Second report from the Select Committee on Ventilation and Lighting of the House : together with the proceedings of the committee, minutes of evidence, appendix and index.

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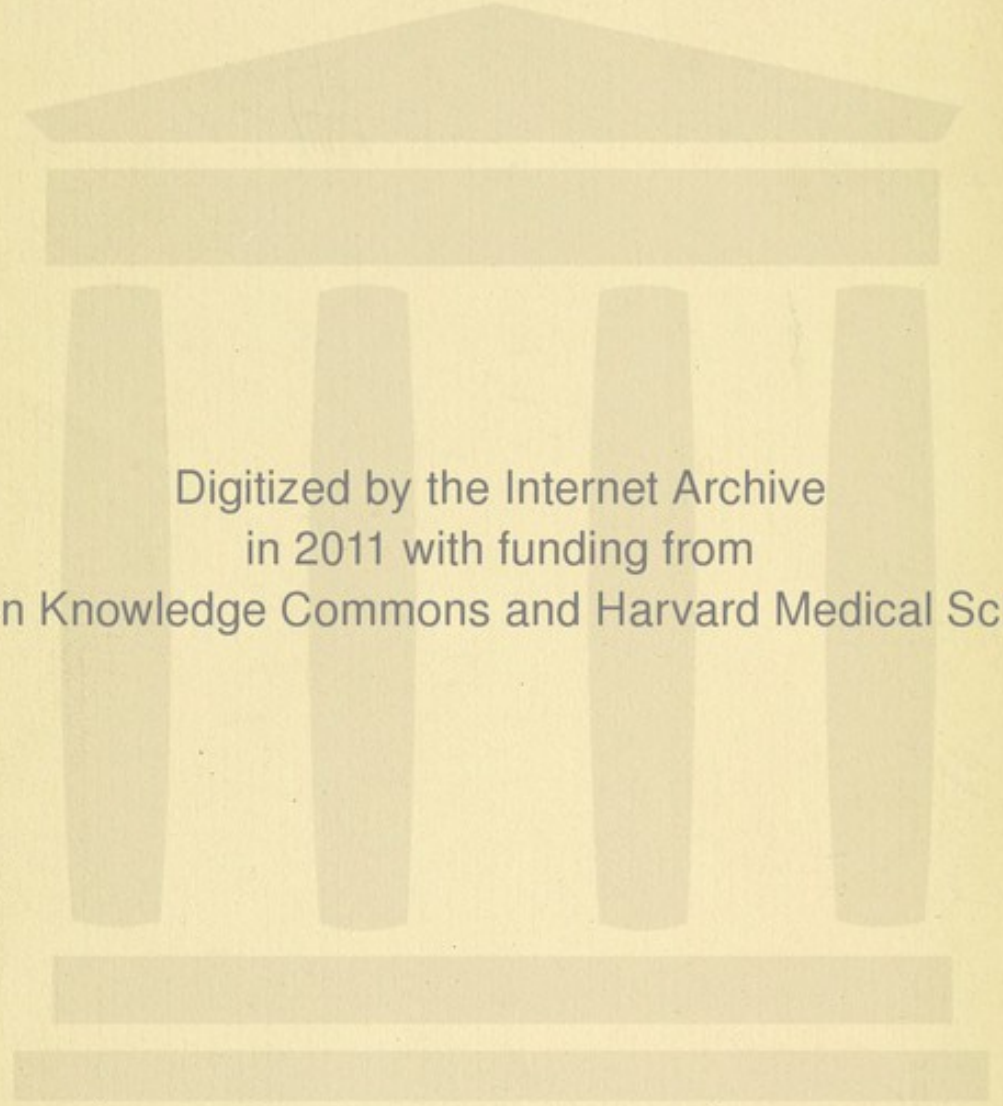

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SECOND REPORT

FROM THE

SELECT COMMITTEE

ON

VENTILATION AND LIGHTING OF THE HOUSE;

TOGETHER WITH THE

PROCEEDINGS OF THE COMMITTEE,

MINUTES OF EVIDENCE,

APPENDIX AND INDEX.

Ordered, by The House of Commons, *to be Printed,*
24 *May* 1852.

402.

Veneris, 19° *die Martii*, 1852.

Ordered, That a Select Committee be appointed to consider the best means of improving the Ventilation and Lighting of the House and its Appendages, and to Report thereupon at as early a period as may be.

Lunæ, 22° *die Martii*, 1852.

Committee nominated, of—

Lord John Manners.	Mr. Cochrane.
Mr. Thomas Greene.	Mr. Deedes.
Viscount Ebrington.	Mr. Henry Hope.
Mr. John Lewis Ricardo.	Viscount Palmerston.
Sir Denham Norreys.	Mr. Bankes.
Lord Robert Grosvenor.	Mr. Henry Drummond.

Ordered, That the Committee have power to send for Persons, Papers, and Records.

Ordered, That Five be the Quorum of the Committee.

Martis, 23° *die Martii*, 1852.

Ordered, That Mr. Stephenson, Mr. Locke, and Mr. Henry Fitzroy be added to the Committee.

Martis, 6° *die Aprilis*, 1852.

Ordered, That the Committee have power to Report, from time to time, to The House.

Lunæ, 24° *die Maii*, 1852.

Ordered, That the Committee have power to Report the Minutes of Evidence taken before them to The House.

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SECOND REPORT.

THE SELECT COMMITTEE appointed to consider the best Means of improving the VENTILATION AND LIGHTING OF THE HOUSE and its Appendages, and to Report thereupon at as early a Period as may be; and who were empowered to report from time to time, and to Report the Minutes of Evidence taken before them to The House; —— HAVE further considered the Matters to them referred, and have agreed to the following REPORT:—

IN obedience to the orders of The House, Your Committee proceeded, as detailed in their First Report, to take evidence as to the ventilation and lighting of that portion of the New Palace which was the object of their inquiry, and they made a personal inspection of the various works connected therewith, in order more fully to comprehend the testimony of the witnesses called before them. The House will have observed, that they recommended certain alterations to be made during the recess, stated by Dr. Reid to be requisite in his Report to The House of the 16th of March, and that in order to guard against incurring unnecessary expense, they added a recommendation that no works should be commenced without the sanction of three Gentlemen, Members of their Committee.

At the termination of the recess Your Committee reassembled, and proceeded to inquire what the results of the alterations were, what the expenditure thereby incurred, and to consider what the future course of Your Committee should be. It seemed that after expending about 700*l.* in a change in the mode of lighting, and 400*l.* in other arrangements, applying generally to the ventilation, the state of the former was greatly improved, and the latter was somewhat ameliorated. The Members of the Committee who were so obliging as to superintend the carrying out of the proposed alterations, not being convinced that the mode proposed by

Dr. Reid for improving the air channels was the best that could be adopted, Your Committee declined to sanction any additional outlay in that direction.

Under these circumstances, Your Committee determined to hear more witnesses, in order to complete the information necessary to satisfy their own minds, and also to enable them to lay before The House sufficient data to form its own opinion upon the important subject of their inquiry.

The only portion of the New Palace under the superintendence of Dr. Reid is the House of Commons, with its division and gallery corridors, the House lobby, and the Speaker's and Cabinet rooms; all the remainder is under the control of the Architect.

At the commencement of the Session the lighting of the House was in charge of Sir C. Barry, but since that period it has been transferred to Dr. Reid.

The method employed to ventilate that portion of the New Palace which is under the superintendence of the Architect is to bring the fresh air in from the top of the Victoria Tower and some other minor sources of supply, and to propel it by means of a fan, worked by steam power, which is placed in the vaults or air passage underneath the building; the air ascends thence by various conduits to the different portions of the structure. When it becomes necessary to warm the air, it is passed through a range of vertical iron pipes, heated by steam, and in juxta-position to the fan; this is called the "Tempering Chamber." At no great distance from this, when further alteration of temperature is required, it is allowed to pass into another low apartment, called the "Mixing Chamber," where there are also iron pipes heated by steam, and where the operation of mixing to secure the desired temperature takes place; thence it passes onward to its destination, always under the influence of the fan, or of a steam jet hereafter mentioned. As, however, the distances to which the air is required to penetrate are considerable, iron pipes for the purpose of preserving its warmth are carried along the air-channels in various directions; and still further to ensure equality of temperature, and to regulate that of the air which is to enter the Committee-rooms, unequally occupied at different times, a separate horizontal coil of pipe, also heated by steam, is placed in the vaults underneath the river front for each Committee-

Committee-room, to be used, or not, at pleasure, with valves to regulate the access of air to each room according to circumstances. And for the purpose, in cold weather, of neutralizing the cooling effect of the windows, there are placed within the room beneath each window of the Committee-rooms separate coils of steam pipes.

The fresh air enters the various divisions of the building in some at the ceiling, in some at the floor, in others at both. A steam jet and steam coil are placed in a shaft for the purpose of extracting the vitiated air, which passes away generally through holes in the ceiling, but in some instances also through a portion of the floor.

Dr. Reid having no present communication with the Victoria Tower, obtains his supply of fresh air from other sources, of which the Clock Tower is the most lofty. The heating apparatus consists of an iron pipe of considerable diameter, warmed by hot water, but coiled horizontally, and the air passes into the House itself principally through the horse-hair carpet, which is laid upon a perforated iron floor.

