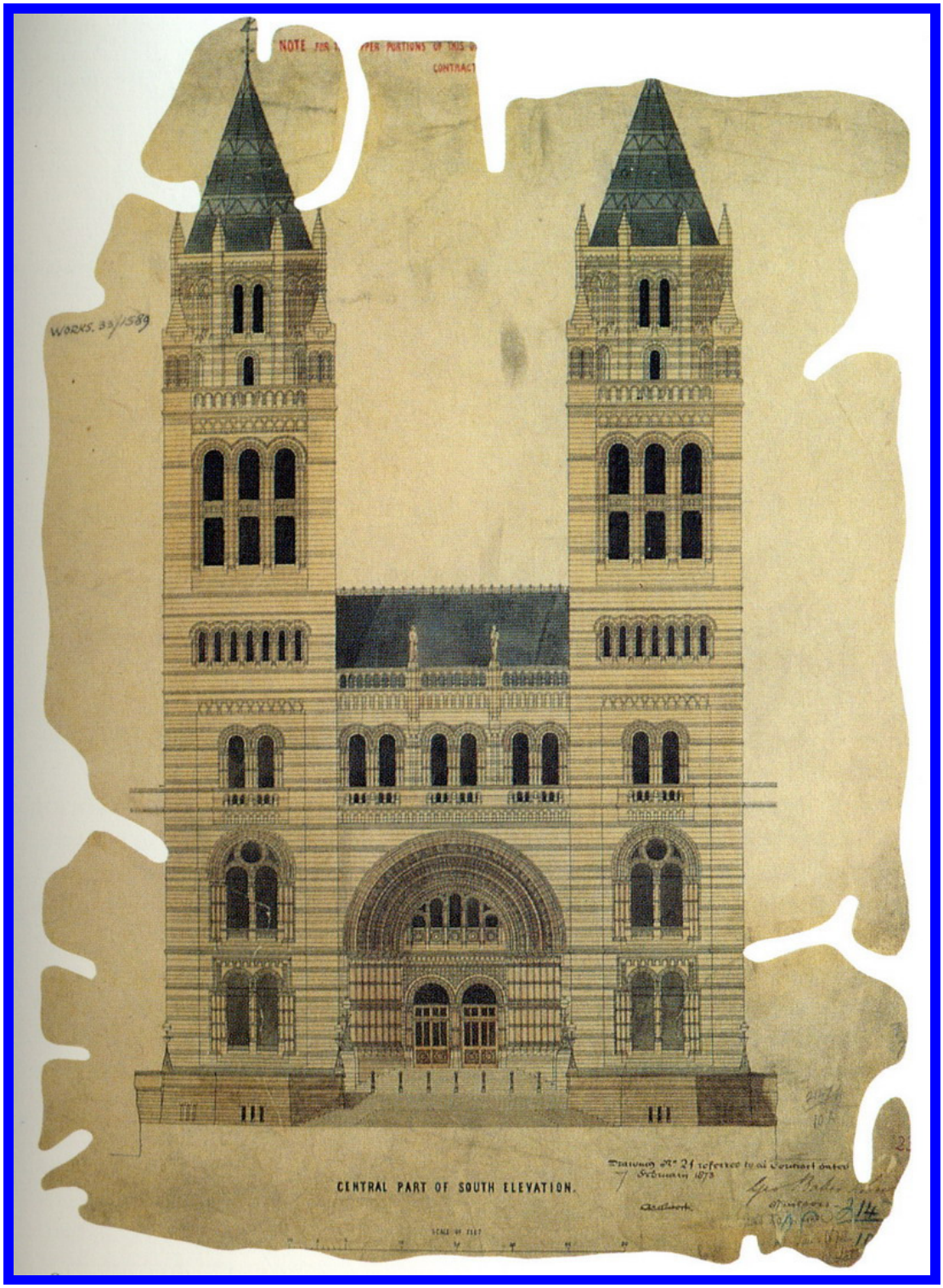
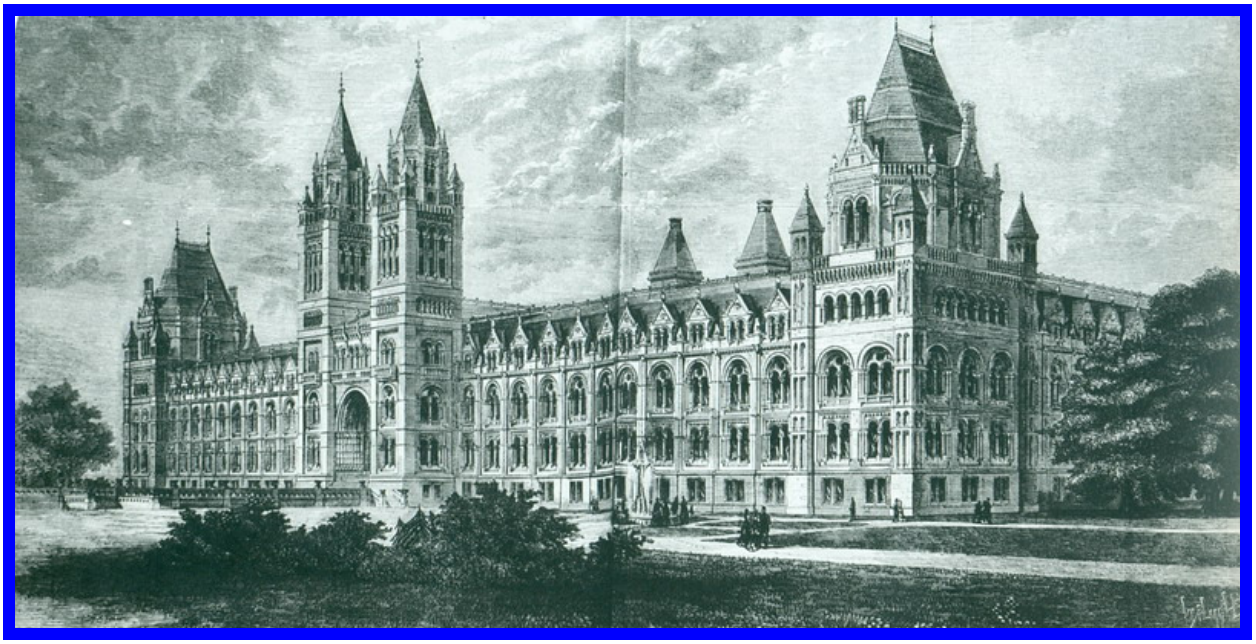
THE NATURAL HISTORY MUSEUM, LONDON