The fan is worked at present by hand, until steam power can be applied. There is an exit contrived in the floor of the House, intended to abstract the vitiated air, and there are the means of introducing a downward current of air from the ceiling, to effect which another fan is placed in a higher portion of the building, to be worked by a steam engine, which forces the air over coils of pipe one inch diameter, heated by steam; there is also a furnace in the shaft to extract the foul air.

There are local apparatus distributed throughout both Houses, for heating the floors of the corridors and apartments in particular cases.

Your Committee are of opinion that the condition of the ventilation of the House of Commons and its appendages is still unsatisfactory, notwithstanding the improvement which has been effected in the House itself since the period when the Committee were appointed.

Much of the inconvenience in regard to ventilation has arisen from the want of a proper understanding between Sir C. Barry and Dr. Reid, to whom the superintendence of different parts of the building has been confided; and the Com-

mittee are of opinion, that for the future, divided responsibility should be avoided, and that the ventilation of the Houses of Parliament, should be placed in the charge of one person only.

The system of Lighting adopted by Sir C. Barry (viz. by large gas chandeliers descending for a considerable distance into the body of the House), however well it may have accorded with the general architectural character of the room, rendered the requisite control over the ventilation difficult if not impossible; the heat radiating from these highly heated surfaces pervaded every part of the House, and rendered the Galleries almost intolerable.

In consequence of defective arrangements in regard to the gas, much of it escaped from the pipes and burners, and contaminated the air which was drawn into the House from the Corridors.

The plan of forcing air into a building by mechanical power, to produce what is called plenum or plus ventilation, combined with the extracting powers of a shaft with furnace or steam jet to effect what is termed vacuum ventilation, with ascending and descending currents for the supply of fresh and the abstraction of vitiated air, is, in the opinion of Your Committee, a complicated system, and one which they are not prepared to approve.

The vaults used for the purpose of transmitting the air to the House of Commons are liable to be affected by damp and impurities arising from bad drainage; and unless this evil be effectually remedied those vaults ought not to be used as air channels.

The air is deteriorated at times by over-heating, which it experiences when in contact with the iron pipes, heated some by steam, others by hot water, contributing to produce the disagreeable taste and smell which has been complained of. This disturbance of the wholesome condition of the atmosphere renders complicated manipulation necessary to restore the balance, an operation attempted in both the systems adopted in the New Palace, and, in the opinion of Your Committee, without success.

Your Committee have not been enabled to obtain satisfactory evidence in regard to any apparatus for warming which shall dispense with metal surfaces for heating the air.

They

They cannot but think, however, that in the present rapidly advancing state of practical knowledge in regard to all these matters, some more appropriate material, such, for instance, as glass, or glazed earthenware, will be found to be applicable to this purpose; and they trust the subject will not altogether be lost sight of.

The present practice of heating a certain portion of the air beyond the ultimately required temperature, and then cooling it down by the admixture of cold air, is not only injurious to the quality of the air, but is productive of ascending currents of air of different temperatures.

One of the causes of defective ventilation in the House of Commons is the want of a sufficient area of openings at the floor of the House, and the necessity which thence has arisen for admitting the air through the interstices of the carpet. This operation, it is found, causes the dust to rise with the ascending current of air, and produces grave inconveniences. Your Committee is therefore of opinion, that the openings for the admission of air at or near the floor of the House should be so enlarged as not to require any portion of the air to be drawn through the fibres of the carpet, which never can be free from dust and other impurities.

This defect has latterly been to a certain degree remedied by the removal of the carpet from a space in the centre of the floor, and it appears to Your Committee to justify the opinion so expressed by them; they are in consequence anxious to see some means devised by which that same remedy can be carried further.

As regards the ventilation of the Committee-rooms, which is in an extremely defective state, it appears that the whole of the contemplated arrangements are not yet completed; but no satisfactory reason has been assigned for the delay which has occurred in perfecting them. Your Committee are of opinion that much improvement would be effected by an enlargement of the openings both for the supply and discharge of air.

The present structural arrangements for ventilation and warming are stated to be sufficient, and susceptible of easy adaptation, at a moderate outlay, to any other system that may be considered preferable.

This Committee are much indebted to two Members of the Committee, Mr. Stephenson and Mr. Locke, for the assistance which their great professional attainments and experience enabled them to afford, and for the valuable time which they devoted to this inquiry; and they are of opinion that if they will continue to give their attention to this subject, great good will ensue.

In the present conflicting state of opinion, both in regard to the theory and practice of ventilation, as applicable to a building of the vast proportions of the New Palace, so unequally occupied at different times, Your Committee are unwilling to do more than direct the attention of those upon whom the responsibility shall devolve of making provision for the future health and comfort of the Members to the evidence of Mr. Gurney, Mr. Price, and Mr. Daukes, in which will be found descriptions of systems of warming and ventilation of much simplicity, which have been successfully introduced into buildings of first-rate magnitude and importance.

Your Committee desire to give it as their opinion that the failure of the ventilation of the House of Commons, at the commencement of the Session, cannot fairly be imputed to any radical defect in Dr. Reid's system, because the House was hastily occupied with an infinity of arrangements incomplete; and the lighting, from which the greatest amount of mischief arose, was neither contrived by Dr. Reid nor under his control; and in surveying the whole of this matter it is perhaps only fair to that gentleman to bear in mind, that his original plan was a comprehensive scheme for the ventilation of the entire building, of the superintendence of the greater portion of which he was deprived when the works were more than half completed; and it is due to him to state, that in St. George's Hall, Liverpool, a building of great importance, where his plans were carried into effect, from the commencement to the termination of the structure, his success is declared by competent witnesses to have been complete.

The alterations made in the Lighting Your Committee consider to have been successful, and the principle upon which they have been made, capable of still further and more satisfactory development.

Although

Although Your Committee did not consider it to be a part of their duty to enter into the merits of the questions at issue between the Architect and the Ventilator, nevertheless the differences unfortunately existing between those gentlemen complicated their inquiries, and interposed a hindrance to the satisfactory elucidation of the subject of their investigation.

These difficulties and complications were further increased by the fact that, in that portion of the New Palace termed the finished portion, which has been delivered up formally by the Architect to the Board of Works, there were still not less than three different and sometimes conflicting authorities, namely, the Architect, the Ventilator, and the Board of Works; and until the whole is placed under the absolute control and vigilant supervision of the Board of Works, it is vain to expect good service or economy; and all attempts at inquiry will be baffled by the allegation of divided responsibility.

Under these circumstances, Your Committee are of opinion, that, as regards future management, the entire responsibility of ventilating and lighting the House, and its appendages, should be confided to one competent person, under the direction and supervision of the Board of Works; and with a view to secure proper attention to any complaints that may hereafter arise, a Committee should be named, at the commencement of each Session, to confer with the Board of Works upon any measures that may appear necessary to remove such complaints.

24 *May* 1852.

PROCEEDINGS OF THE COMMITTEE.

Martis, 23° *die Martii*, 1852.

MEMBERS PRESENT:

Lord R. Grosvenor.	Mr. Greene.
Mr. J. L. Ricardo.	Mr. Henry Drummond.
Sir Denham Norreys.	Mr. Bankes.

Lord ROBERT GROSVENOR called to the Chair.

Committee deliberated on the course of proceeding.

[Adjourned to Thursday next, at Twelve o'clock.

Jovis, 26° *die Martii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Deedes.	Mr. Cochrane.
Mr. Stevenson.	Mr. Bankes.
Mr. Henry Hope.	Sir D. Norreys.
Mr. Henry Drummond.	Lord Palmerston.
Mr. Greene.	Lord J. Manners.
Lord Ebrington.	

Mr. *Robert Chalmers*, Col. *Thompson*, M.P., Mr. *Thos. Thornton* Mr. *J. Postlethwaite*, Mr. *J. Gudge*, Mr. *Cornwall Legh*, M.P., Mr. *Goldsworthy Gurney*, Mr. *T. Vardon*, Mr. *Wilson Patten*, M.P., Col. *Romilly*, M.P., Sir *Denis Le Marchant*, Bart., Mr. *George Stone*, Mr. *J. B. Bull*, Dr. *Reid*, Sir *Denham Norreys*, a Member of the Committee, Mr. *John E. Dorington*, and Mr. *Edward Dawes*, M.P., examined.

[Adjourned to To-morrow, at Twelve o'clock.

Veneris, 26° *die Martii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Greene.	Lord Ebrington.
Mr. Cochrane.	Mr. Ricardo.
Sir Denham Norreys.	Lord Palmerston.
Mr. Deedes.	Mr. Hope.
Mr. Henry Drummond.	Mr. Bankes.

Lord *Charles Russell*, Mr. *William Ayliffe*, Mr. *Thomas Blackman*, the Right Hon. *The Speaker*, and Dr. *Reid*, examined.

[Adjourned to Monday next, at Twelve o'clock.

Lunæ, 29° *die Martii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Greene.	Lord Palmerston.
Mr. Hy. Drummond.	Mr. Bankes.
Sir Denham Norreys.	Lord Ebrington.
Mr. Hope.	Mr. Fitzroy.
Lord J. Manners.	Mr. Deedes.

Sir *Augustus Clifford*, Mr. *H. Mulhenkamp*, and Dr. *Reid*, examined.

[Adjourned to To-morrow, at Twelve o'clock.