Waterhouse's original design for the towers was rejected as too expensive but Captain Shaw of the London Fire Brigade urged their reinstatement to hold reservoirs for firefighting ("Imperial London," M H Port, 1995)



Design by Alfred Waterhouse, 1875 (Port)

3.3 Natural History Museum, Kensington, London, 1873-80
Architect Alfred Waterhouse

It was Professor Richard Owen (the first Superintendent of the Natural History Museum) who was largely instrumental (1858) in proposing to move the natural history collections of the British Museum from Bloomsbury to a new building. He wanted top-lit galleries and a specimen plan (1862) was to be used as a basis of later designs. An attempt to use the redundant 1862 Exhibition Building was thwarted when much of it was taken away and incorporated in the first Alexandra Palace, but the site was acquired for the museum. A competition (1864) attracted thirty-three entries. Captain Francis Fowke RE was first, with second: Robert Kerr; third: Cuthbert Broderick. [VBL, 121-4]. But before work could begin, Fowke died (1865).

The First Commissioner of Works then appointed Alfred Waterhouse as architect, possibly as a consolation prize for not having been awarded the commission for the Law Courts in the Strand (which was given to G E Street). Though Waterhouse had been asked to complete Fowke's design, he prepared his own (1868). However, a delay then occurred as the Government considered locating the Museum by the Thames Embankment, but eventually (1870) the Kensington site was finally agreed upon. The difficulties were not over, as the new First Commissioner of Works, A S Ayrton, demanding swingeing economies. Waterhouse prepared a further design (1872) allowing work to finally begin (1873). Later (1876), Disraeli's Conservative Government allowed the restoration of one of the north smoke and ventilation towers, while the two south ventilation towers were restored to their full height (though this was largely on the insistence of Captain Shaw, the London Fire Officer, because the towers contained water tanks and the full height was required to adequately pressurise the fire hoses.)