Martis, 30° *die Martii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Deedes.	Mr. Stephenson.
Mr. Greene.	Sir D. Norreys.
Mr. Fitzroy.	Mr. Hope.
Mr. Hy. Drummond.	Lord Palmerston.
Mr. Bankes.	Lord Ebrington.
Mr. Locke.	

Lord *Redesdale*, Earl of *Lonsdale*, Lord *De Ros*, Earl *Grey*, and Sir *C. Barry*, examined.

[Adjourned to Thursday next, at Twelve o'clock.

Jovis, 1° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Greene.	Mr. Ricardo.
Mr. Locke.	Mr. Hope.
Sir Denham Norreys.	Lord Ebrington.
Mr. Deedes.	Mr. Henry Drummond.

Mr. *Wm. Fredk. Pollock* and Mr. *Goldsworthy Gurney*, examined.

[Adjourned to To-morrow, at Twelve o'clock.

Veneris, 2° die Aprilis, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Greene.	Mr. Stephenson.
Mr. Bankes.	Mr. Hope.
Lord Ebrington.	Mr. Cochrane.
Sir D. Norreys.	Lord Palmerston.
Mr. Locke.	Mr. Drummond.

Dr. *Arnott,* Mr. *William Clark,* and Sir *Charles Barry,* examined.

[Adjourned to Monday next, at Twelve o'clock.

Lunæ, 5° die Aprilis, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. H. Drummond.	Sir Denham Norreys.
Mr. Greene.	Lord Palmerston.
Mr. Bankes.	Mr. Locke.
Mr. Stephenson.	Lord John Manners.

Sir *Charles Barry* and Mr. *Samuel Whitfield Daukes,* examined.

[Adjourned to To-morrow, half-past Twelve o'clock.

Martis, 6° die Aprilis, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Locke.	Mr. Stephenson.
Lord John Manners.	Lord Palmerston.
Mr. Greene.	Mr. Deedes.
Sir Denham Norreys.	

Sir *George Bowles,* K.C.B., Mr. *S. W. Daukes,* Mr. *John Turnbull,* and Mr. *Goldsworthy Gurney,* severally examined.

The Chairman delivered in a letter received by him from Baron Parke, on the subject of the Ventilation of the Court of Exchequer and the Courts at Liverpool.—*Vide* Appendix.

Sir *C. Barry* gave in a paper in reference to his evidence of yesterday.

The Committee agreed to their First Report.

Resolved, "That the Chairman be instructed to move for leave to report from time to time." Ordered to report.

Martis, 20° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Drummond.	Mr. Bankes.
Mr. Greene.	Mr. Stephenson.
Sir Denham Norreys.	Mr. Deedes.
Mr. Fitzroy.	Mr. Hope.

Dr. *Reid*, examined. [Adjourned.

Jovis, 22° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. H. Drummond.	Mr. Locke.
Mr. Bankes.	Mr. Stephenson.
Mr. Greene.	Lord John Manners.
Mr. Fitzroy.	Mr. Hope.
Sir Denham Norreys.	Lord Palmerston.
Mr. Deedes.	

Dr. *Reid*, further examined; Mr. *Alfred King*, and Mr. *Henry Cruger Price*, examined.

[Adjourned to To-morrow, half-past Twelve o'clock.

Veneris, 23° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Greene.	Mr. Fitzroy.
Sir D. Norreys.	Mr. Ricardo.
Lord J. Manners.	Mr. Bankes.
Mr. Henry Hope.	Mr. Locke.
Mr. Stevenson.	Lord Palmerston.
Mr. Henry Drummond.	Mr. Deedes.

Dr. *Reid* further examined.

Room cleared.

Motion made and question proposed (Mr. *Bankes*): "That this Committee will not sanction any further expenditure on account of the experiments undertaken during the recess, the expenditure already incurred appearing, from the evidence of Dr. Reid, to amount at this time to the sum of 1,100 *l.*" Amendment proposed (Mr. *Greene*), to leave out from the word "That" to the end of the question, in order to add the words "Mr. Meeson be called in."

Question

Question "That the words proposed to be left out stand part of the question," put. Committee divided.

Ayes, 3.	Noes, 9.
Mr. Ricardo.	Lord J. Manners.
Mr. Bankes.	Mr. Greene.
Mr. Fitzroy.	Sir D. Norreys.
	Mr. Deedes.
	Mr. H. Hope.
	Lord Palmerston.
	Mr. H. Drummond.
	Mr. Stevenson.
	Mr. Locke.

Words left out. Proposed words added. Main question, as amended, put and agreed to.

Mr. *Alfred Meeson*, examined.

[Adjourned to Monday next, at half-past Twelve o'clock.

Lunæ, 26° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Drummond.	Mr. Hope.
Sir Denham Norreys.	Mr. R. Stephenson.
Lord Palmerston.	Mr. Locke.
Mr. Fitzroy.	Mr. Greene.

Mr. *Goldsworthy Gurney*, examined.

[Adjourned to To-morrow, at Twelve o'clock.

Martis, 27° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. H. Drummond.	Mr. Stephenson.
Mr. Greene.	Lord Palmerston.
Mr. Hope.	Sir Denham Norreys.
Mr. Ricardo.	Mr. Fitzroy.
Mr. Locke.	Mr. Deedes.

Mr. *Goldsworthy Gurney*, further examined; Mr. *John Leslie*, examined.

[Adjourned to Thursday next, at One o'clock.

Jovis, 29° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord Robert Grosvenor in the Chair.

Mr. Greene.	Sir D. Norreys.
Mr. Stephenson.	Mr. Locke.
Mr. Deedes.	Mr. Drummond.
Mr. Hope.	Lord Palmerston.

Mr. *Goldsworthy Gurney*, further examined; Mr. *John Phipps* and Dr. *Reid*, examined.

[Adjourned to To-morrow, at One o'clock.

Veneris, 30° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord Robert Grosvenor in the Chair.

Sir Denham Norreys.	Mr. Stephenson.
Mr. Drummond.	Mr. Locke.
Mr. Greene.	

Dr. *Reid* and Mr. *George Appold*, examined.

[Adjourned till Tuesday, at One o'clock.

Martis, 4° *die Maii*, 1852.

MEMBERS PRESENT:

Lord Robert Grosvenor in the Chair.

Mr. Greene.	Mr. Hope.
Mr. Henry Drummond	Lord Palmerston.
Sir Denham Norreys.	Mr. Locke.

Mr. *T. Brown*, examined.

[Adjourned.

Lunæ, 10° *di Maii*, 1852.

MEMBERS PRESENT;

Lord ROBERT GROSVENOR in the Chair.

Sir D. Norreys.	Mr. Hope.
Mr. Bankes.	Mr. Greene.
Mr. Stephenson.	Lord J. Manners.
Mr. Drummond.	Mr. Locke.
Lord Ebrington.	Mr. Fitzroy.

Mr. *George Stone*, Mr. *Alfred Meeson*, Mr. *John George Appold*, and Mr. *Robert Stephenson*, examined.

[Adjourned till Friday, at One o'clock.

Veneris, 14° *die Maii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Lord Ebrington.	Mr. Locke.
Mr. Drummond	Mr. Hope.
Mr. Greene.	Lord Palmerston.
Mr. Bankes.	Mr. Deedes.
Sir D. Norreys,	

The following correspondence was delivered in and ordered to be printed in the Appendix.

Letter from Viscount Duncannon to Viscount Melbourne, 30t March 1839.
Letter from Viscount Melbourne to Viscount Duncannon, 9th November 1839.
Letter from Viscount Duncannon to Viscount Melbourne and the Chancellor of the Exchequer, dated 28th November 1839.
Letter from the Treasury, dated 27th December 1839.
Letter from Office of Woods, &c. to Mr. Barry, dated 16th January 1840.
Letter from Office of Woods, &c., to Dr. Reid, dated 16th January 1840.
Letter from Office of Woods, &c. to Dr. Reid, dated 24th January 1840.
Letter from Dr. Reid in reply thereto, dated 15th February 1840.

Draft Report proposed by the Chairman, read 1° and 2°.

[Adjourned till Monday, at One o'clock.

Lunæ, 17° *die Maii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Locke.	Mr. Greene.
Sir. D. Norreys.	Lord J. Manners.
Mr. Stephenson.	Mr. Hope.
Mr. Drummond.	Lord Palmerston.
Lord Ebrington.	Mr. Bankes.

The Committee proceeded with the consideration of their Report. Several paragraphs agreed to.

The following paragraph was proposed by Mr. *Locke:* "Much of the inconvenience in regard to ventilation has arisen from the want of a proper understanding between Sir C. Barry and Dr. Reid, to whom the superintendence of different parts of the building has been confided; and the Committee are of opinion, that for the future, divided responsibility should be avoided, and that the ventilation of the Houses of Parliament should be placed in the charge of one person only." Amendment proposed, to leave out the words "Houses of Parliament" for the purpose of inserting the words, "House of Commons and its appendages."

Question, "That the words proposed to be left out stand part of the proposed paragraph," put. The Committee divided.

Ayes, 7.	Noes, 2.
Mr. Greene.	Lord J. Manners.
Lord Ebrington.	Lord Palmerston.
Mr. Drummond.	
Sir D. Norreys.	
Mr. Stephenson.	
Mr. Locke.	
Mr. Hope.	

Question, "That this paragraph form part of the proposed Report," put and agreed to.

The following paragraph was proposed by Sir *D. Norreys:* "That although the duty of properly ventilating the House of Commons was entrusted to Dr. Reid, yet he was deprived of all control over the several passages and corridors leading from the external air, and the Great Central Hall into the House Lobby, the consequence of which was that large currents of air, at varying temperatures, were drawn through the House Lobby into the body of the House, and were a constant source of disturbance to the ventilating arrangements."

Question, "That this paragraph form part of the proposed Report," put. The Committee divided.

Ayes, 4.	Noes, 6.
Lord Ebrington.	Mr. Bankes.
Mr. Drummond.	Mr. Greene.
Sir D. Norreys.	Lord J. Manners.
Lord Palmerston.	Mr. Stephenson.
	Mr. Locke.
	Mr. Hope.

The following paragraph was proposed by Sir *D. Norreys:* "The system of Lighting adopted by Sir C. Barry (viz. by large gas chandeliers descending for a considerable distance into the body of the House), however well it may have accorded with the general architectural character of the room, rendered the requisite control over the ventilation difficult if not impossible; the heat radiating from these highly heated surfaces pervaded every part of the House, and rendered the Galleries almost intolerable." Question, "That this paragraph form part of the proposed Report," put. The Committee divided.

Ayes, 8.	Noes, 2.
Lord J. Manners.	Mr. Bankes.
Lord Ebrington.	Mr. Greene.
Mr. Drummond.	
Sir D. Norreys.	
Lord Palmerston.	
Mr. Stephenson.	
Mr. Locke.	
Mr. Hope.	

The Committee proceeded in their proposed Report.

The following paragraph was proposed by Sir *D. Norreys:* "That the channels or vaults through which fresh air had to be drawn from the Clock Tower were not under the control of Dr. Reid; they were damp, and subject to the infiltration of impure water from drains, and consequently rendered it impossible for Dr. Reid to supply pure air to the House." Question, "That this paragraph form part of the proposed Report," put and negatived.

The following paragraph was proposed by Sir *D. Norreys:* "That under these circumstances it could scarcely be expected that the air of the House should have been otherwise than heated and dry to excess; polluted by noxious smells, subject to alternate hot and cold currents, and generally unwholesome." Question, "That this paragraph form part of the proposed Report," put and negatived.

The following paragraph in the Draft Report proposed by the Chairman was read:—"Your Committee have not been enabled to obtain satisfactory evidence in regard to any apparatus for warming which shall dispense with metal surfaces for heating the air. They cannot

cannot but think, however, that in the present rapidly advancing state of practical knowledge in regard to all these matters, some more appropriate material, such, for instance, as glass, or glazed earthenware, will be found to be applicable to this purpose; and they trust the subject will not altogether be lost sight of." Question, "That this paragraph form part of the proposed Report." The Committee divided.

Ayes, 5.	Noes, 4.
Mr. Bankes.	Mr. Drummond.
Mr. Greene.	Sir D. Norreys.
Lord Ebrington.	Lord Palmerston.
Mr. Stephenson.	Mr. Locke.
Mr. Hope.	

[Adjourned till Thursday next, at Two o'clock.

Jovis, 20° *die Maii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Locke.	Mr. Bankes.
Mr. Hope.	Mr. Stephenson.
Mr. Drummond.	Mr. Deedes.
Mr. Greene.	Lord Palmerston.
Sir D. Norreys.	

The following paragraph in the Draft Report of the Chairman was read: "In the present uncertain state both of the theory and practice of ventilation, as applicable to a building of the vast proportions of the New Palace, so unequally occupied at different times, Your Committee are not prepared to recommend the substitution of any specific system in lieu of those now in force." Amendment proposed (Mr. *Locke*), to leave out from the word "times" to the end of the paragraph.—Question, "That the words proposed to be left out stand part of the paragraph," put. The Committee divided.

Ayes, 3.	Noes, 5.
Sir D. Norreys.	Mr. Bankes.
Mr. Hope.	Mr. Greene.
Mr. Stephenson.	Mr. Drummond.
	Mr. Locke.
	Mr. Deedes.

Paragraph, as amended, negatived.

The Committee proceeded in their proposed Report.

[Adjourned till To-morrow, at One o'clock.

Veneris, 21° *die Maii*, 1852.

MEMBERS PRESENT:

Lord ROBERT GROSVENOR in the Chair.

Mr. Drummond.	Lord J. Manners.
Sir D. Norreys.	Mr. Locke.
Mr. Bankes.	Lord Palmerston.
Mr. Greene.	

The Committee proceeded in their proposed Report.

The following paragraph was proposed by Mr. *Locke*: "That as regards future management, Your Committee is of opinion that the entire responsibility of ventilating and warming should be confided to one scientific person, under the direction and supervision of the Board of Works; and with a view to secure proper attention to any complaints that may hereafter arise from defective ventilation or other causes, a Committee be named to confer with the Executive and the Board of Works, and to decide from time to time on any measures that may become necessary in order to remove such complaints." Several amendments made to the proposed paragraph.

Motion made (Sir *D. Norreys*), to leave out the word "scientific" for the purpose of inserting the word "competent."—Question, "That the word 'scientific' stand part of the paragraph." The Committee divided.

Ayes, 3.	Noes, 3.
Mr. Greene.	Mr. Bankes.
Mr. Drummond.	Lord J. Manners.
Mr. Locke.	Sir D. Norreys.

The Chairman gave his vote to the Noes.

Word "scientific" struck out.

Question, "That the word 'competent' be there inserted," put and agreed to.

Paragraph further amended and postponed.

The following paragraph in the Draft Report of the Chairman was read: "These difficulties and complications were further increased by the fact that, in that portion of the New Palace termed the finished portion, which has been delivered up formally by the Architect to the Board of Works, there were still not less than three different and sometimes conflicting authorities, namely, the Architect, the Ventilator, and the Board of Works; and until the whole is placed under the absolute control and vigilant supervision of the Board of Works, it is vain to expect good service or economy; and all attempts at inquiry will be baffled by the allegation of divided responsibility." Amendment proposed (Mr. *Locke*), after the word "works," in l. 8, to insert the words "or of some other Public Department."

Question,

Question, "That these words be there inserted."

The Committtee divided.

Ayes, 3.	Noes, 4.
Mr. Drummond.	Mr. Bankes.
Sir D. Norreys.	Mr. Greene.
Mr. Locke.	Lord J. Manners.
	Lord Palmerston.

Paragraph agreed to.

Postponed paragraph agreed to.

Proposed Report, as amended, read.

Question, "That this be the Report of the Committee," put and agreed to.

Ordered, "That the Chairman do report the Minutes of Evidence to The House."

Ordered to Report.

EXPENSES OF WITNESSES.

NAME of WITNESS.	Profession or Condition.	By what Member of Committee Motion made for Attendance of the Witness.	Date of Arrival.	Date of Discharge.	Total Number of Days in London.	Number of Days under Examination by Committee, or acting specially under their Orders.	Expenses of Journey to London and back.	Expenses in London.	TOTAL Expenses allowed to Witness.
							£. s. d.	£. s. d.	£. s. d.
Mr. T. Brown -	Architect - - -	Chairman -	30 April	4 May -	5	1	8 14 -	15 15 -	24 9 -
Mr. Goldsworthy Gurney - -	Civil Engineer	Ditto -	- -	- -	- -	10	- -	31 10 -	31 10 -

The following is a List of Reports from Select Committees of the House of Commons relating to Ventilation and Lighting of the Houses of Parliament, from the Year 1835 to 1842 inclusive :—

Report from Select Committee on the Ventilation of the Houses of Parliament; Sess. 1835, No. 583.

Report from the Select Committee on Lighting the House; Sess. 1839, No. 501.

Report from the Select Committee on Ventilation of the New Houses of Parliament; Sess. 1841, No. 51.

Report from the Select Committee on Ventilation of the New Houses of Parliament; Sess. 1842, No. 536.

Report from the Select Committee on Lighting the House; Sess. 1842, No. 251.

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MINUTES OF EVIDENCE.

Jovis, 25° die Martii, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Viscount Ebrington.
Mr. Greene.	Mr. Deedes.
Mr. Cochrane.	Mr. Bankes.
Mr. Henry Drummond.	Viscount Palmerston.
Mr. Henry Hope.	Lord John Manners.
Mr. Stephenson.	

LORD ROBERT GROSVENOR IN THE CHAIR.

Robert Chalmers, Esq., called in; and Examined.

R. Chalmers, Esq.

25 March 1852.

1. *Chairman.*] YOU are at the head of the Committee Clerks Office?—I am.

2. Is the room which you now inhabit the same that you have inhabited for some time, or have you inhabited a temporary room before?—We have inhabited different rooms in the Speaker's late house, but we have inhabited our present room in the new building, I think, for two Sessions before the present.

3. Will you state to the Committee what the sort of ventilation is?—I think our ventilation is in a very satisfactory state, except that I find the smoke is very troublesome when the wind blows strongly from the east or from the north-east. During the early part of this Session I found, on some days, the ventilation very bad, and was obliged to let the fire out and bear the cold rather than be stifled with the smoke.

4. Do you face the river?—Yes, our office is at the extreme east end of this corridor; it is beyond the last committee-room, and beyond it is the Speaker's intended house.

R. Chalmers, Esq.

25 March 1852.

5. Generally speaking, is the air agreeable when there is no smoke?—It is; but we suffer sometimes from the cold air, from the windows not being sufficiently tight; complaints of that kind I have sometimes heard.