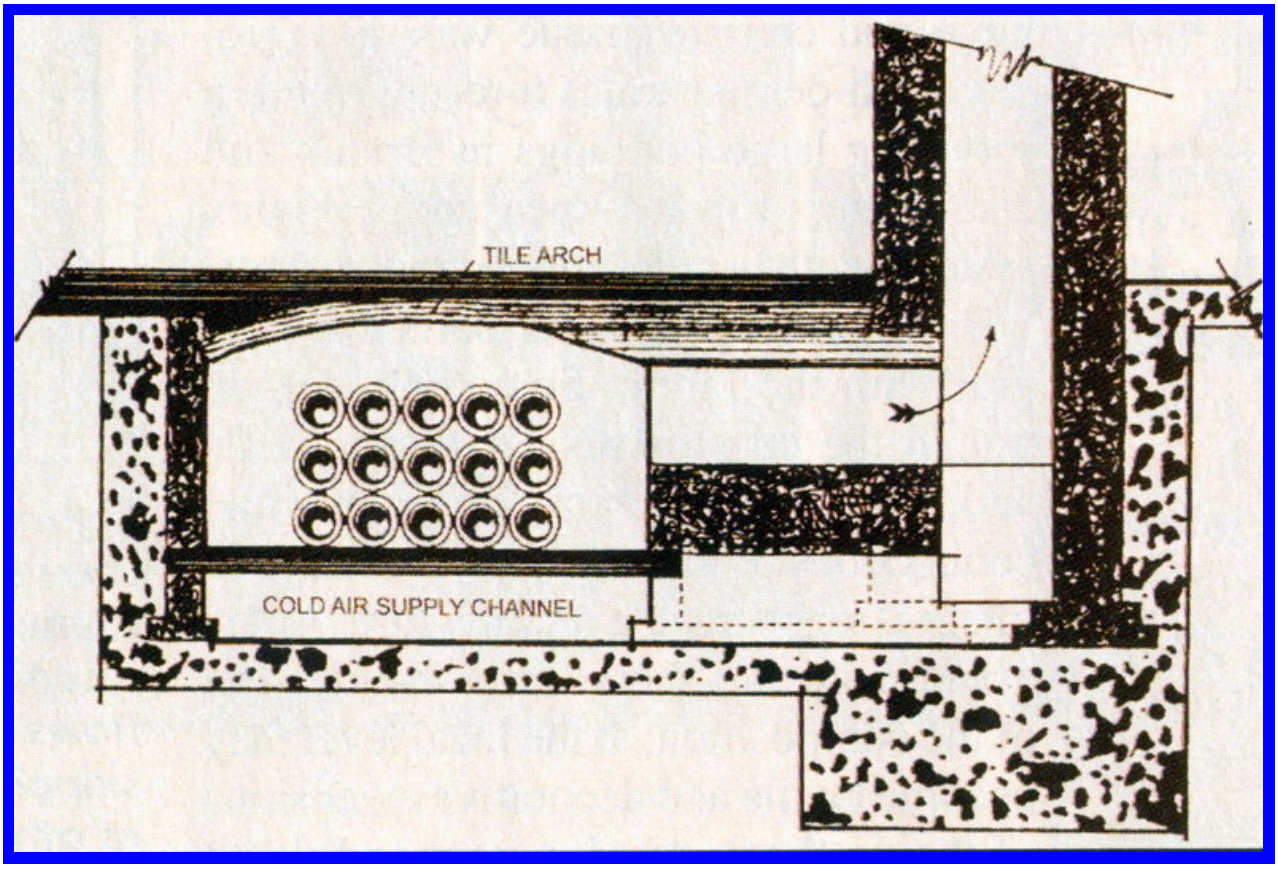
The design and installation of the heating and ventilation by Phipson has recently been researched in some detail by Professor Jeffrey Cook and Tanis Hinchcliffe in a series of articles. [DWI, DWTI & DVH] A comparison of the schemes proposed by the competing design-contractors, Haden and Phipson, was given by Waterhouse his letter to the client, The Right Hon. The First Commissioner of H M Works [Public Records Office, Kew, file "Works" 18-18/3 p.15 ff]:

Text extract from "Wilson Weatherley Phipson: Victorian Engineer Extraordinary, 1838-91," Brian Roberts, 2006

".....Messrs Haden propose to warm the entire building by hot water circulation from four boilers each 118 ft x 6 ft 6 in. Mr Phipson proposes to warm the building by Hot Water too, but the water would be heated not by the boilers direct but by Steam Heaters supplied with Steam at low pressure from three boilers each 15 x 5 ft. In each case two boilers would be sufficient for performing the Work, the remaining one, in Mr Phipson's case, or two in Messrs Haden's, being a reserve to meet the Contingency of repairs to those in use. My impression is that one such spare boiler would suffice.