6. What you principally suffer from is the smoky chimney?—Yes.

7. Mr. *Greene.*] What is the number of rooms occupied by yourself and the other Committee clerks?—I occupy small private room which looks over the Speaker's court; there is only one other room which is occupied by the rest of the office, which fronts the river.

8. To which of the rooms does your observation respecting the smoke apply?—It applies to my own room chiefly, but the other room also suffers from smoke, but not to such an extent as mine.

9. Mr. *Stephenson.*] You said that you felt some inconvenience from the draught from the windows. Does that depend upon any particular direction of the wind?—I think it does; it is felt most when the wind blows from the east.

10. But generally you find the ingress of the air inconvenient?—Yes; we complain that the windows are not sufficiently tight whenever the wind blows strongly in that direction.

11. Mr. *Hope.*] Did you ever go into a new house before?—Yes.

12. Did you ever know a new house in which the chimnies did not smoke?—No, I cannot say that I did.

Lieutenant-colonel *T. Perronet Thompson*, a Member of The House; Examined.

Lieut.-col. *T. P. Thompson*, M. P.

13. *Chairman.*] YOU attend here to-day at the request of the Chairman?—I do.

14. You are a very constant attendant at the House of Commons?—Pretty constant.

15. Therefore you are able to speak as to your own feelings with regard to the warming and ventilation of the House?—I am.

16. Will you have the goodness to state what your feelings have been since you have sat in the New House; whether you find fault with the ventilation, or whether it is such as you approve?—I have not seen any reason to find fault with the ventilation of the House generally. I have found it sometimes a little cold, but that I apprehend is a mere matter of regulation: the heat is regulated, and I have

have sometimes found it a little cold, but no uncomfortable sudden variation that I can complain of.

17. Upon what bench do you generally sit?—The second or third bench from the front, about the middle, above the gangway.

18. Then, upon the whole, you see nothing to complain of in the ventilation?—I can mention a point, if the Committee pleases, which may be connected with the ventilation, perhaps. There are very unpleasant smells occasionally. I think I can trace them, and that I know the places they come from. I do not know that it depends upon the want of ventilation; it depends upon the presence of something that is not the ventilation; it simply proceeds from the urinatories, I believe; the smell from them is sometimes very bad. It was just the same in the old House, and I apprehend it will be so everywhere, unless the precaution is taken which is taken in barracks and in the Inns of Court, of insulating things of that sort. The smell in the actual places is very bad indeed; I can only compare it to that of a dissecting room; and it does, every now and then, find its way into the House. Still I apprehend that this is hardly a fault in the ventilation of the House; it is a fault in something else.

19. Have you experienced draughts in the place where you sit?—None; I cannot say that I ever felt a draught.

20. Mr. *Deedes*.] You have said that you attribute the smell entirely to the urinatories?—Entirely: I never traced it to anything else than that. Knowing that I was to come here, I have tried to compare one position in the House with another, and I think they are all alike.

21. In your opinion, were the same smells from the urinatories to be found in the old House?—Yes; I recollect them, particularly in the part of the House behind The Speaker.

22. You are speaking of the part where the urinatories themselves are, and not of the body of the House?—No; but the smell from them does find its way into the body of the House.

23. Did you experience it in the old House, in the body of the House?—I cannot say that I found it in the old House; I have found it in this.

24. Viscount *Ebrington*.] You spoke of the temperature being occasionally rather unequal?—Yes, unequal occasionally, but not variable within short intervals of time. I

Lieut.-col. *T. P. Thompson*, M. P.

25 March 1852.

apprehend that its being sometimes colder than suits my feelings, is a mere matter of arrangement.

25. You have felt no inconvenience from what is quite a separate matter from the temperature, from the closeness and deterioration of the atmosphere?—I cannot say that I have ever felt that.

Thomas Thornton, Esq., called in; and Examined.

T. Thornton, Esq.

26. *Chairman.*] ARE you a Reporter for the Press?—I am not a reporter, but I sit in the gallery every night, from the time the House meets till the time it closes, to write a summary of the debates for a daily paper, and it was thought in the gallery that I could speak more distinctly and directly to the subject of the Committee's inquiry than a person who came there only casually, and went away in half an hour or an hour.

27. In fact, in consequence of my own request to the reporters, that some one should come here and give evidence as to their feelings with regard to the ventilation, you are deputed by them so to do?—Just so.

28. Will you have the goodness to state what your feelings have been; whether you have been inconvenienced or otherwise by the state of the ventilation in the Reporters' Gallery?—The great inconvenience, and I may say the positive evil which has been experienced there, has arisen from a draught or current of exceedingly cold air, which, not every night, but repeatedly at intervals, has swept along the whole length of the gallery, and I have no doubt it finds its way round the side galleries. The air is exceedingly cold, and the current so strong, that if I hold up a slip of paper it blows it backwards and forwards like a fan.

29. Do you wish the Committee to understand that, generally speaking, the ventilation has been exceedingly disagreeable in consequence of what you have stated?—In that particular, undoubtedly it has generally; there has been a want of uniformity of temperature; at some parts of the evening the temperature is very high, and at others comparatively low.

30. Can you state, of your own knowledge, whether any illness has been caused by it?—Decidedly. For the purpose of this inquiry I have asked the question of, I think, a dozen gentlemen, and I do not think in a single instance I have received any other answer than that they have experienced

enced very severe colds. I can give the Committee still more positive testimony upon that subject, for I am myself suffering now personally under a cold in the head, which I have no doubt I caught from that cause; not being subject to cold or rheumatism, I cannot attribute it to any other cause.

31. Have you anything to say with regard to the quality of the air when the temperature has been otherwise agreeable to your feelings?—I am not aware of any disagreeable smell, or anything of that kind. I have no doubt this cold air descends from the Ladies' Gallery; I went up yesterday to examine the approaches to the gallery.

32. With regard to the light, is that agreeable to you in the gallery or not?—It has been very much improved since the chandeliers have been raised; still there is an immense body of light which is thrown upon the eyes of persons in the gallery; I do not know how that could be obviated, but it is not so inconvenient as it was before.

33. You say that it has been improved since the lights were placed higher?—Decidedly so; when the lights were very nearly upon a level with the eye, the pain to the brows was quite serious.

34. Are gentlemen connected with your occupation peculiarly susceptible to any variation of light?—I do not know that; I am not aware of it myself.

35. It is a great advantage to their eyes to have suitable light to work by?—No doubt it is of very great importance.

36. Do you feel heat at all from the chandeliers?—I cannot say that it is directly from the chandeliers, but the chandeliers must add considerably to the heat.

37. Viscount *Ebrington*.] You spoke of the absence of disagreeable smells; but apart from any disagreeable smell, you are aware that the atmosphere may be very close and deteriorated by repeated respiration; have you been at all conscious of that in the part of the house in which you sit?—I cannot say that I have been particularly annoyed by it; of course with the immense body of air respired there must be an inconvenience, but I cannot say that in the present House I feel it to a greater extent than in the late House; it is the want of uniformity of temperature that I complain of myself.

38. Mr. *Drummond*.] What is the number of persons ordinarily in the Reporters' Gallery?—In a full debate, when it is necessary to keep up a constant supply, I should say 24 or 30; there is a double row of seats, and they are generally filled that the change may be quick.

 39. I understand

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39. I understood you say that the draught came sideways, and then again you said, that it descended from the Ladies' Gallery; that is, overhead?—Yes. I cannot trace the current to any other cause; there is no door at the side of the Reporter's Gallery; if there was there is a partition that would keep the draught off; but this air, I suppose, would descend, being of a denser quality than the air which it displaced. I have satisfied myself that that is the cause of it; it does, however, come sideways, and I have generally remarked that it comes from left to right.

Joseph Legg Postlethwaite, Esq. called in; and Examined.

J. L. Postlethwaite, Esq.

40. *Chairman.*] YOU are employed in the Vote Office?—In the Votes and Proceedings Office.

41. Whereabouts is that?—It is on one side of the Lobby, close to the House.

42. Do you occupy two rooms or one?—Two rooms.

43. Will you inform the Committee in what state the ventilation is, in those rooms?—The ventilation of the new room in which Mr. Rowland and myself carry on our portion of the duty is extremely good; that is the smaller room; the other room is for the petition portion of the business, and the gentlemen who are in that room consider that there is sometimes a good deal of air passing through the room which affects their forehead; they feel it very much. In other respects I do not understand but that they are perfectly satisfied.

44. You are not in that room yourself?—Not very often. I go in occasionally, but very rarely, to that room.

45. Is there anybody in that room who can speak to it? I think there is.

46. With regard to the room in which you sit, the ventilation is quite to your satisfaction?—Quite; as well as, I may safely say, to the satisfaction of Mr. Rowland, who does the duty alternately with me.

47. Mr. *Greene.*] Will you describe the position of the room which you occupy; how do you come to it on entering the lobby from the great central hall?—As you enter the lobby from the great central hall, to arrive at the room where I go to perform my duties, you must turn immediately to the left; it is called the Votes and Proceedings Office.

48. Mr. *Deedes.*] Are the two rooms considered as belonging to your own office?—Yes.

49. Is the door between them generally open?—The door between the two rooms is generally open.

James Gudge, Esq., called in; and Examined.

50. *Chairman.*] YOU are employed in the Journal Office?—I am.

51. Whereabouts is the Journal Office?—It is even with the terrace on the ground floor; there are rooms under it below the terrace.

52. Is it near the smoking-room?—I believe it is, but there is no communication from our corridor to the smoking-room.

53. Do you look out at the river?—Yes.

54. Will you have the goodness to inform the Committee in what state the ventilation is in your office?—It is anything but satisfactory; sometimes I am obliged to sit with my great coat on, and at other times the room is oppressive. About a week ago there was a very disagreeable smell, as if a dead rat was under the floor, so that we were obliged to burn brown paper; and at other times there is an oily smell, the same as you perceive on entering a factory. There does not seem to be any way in which a sufficient supply of fresh air can come in, for the corridor into which our doors open is sometimes many degrees hotter than our sitting-rooms and there is no efficient ventilation; there is a small fan over the door, which is supposed to let out the foul air.

55. How long have you inhabited that room?—I think from last February twelvemonth; we began with last session.

56. Has the ventilation altered, since you have inhabited your office, for the better or for the worse?—I think this session it is not so raw and cold as it was in the first session when we tenanted it.

57. But it is in a highly unsatisfactory state?—Certainly.

58. Mr. *Bankes.*] You were understood to say that there is a floor under your office?—Yes.

59. To what purpose is that applied?—I imagine that that is to be applied for the deposit of sessional papers, and indeed I understand that the Journal Office floor was never intended for offices, but for a deposit for papers; the rooms are more like some of the catacombs of a new-built church in these days than anything else.

60. Will not the floor below your establishment be under the bed of the river?—It is, I believe, under high-water mark; I cannot say whether it is under the bed of the river.

61. *Chairman.*] Do you occupy this office temporarily, or is it a permanent office?—It is permanent.

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62. Sir *D. Norreys.*] There is no open fireplace?—There are no fireplaces.

63. Are there any flues?—There are pipes all round the skirting-board; it is perforated, and the warm air passes through.

64. Mr. *Deedes.*] What means is there of the air escaping from your room, if there is no fireplace; are there any open gratings?—There are gratings round the skirting-board; and if you open the door there is a small fan over the door that is supposed to let out the foul air.

65. There is no fireplace?—No.

66. There is no chimney?—No.

67. Does the air go out by the fan as well as come in by the fan?—I believe the air comes in through gratings round the room, and is supposed to go out by the fan. We open the office door sometimes into the corridor, and at the end of the corridors there are windows, and the lower part of those windows are perforated, and I apprehend cold air comes in from thence.

68. Mr. *Stephenson.*] Does the fan generally work, whether the door is open or shut?—You cannot see the fan; but I understand that the moment the door is open it turns the fan round, and that allows a little air to leave the place.

69. Mr. *Deedes.*] Then is it your opinion that it is only by means of opening and shutting the door that air either comes in or escapes?—I think the only efficient mode is by opening the door and the windows.

George Cornwall Legh, Esq., a Member of The House; Examined.

G. C. Legh, Esq., M.P.

70. *Chairman.*] YOU have had the goodness to attend here at my request?—Yes.

71. You have attended the House very frequently since the new House has been occupied?—I have.

72. Have you also sat upon Committees?—I have.

73. Will you have the goodness, in the first place, to say what you have found to be the state of the ventilation inside the House?—The first week or 10 days I found it very disagreeable indeed, so much so that I caught cold, and was laid up for some days; and other Members who sat in the same part of the House that I did found the same fault.

74. Was your objection only to the variations in the temperature, or did you also experience a bad smell?—The principal evil I found at the time I mention was having a current

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current of air coming in on the shoulders; it was on the opposition side of the House, the third or fourth bench, that I found it most objectionable. It was generally very cold; sometimes it was quite hot; but the general effect was that it was always a strong current of air, so much so that it was almost impossible to sit with any comfort on those benches at that time.

75. You stated that you had had experience of the ventilation of the House during the earlier days of the present Session; do you think it has altered at all since that time? —I have not been sitting in that part of the House so much lately, and therefore I could not, I think, exactly give an opinion upon that; I have religiously avoided that part of the House ever since.

76. In the part of the House which you have frequented since, do you find any improvement?—Yes; I think there is an improvement in it; I have not experienced the same evil myself, but that might be from the circumstance of my not sitting in that part of the House.

77. Mr. *Greene.*] Did the current of air, of which you complain, come from the door behind the Speaker's chair, or from that direction?—I cannot exactly speak to that; I thought at first it did, but when I moved higher up to avoid it, I found still the same evil. I do not think really that it came from that; I think it was from some other cause.

78. *Chairman.*] Have you perceived any bad smell?—No, I have not.

79. Will you state what your experience has been of the Committee-rooms in which you have served?—I sat upon a Committee about a fortnight ago; the room was rather crowded, and I must say it was extremely disagreeable, so much so, that we had to open those little windows, which you see, in order to ventilate the room to make it bearable; and that of course, in very cold weather, would be extremely disagreeable, so that we were obliged to shut them again; and that being done constantly, backwards and forwards, was very disagreeable.

80. Then you concur in the opinion which you have no doubt heard expressed, that the ventilation of the committee-rooms is as bad as possible?—I think it is very defective indeed.

81. Sir *D. Norreys.*] Was the position in which you sat in the House about in a line with The Speaker's chair, or was it nearer the door or nearer the Bar?—It was on the third bench; it was on the same bench on which Sir James Graham

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Graham used to sit before the change of Government; I used to sit generally in that part of the House, and that was the part where I used to find the greatest inconvenience.

Goldsworthy Gurney, Esq., called in; and Examined.

G. Gurney, Esq.

82. *Chairman.*] YOU have turned your attention very much to the subject of ventilation, have you not?—I have.

83. In consequence of the order of The House, you have been lately inspecting the method of ventilation adopted by Dr. Reid?—I have.

84. And you have been observing the state of the atmosphere inside the House?—Yes.

85. In consequence of that, have you addressed a letter to The Speaker?—I have addressed a letter to The Speaker, intending it as my first report to The House, upon the inquiry I have made as to the state of the ventilation. The Speaker has requested me to present that letter to this Committee.

86. Will you have the goodness to put it in?

[*The same was delivered in, and read as follows*:]

FIRST REPORT of Mr. *Goldsworthy Gurney*, on the Ventilation of the New House of Commons.

To the Right Honourable The Speaker of the House of Commons.

Sir,

IN obedience to the order of your Honourable House, dated the 12th day of March 1852, I am proceeding to investigate the arrangements for the warming, ventilating, and lighting the New House of Commons. And having been given to understand by several Members of your Honourable House, that it will be acceptable to The House that I should make a First Report on the state of its ventilation at as early a date as possible, I beg to report as follows:

Although I have been interrupted in making my investigations in the House as full and complete as I could have wished, I have seen sufficient to satisfy myself of the causes of the great inconvenience experienced from the existing state of its ventilation.

I find the atmosphere of the House in a desiccated and ferruginous state, and subject to constant disturbance from initial and retrogade currents passing in all directions, apparently at random, and without control, producing direct draughts in particular parts of the House, and oppression in others. I also find, from the same want of proper control, that offensive vapours and effluvia, emanating from excrementitious sources, are drawn into the House.

These evils could be corrected by a simple arrangement, at an expense comparatively trivial; and although this is a common-sense question,

question, it would be difficult to demonstrate on paper, unaccompanied by actual experiment; or explain the facts and conditions on which this conclusion is arrived at. As on former occasions an unfair advantage has, I think, been taken of written statements and published evidence which I have given from time to time on the great principles of ventilation, which I know to be true; and portions of my plans have been adopted without consulting me, and imperfectly carried out, I am induced to beg permission to be allowed to refrain from at present entering into details.

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The principles of ventilation which have been recommended by me, and to the best of my belief acted upon in the Chamber of Deputies in Paris, and now in operation in the Courts of Exchequer and Common Pleas in Westminster Hall (under this roof), which courts were previously unsatisfactorily ventilated, by a similar arrangement to that now applied to this House, and the success in every court of judicature in the provinces and other places to which they have been extended, affords sufficient evidence, in connexion with what I have seen in this House, to induce me to say, that if the entire control of the ventilation of the House were placed in my hands for a short time, say one week, I would pledge myself to remove all the material evils that at present exist, and at a very trifling expense, even with the present cumbrous apparatus; and at the expiration of that period to restore it again, if required, to its present state within the space of a few hours.

I have, &c.
(signed) *Gold^y Gurney.*

Thomas Vardon, Esq., called in; and Examined.

87. *Chairman.*] YOU are Principal Librarian of the House of Commons?—Yes.

T. Vardon, Esq.

88. When did you get possession of the present library?—In January 1852.

89. Will you give the Committee your opinion as to the state of ventilation of the libraries?—The libraries are ventilated by means of the ceiling, and they are heated by steam pipes in the windows.

90. The question is not so much as to the means by which it is effected, but as to what your sensations are from the ventilation?—The general result to myself, and to all who enter the library (who are as competent to give an opinion as myself) is, that it is very comfortable. The heat can be regulated to any temperature. The thermometer varies from 59° to 64° as messages are sent to make it warmer or colder.

91. Do you think it an agreeable air to breathe?—As agreeable as an exactly equal temperature pervading the whole area of the room can be.

92. Did

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92. Did it ever strike you as close?—No.