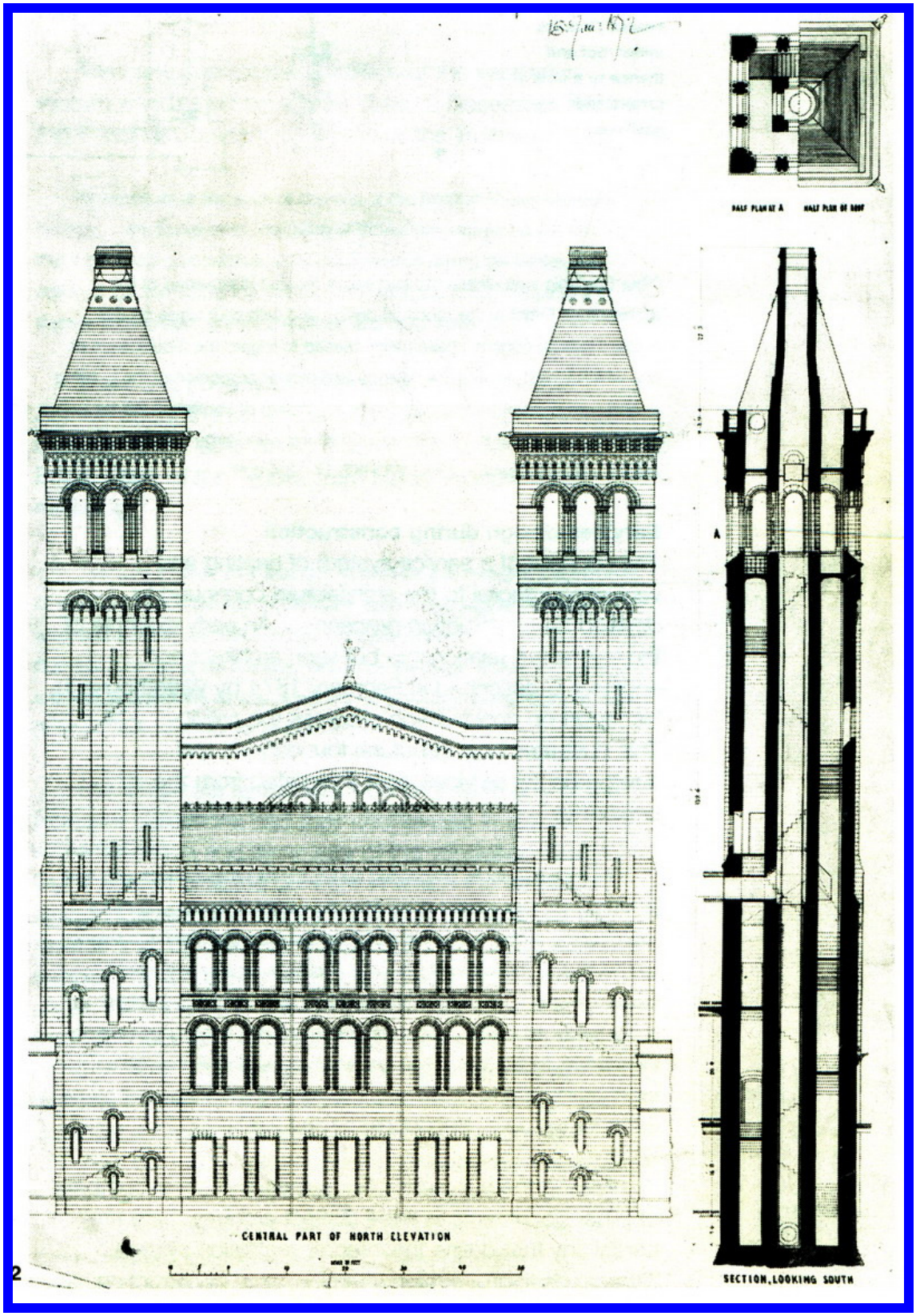
To warm the Basement Storey, Messrs Haden propose to carry their Flow pipes under the Ceilings of the Rooms in that Story and the Return pipes under the Floors. To warm the top-lighted Galleries in the rear, they propose to place batteries of pipes under the floor, with iron Gratings above. The Front Galleries on the Ground and First Floors, they propose to warm by the method adopted by them for many years past with much success, in connection with Gaols, (authors' note: eg. Pentonville Prison, 1844, see QC, 110) *namely, by taking up Flues in the walls from the Basement and discharging warmed fresh air into the various rooms, on both stories, near the floor. To warm the Second Floor, Messrs Haden would arrange Coils and Pedestals in the positions shown.*