93. Do you ever suffer in health from it?—Not in the least.

94. Are your feelings very much alive upon the subject of ventilation?—Yes; I think after what I have experienced in the old Library from the different alterations in the system which have taken place in the last 17 years, I am somewhat alive to it both as a matter of curiosity, and as a matter of feeling.

95. Did not you suffer a great deal for the state of the temporary Library?—Yes; it was painfully disagreeable at times.

96. Mr. *Deedes.*] Have any complaints been made to you of cold near the tables by the windows in the Library?—Yes; it continually happens that there are temporary draughts of cold air near the windows; but they may arise from some members liking to open the windows when they are near them, and then when they have left the seat some one else takes it, who does not like so much air, and a complaint is made and the windows are closed. Altogether the general result has been a general expression of opinion that it is the most comfortable place about the building. Everybody says so that comes into the Library, considering that the fires are seldom lighted, and admitting that equality of temperature is desirable, I think that result is certainly obtained.

97. Have you been sensible that, even when the windows are closed at certain times with certain winds, a great deal of air comes in which causes inconvenience to the persons sitting near the windows?—Yes; that has repeatedly occurred, particularly with this easterly wind which has set in severely for so many days without change.

98. Mr. *Greene.*] Would it not in some degree add to the comfort of the Library, if you more frequently made use of the fire-places, by which means those who wished a warm temperature might obtain it without inconvenience to others who prefer a cooler air?—The fires are always laid, and have always been lighted the instant that any person desired it. In the first month that The House sat we frequently lighted them. There is always one room with a lighted fire in it, and in the other libraries the fires are always laid.

99. Mr. *Bankes.*] Is there not a considerable difference between the temperature of the first room and that of the other Libraries?—Yes, there is; but this is caused by the fire.

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100. Have you observed that a greater number of Members sit in the first room than in the other rooms?—Yes.

101. Do you attribute that in part to the difference of temperature?—It is difficult to say. That room is nearest to the House, and the conveniences of the Post-office are in it, and the light pervades that room more completely than it does any other room, owing to the great oriel window. Those may be reasons why it may be preferred.

102. Do you know what is the temperature of Westminster Hall. No, I never noted the thermometer in Westminster Hall. It is only within the last three or four weeks that it has been warmed.

103. Does it not strike you that the temperature of Westminster Hall, large as that building is, is infinitely more pleasant than that of your Libraries?—I have never tried the two with a view to compare them. It is only within the last few weeks that Westminster Hall has been warmed. But I very much question whether, if you sat down in Westminster Hall for an hour or two to read, you would find it more pleasant. You can hardly compare walking through cold air with sitting down to any employment.

104. Is not the temperature of Westminster Hall higher than that of your Library?—I do not know at what temperature they keep Westminster Hall. It is only since the last recess that it has been warmed.

John Wilson Patten, Esq., a Member of the House; Examined.

J. W. Patten, Esq., M. P.

105. *Chairman.*] YOU have come here at my request?—I have.

106. You are Chairman of the Standing Orders Committee?—Yes, I am.

107. Your duties lead you to be in constant attendance both in the House and on Committees?—As chairman of the Standing Orders Committee, and of the Committee of Selection, I am here every day.

108. Will you have the goodness to inform the Committee what is your idea as to the state of ventilation inside the House?—Inside the House, it appears to me that in every part of the House there are almost constant draughts; it is almost impossible to take a place in the House, without, at some period or other of the evening, being subject to a draught; it varies, I think, at different times of the evening;

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ing; at some periods, one part of the House is free from draught, and that same part at another time is subject to it.

109. Have you ever perceived any bad smell?—I think once or twice I have, but not more than once or twice; I have not perceived any smell lately.

110. Are those draughts accompanied by considerable alternations of temperature?—They are; it becomes occasionally so cold that one can scarcely retain one's seat.

111. Will you now be good enough to state your opinion as to the ventilation of the committee-rooms?—I think they vary very much; some of the committee-rooms seem to be tolerably well ventilated, only extremely cold; the one in which I sit as chairman of the Committee of Selection and of Standing Orders has been so extremely cold during the last east wind, that we were obliged to request the housekeeper to give us up another room; all the Members united in the request to the housekeeper, Captain Gosset, that we might have another room, finding it totally impossible to transact business any longer in that room. I may also state, as chairman of the Committee of Selection, that one of the great difficulties we have to contend with in getting Members to serve upon Committees is, that they do not, especially Members in delicate health, like to subject themselves to the danger of sitting in the committee-rooms, as they now are; but I think I am bound to state this, that the greatest attention has been paid to the suggestions made by the Committee, particularly within the last week. I think we have never sat without some person from Sir Charles Barry coming to ascertain the state of the room, and any suggestion that has been made has been directly attended to; but I do not think the defect has been completely remedied at present.

112. Has it been improved at all by the alterations?—In that particular room I cannot say that I think it is improved; the nature of the window is such that when there is an east wind it is almost impossible to keep it out of the casements as they are; they are made of iron, and whether it contracts in cold weather I do not know, but it appears to me almost impossible to keep out the east wind in that particular room. The window in that room is not like this; it is an oriel window, and it is more exposed than this window.

113. Mr. *Deedes*.] Have you been sensible at any time of any bad smells in the House?—I think once or twice my attention

attention was called to it, and I perceived an unpleasant smell, but not of late. *J. W. Patten*, Esq., M. P.

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114. Did you happen to be in the House yesterday morning at the sitting?—I was.

115. Did you observe a bad smell then?—I did not observe it.

116. Mr. *Drummond.*] You specified one room as being particularly cold; in that room is the surface of glass larger in proportion to the size of the room than it is in this room?—I think it is. I think these diamond windows cannot be made as they now are to shut sufficiently close; in several of the committee-rooms we have tried to get them closer, and we have not been able to succeed. I think they vary according to the temperature outside, and that sometimes it is almost impossible to get them closed sufficiently to keep out the draught.

Colonel *Frederick Romilly*, a Member of the House; Examined.

117. *Chairman.*] YOU attend the Committee to-day at my request?—I do. Colonel *F. Romilly*, M. P.

118. Will you have the goodness to state whether you have suffered from the ventilation of the House, or whether you have found it agreeable?—I must confine my evidence to stating the fact that I have suffered a great deal from head-aches in this House which I was not subject to in the old House, and it is very much the same sort of head-ache which I have occasionally experienced from being at theatres and other large rooms lighted with gas; that is the impression that is produced upon me by it.

119. Have you found the temperature uniform in the House, or have you experienced a variety of temperatures?—I have constantly felt considerable draughts coming in near The Speaker's chair.

120. Do you generally sit in nearly the same place?—Pretty nearly, not far from The Speaker's chair, and I have generally felt a considerable draught coming in from that quarter.

121. About which row do you sit?—I do not sit in one row, more commonly than in another.

122. Lord *J. Manners.*] Have you suffered as much from the gas since the chandeliers have been raised as before?—I think I suffered more last Friday night than at any other time, and I ascribe it to the gas.

123. Sir

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123. Sir *D. Norreys.*] Did you ever sit in the gallery?—Not for any length of time.

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Sir *Denis Le Marchant*, Bart., called in; and Examined.

Sir *D. LeMarchant*, Bart.

124. *Chairman.*] WILL you have the goodness to inform the Committee what your opinion is as to the ventilation of the House, in which you are a very constant sitter?—I find the air very disagreeable; I do not think I am very susceptible of atmospheric influence, but I have felt at times a great oppression on the chest, and sensations otherwise very disagreeable; in fact, it has struck me forcibly that there is a great difference between the ventilation of the present House and of the late House. When I was appointed to my office, I was very apprehensive of suffering from the air of the House of Commons from my recollection of the old House of Commons, which I very often attended and suffered very much from; but in the late House I never suffered at all, and, in fact, I thought that in warm weather in the summer there was no room where it was less disagreeable to sit for a number of hours together than in the late House of Commons. When one comes to be in any room for 12 hours in the day, as I have often been during the last year, when there was a morning sitting, no room will be very agreeable all that time, but last year I never suffered the least inconvenience from want of ventilation; this year I have at times very much.

125. Have you experienced great alternations of temperature by currents of air?—Decidedly; I think rather less in the last three or four days. In the first days of the Session I thought the alternations were much more decided; I caught a very bad cold in consequence, from a gust of cold wind which produced a chill over me. It was exceedingly uncomfortable in every way.

126. Have you anything to say as to the lighting?—No; I think the lighting is very tolerable; I see very well.

127. Have you inquired of your colleagues at the Table what their experience is?—I have, and they quite agree with me; except that they say that they have not suffered in health at all. I think Mr. Ley had a cold at first, but the last few days they say they have not much to complain of, except the air being very close and very disagreeable; but I have suffered from pain about the heart, which I never did before. Mr. Ley said that he had not suffered in that way, but that he thought the air very disagreeable.

128. What

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128. What you all complain of more, is not having sufficient elbow room at the table?—That is rather a defect; but I would submit to the Committee that, independently of the want of better ventilation, there sometimes is a very unpleasant smell; it was the case yesterday. I have heard great complaints from the Members of the smell.

129. Lord *J. Manners.*] What was the nature of the smell; was it from the gas?—I thought so; it was rather gaseous; but I am not much of a chemist, and I am unable to analyse it.

130. Viscount *Palmerston.*] Was it the smell of a drain?—It might be the smell of a drain, or of gas.

131. Mr. *Bankes.*] Have you observed that those smells are more complained of in the morning sittings than they are in the evening?—No, I never heard any complaint of a smell in a morning sitting before yesterday; I have observed a very unpleasant smell late in the evening two or three times.