Mr Phipson keeps all his pipes in the Basement, bringing warmed air up through the walls, in the case of the front Galleries, and through the floors in the case of those in the rear. Except in the British Natural History Museum & Index Museum, in which latter place he has coils of pipes, like Messrs Haden, under the Stairs and near the Entrance.



Air supply tunnels and steam heating pipes
"Designing Ventilation with Heating," Jeffrey Cook, *ASHRAE Journal*, April 1998

The late Jeffrey Cook AIA was Regents Professor of Architecture at Arizona State University and a member of the CIBSE Heritage Group



Construction document of 1872 showing two smoke and ventilation towers ("Delivering the well-tempered institution of 1873," Jeffrey Cook & Tanis Hinchcliffe, *Architectural Research Quarterly*, autumn, 1996)

Mr Phipson Estimates that his system would renew the entire bulk of the air in the various Museums, three times per hour. Messrs Haden have not given me a corresponding Estimate with regard to the system proposed by them. The temperature to which Messrs Haden propose to bring the Air of the Museums is 56° F and the Workshops 60° F, assuming the External Air to be 32° F. Mr Phipson would give a maximum temperature to the Workshops of 56° F and a minimum temperature of 51° F. And the Index Museum, max: 58° F; Galleries, Max: 60° F, min: 54° F.

Mr Phipson's tender amounted to £5,115.12.0 and he informs me that his arrangements will admit of his still undertaking the execution of the Work for that sum. Messrs Haden's tender amounted to £5,242, and they now inform me that in consequence of the Great Rise that has taken place in the cost of labour and material since they delivered their Tender, twelve months ago, they could not undertake the work except at an advance upon their tender of from 15 to 20 per cent."

The firm of Haden, based in Trowbridge was established by the brothers George and James Haden in 1916, starting in business by erecting steam engines in the West Country on behalf of Boulton & Watt. They soon became stove manufacturers and the best known heating contractor in Britain. It is surprising that Phipson beat them in competitive tender, though judging by the Haden comment on increased costs, it appears they decided they didn't want the contract. Whether Phipson made a profit is unknown.

The Waterhouse Report continued:

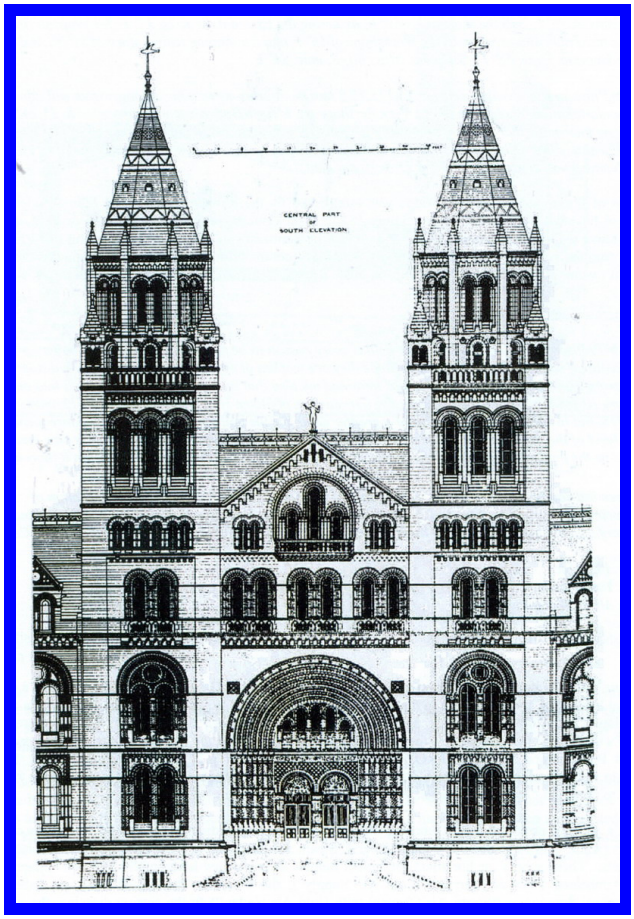
".....Mr Phipson ....has informed me that he has every reason to be satisfied that his Steam boilers are practically as safe as Hot-Water boilers since they are worked at so low a pressure; and he considers them much more economical in working. He has informed me also that he could convert his System into one of ordinary Hot Water Circulation, without the introduction of Steam Heaters, and reduce his Estimate to £4815, but in such case he would want a greater depth for his boilers by 2 ft, Which, in consequence of the level of the drains, I fear we could not by any possibility give him. The boiler-space is now arranged 5 ft below the level of the Basement floor and as it is, it will be only just practicable to drain it thoroughly.

I may remind you in conclusion, that, having taken Counsel of Mr Galton during the preparation of my drawings, I have made plans to suit the System proposed by Mr Phipson, as it was necessary to make them conformable to one or other of them in order to get the needful builder's work included in the Contract.

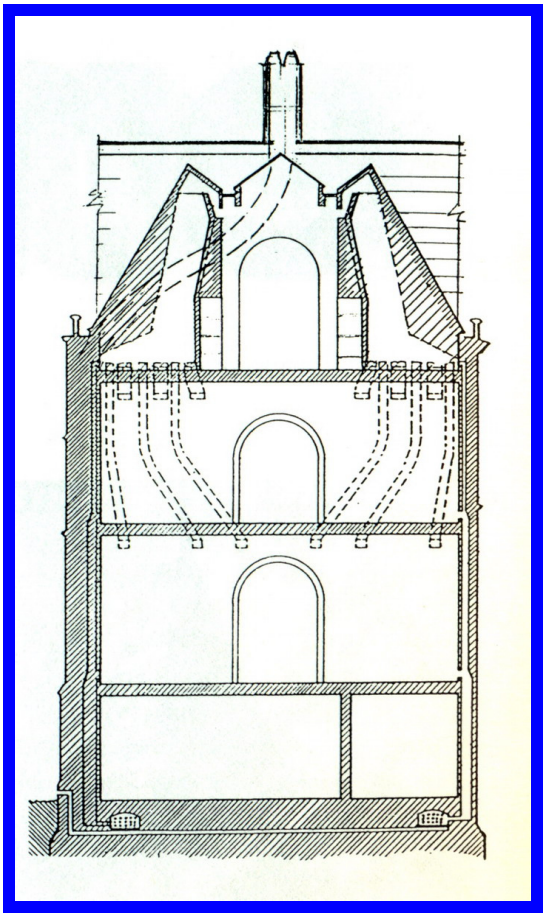
I am, Sir,
Your Obedient Servant,
Alfred Waterhouse." [quoted in DVH, 46]

The Counsel that Waterhouse had taken was that of Sir Douglas Strutt Galton (1822-1899), one time a Captain in the Royal Engineers, then Secretary to the Railway Commission and Referee for the plans for the main drainage of London. Galton was particularly associated with sanitary science and may have been impressed with Phipson's ventilation rate guarantees, for in another document Phipson took the then unusual step a providing an intended Performance Schedule [PRO, Kew, file "Works" 17-18, p.3] which listed Minimum, Mean and Maximum internal temperatures (with slight differences to Waterhouses's Report), the air change rate and to pledged to maintain *"a proper Hygrometrical state of the air in all seasons."*

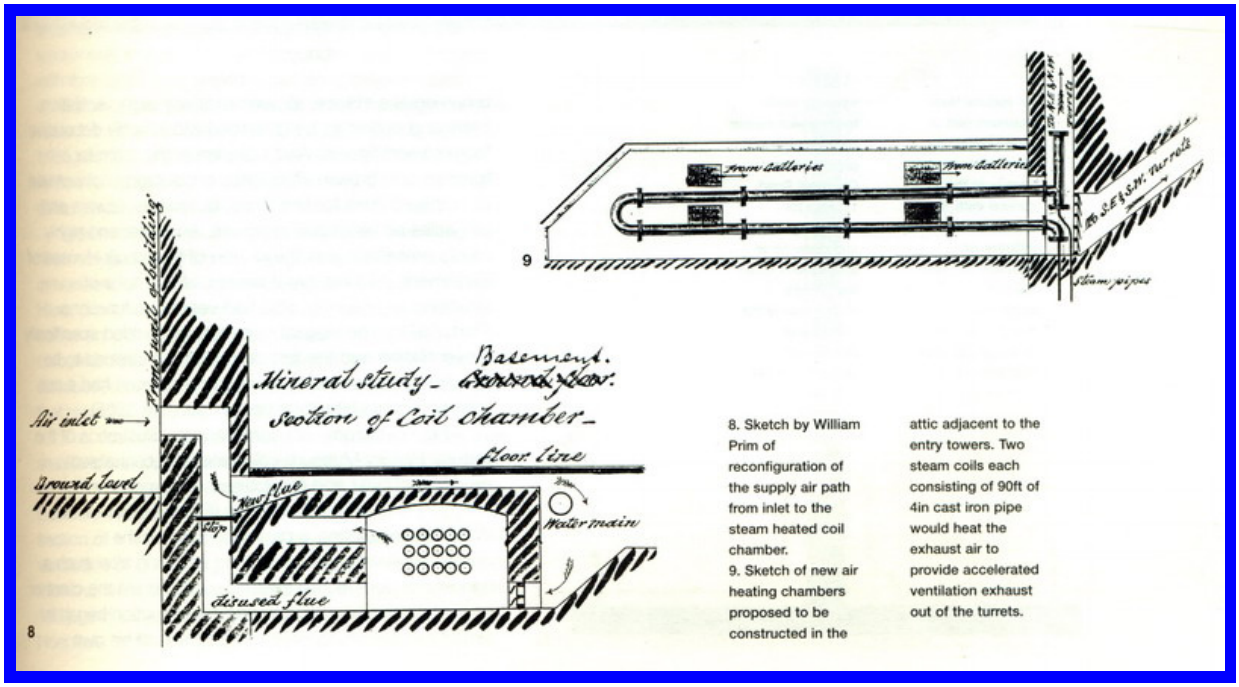
Phipson's scheme provided 3-coal burning steam boilers serving radiators on outside walls, placed beneath windows (some with fresh air inlets and dampers). Steam was also supplied to heating batteries placed in fresh air tunnels. These supply air horizontal basement tunnels were divided horizontally into two "channels." One was for unheated fresh air (termed "Cold Air Supply"), the other for the heated fresh air (labelled on a contemporary drawing as "Warm Air Channel with Cold Air Under.") In the section drawing, the warmed air tunnel is 5 ft wide by 2 ft 6 in high and contains 15 steam pipes: the cold channel beneath is 5 ft wide x 9 inches high. These channels fed into vertical branch shafts with local mixing arrangements, supplying air into the galleries by way of floor grilles. Exhaust from the skylit galleries was through a series of 9 inch square



Front elevation
(*British Architect & Northern Engineer* June 1878)

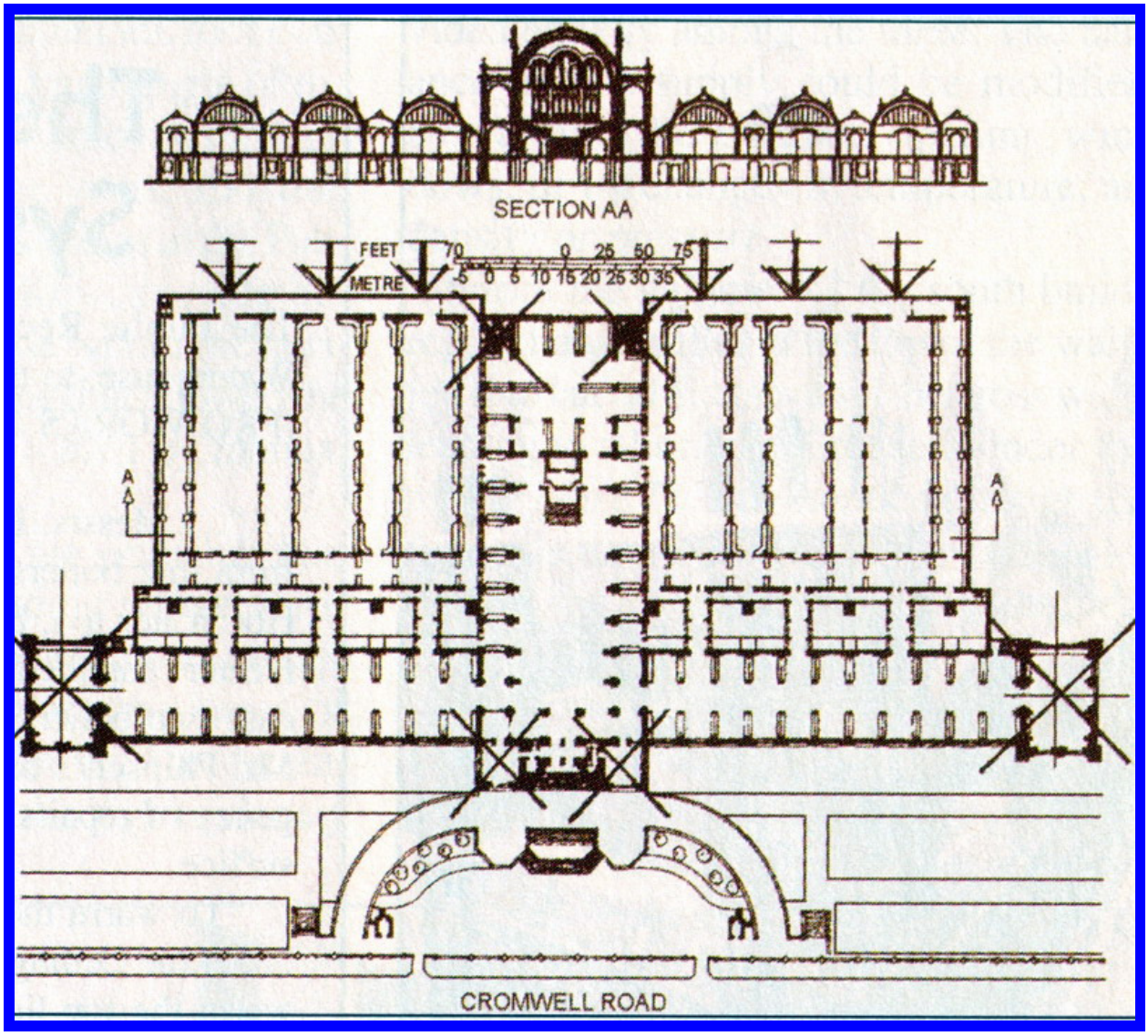


Section showing under basement steam coils, warm air risers and ceiling exhaust ducts (Cook)



8. Sketch by William Prim of reconfiguration of the supply air path from inlet to the steam heated coil chamber.
9. Sketch of new air heating chambers proposed to be constructed in the attic adjacent to the entry towers. Two steam coils each consisting of 90ft of 4in cast iron pipe would heat the exhaust air to provide accelerated ventilation exhaust out of the turrets.

Later modifications (Cook & Hinchcliffe)



Plan and section showing daylighting and ventilating arrangements;
The north arrows are fresh air inlets while the crosses are exhaust towers (Cook)

ceiling grilles, into horizontal wooden ducts, exhausting to atmosphere through continuous metal ridge vents fitted with a manual dampering device.

Control was effected by manual regulation of steam valves and local dampers, for labour was plentiful and cheap. The Natural History Museum Trustee Minutes [Vol.II, 31 December 1878, p.167, quoted in DVH, 48] provide for a heating maintenance staff of one foreman stoker (27 shillings per week), five stokers (24 shillings per week) and five labourers (24 shillings per week).

Phipson's design of a heat-assisted ventilation scheme took full advantage of the architectural opportunities available to house equipment and a large system of builders work ducts. Why he chose not to employ engine-driven fans as he used at the nearby Albert Hall is unclear. In a way he may have foreseen the assisted natural ventilation systems of the 1990s. As summed up by Prof. Cook, *"The Natural History Museum indeed may present both a monument of its time in its environmental control, and a model for a future of passive and low energy buildings."*

(Roberts)