132. Mr. *Cochrane.*] Is it always late in the evening that you have remarked it?—I have observed it more late in the evening: but I heard great complaints of it yesterday in the morning sitting. One Member stopped me, and said, "I think it will be the death of you all where you are if this smell continues."

133. Do you think it possible that the effluvia from some of the manufactories over the water may be pumped in in the morning sittings?—I do not think it improbable.

134. From burnt bones and articles of that kind?—I should think it not improbable.

135. Viscount *Ebrington.*] Is it your impression that the drainage of the House is in a satisfactory state?—I have had no opportunity of judging of that. I understand that in the mornings there is a very unpleasant smell in the corridors leading out of the Great Hall. I hear the clerks coming into the House early in the morning say that it is most disagreeable, and they think it is from the gas.

136. Mr. *Bankes.*] That is when they first open in the morning?—When they first open, about 10 o'clock. I think there is a great peculiarity in the air; that there is something too dry in the air. There is a great difference between the air of the present House and of the late one; that I have heard very often observed.

137. Mr. *Greene.*] Did it at all occur to you yesterday that the smell of which you complain was like the smell of chloride of lime, or something put there for the purpose of

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purifying the atmosphere?—No, I do not think it was at all like chloride of lime.

138. Viscount *Palmerston.*] Have you ever yourself experienced, or have you heard Members complain that they experienced, sensations as if there was a quantity of dust floating in the air of the House, producing a tendency to cough violently?—I have heard Members complain of something in the air which causes a tendency to cough, and considerable irritation in the chest and throat; I cannot say that I felt it myself, but I have heard it complained of by many Members.

George Stone, Esq., called in; and Examined.

G. Stone, Esq.

139. *Chairman.*] YOU are employed in the Vote and Proceedings Office?—I am.

140. Will you inform the Committee of the state of ventilation of the room which you occupy?—One room is very comfortable, I believe, but in the room in which we transact business, which is the larger room of the two, one feels a current of air which proceeds from some place or other, either the window, or the ceiling, or the floor, on either side of one's face as one sits near the window. I have pasted the window up, but that does not seem to have much effect upon it; there is still a current of air as one sits near the window.

141. You find it very disagreeable?—I find it unpleasant; the other gentleman who sits there also says that he feels it on the top of his head; I feel it on the side of my face; I cannot exactly say where it comes from; it is certainly very perceptible in the room.

142. Mr. *Bankes.*] Do you perceive any smell in the office?—No; I have not found any unpleasant smell there.

James B. Bull, Esq., called in; and Examined.

J. B. Bull, Esq.

143. *Chairman.*] WHAT portion of the House do you occupy?—I occupy a room on the basement floor, facing the river front; it is called the Public Petitions room; I am clerk to the Public Petitions Committee.

144. Will you inform the Committee what the state of ventilation of that room is?—I consider it defective; there is no fireplace in the room, which is vaulted; the atmosphere is often close and stifling; sometimes it is more agreeable than at others, but it is generally close.

145. From

145. From a deficiency of ventilation?—From a deficiency of ventilation, a deficiency of pure air. *J. B. Bull*, Esq.

146. Is that near the Public Journal Office?—It is one of that suite of rooms. 25 March 1852.

147. Is it cold or hot?—Sometimes in the morning it is excessively close and stifling, and at other times it is almost too cold to write in; there is no fireplace, and I consider the ventilation very unsatisfactory.

148. Lord *J. Manners.*] Do you complain of the lighting at all?—It is lighted with gas, which I consider to be always unhealthy; but I have no special complaint to make of that.

149. *Chairman.*] You mean lighted at night?—Yes.

150. Mr. *Stephenson.*] Have you any means of regulating the admission of air to your room?—None, except by opening the door and the windows.

151. Mr. *Greene.*] How long do you remain in your office in the evening?—It varies according to the number of public petitions presented on the preceding day; generally till six, often till seven or eight o'clock; sometimes much later.

Sir *Denham Jephson Norreys*, Bart., a Member of the Committee; Examined.

152. *Chairman.*] YOU have attended the House very regularly from the commencement of the present Session?—I have. Sir *D. J. Norreys*, Bt., M. P.

153. And you have paid particular attention to the state of the ventilation and lighting?—Some attention, I have.

154. Will you inform the Committee how you have felt when sitting in the gallery?—I have felt a burning sensation, such as if I were exposed to red hot iron, to so great an extent, that I have been obliged to leave the place in which I sat. I tried then to sit in the end of the gallery, at the reporters' end of the House; and I found such a current of cold air rushing down from the Ladies' Gallery, that I was obliged to leave that position, or rather to place myself so close in to the panelling as to be out of the line of the current.

155. To what do you attribute that burning sensation when you were sitting in the gallery?—To the great heat proceeding from the gas-lights; they appeared to be like furnaces.

156. Mr. *Greene.*] The gas-lights are considerably higher now than they were when the House commenced its sittings this year?—They are.

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157. Have you perceived any difference in consequence of their being raised?—I still perceive that disagreeable sensation: I tried it on Friday night. Probably Dr. Reid will be able to give an explanation in his examination of the circumstance which I am about to state. I forget on what night it was, but it was on one of the crowded nights that we had, the thermometer behind the Serjeant's chair was 62½°, and in the gallery, on the right of The Speaker, near the Strangers' Gallery, the thermometer was at 70°, and on the bench in the gallery, on the left of The Speaker, it was 71½°, being a difference of 9° between the thermometer behind the Serjeant's chair and the thermometer on the bench in the gallery. On Friday night also Mr. Gurney pointed my attention to the difference of temperature between the floor in the diplomatic seats and the seat itself; there appeared to be a difference of 3° or 4°; and although the upper temperature was quite comfortable, my feet were as if they were in ice, from the strong current of cold air which appeared to come in. We then took up the thermometers to the gallery, and we found that the thermometer on the seat was at 71°; we raised the thermometer about a yard or four feet above the seat, and kept it there for some minutes, and it rose to 73°. We then placed the thermometer below, on the floor, where it was protected from the heat of the gas-lights, and it sunk to 68¼°. Therefore, a Member sitting in the gallery at this point would have his feet in a temperature of about 68¼°, the centre of his person atabo ut 70°, and a very little above his head it would be about 73°.

158. Have you any remarks to make on the subject of smells?—I have frequently perceived a smell from the escape of gas; but I know how difficult it is to arrange an extensive series of gas-pipes without accidents of this kind at first.

159. What is your opinion as to the general state of the air which you breathe in the House; is it agreeable or otherwise?—I think it is agreeable in quality, but I do not think it is administered well; it is allowed to come in too much by draughts.

John Edward Dorrington, Esq., called in; and Examined.

J. E. Dorrington, Esq.

160. *Chairman.*] WHERE is your office?—It is adjoining the lobby of the House of Commons, on the right hand side as you enter from the central tower.

161. What is it called?—The Public Bills and Fees Office.

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162. Will you give the Committee your opinion as to the state of ventilation of your office?—Our first annoyance arose from smoke, which I hope has been remedied; then we complained of some currents of air which came from the ventilated ceiling; the ventilators were altered, and they prophesied that we should then find it too hot, and that has certainly taken place. We now propose to have some of them raised again, and we hope that then the ventilation will be in a satisfactory state.

163. Your requests were attended to?—My requests have always been attended to.

164. And as far as you have gone an improvement has been made?—Indisputably. Hot air is admitted into the passage by my room, and we shall ask for a key, so that we may shut it off when necessary.

165. Mr. *Stephenson*.] Have you a fireplace in your room?—Yes; there are four rooms, two on the first floor and two on the basement, all with fireplaces. With regard to the basement, I shall make an application to get some warm air into that quarter, because it is cold.

David Boswell Reid, Esq., M.D., called in; and Examined.

D. B. Reid, Esq., M.D.

166. *Chairman*.] WHAT portion of the House is at present placed under your superintendence for the purposes of ventilation and lighting?—Will the Committee, before I answer that question, allow me to say that I have been now six years under protest under extreme circumstances, daily demanding leave to prove my case, but refused an honourable opportunity of retiring or of trial; and before I give my evidence, I wish, if the Committee will permit me, to say a few words under the very extraordinary position in which I have been placed. If there is any objection, then I will at once proceed to answer the question; but I have been placed in a position of so extreme a nature, that I must claim the consideration of the Committee. I have twice asked the Government to send a medical man, that he might report on my case; but that was objected to; it has hitherto been refused. I have been silent more recently, in expectation that I should be heard before this Committee.

167. If in the course of the examination, in answer to complaints which have been made, you desire to state that it would have been better had such and such things not been done, it will be perfectly competent to you to make such statements; but at the present moment the Committee merely wish

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wish to inquire as to the complaints made of the ventilation of the House, and the best mode of remedying them?—In this case I wish nothing but to explain specifically how I stand with respect to these immediate questions to which the Committee are now restricting their inquiry, in order that my answers may be understood. I think it is impossible, under the peculiar position in which I stand, without stating in what manner I have received those plans, and am acting at present, that the Committee can put a right interpretation upon my answers.

168. Will you explain to the Committee what portion of the building is now under your superintendence and direction?—The portion of the building which commences with the south side of the House lobby and terminates at the corridor between The Speaker's rooms and the Cabinet rooms; that is, the corridor behind the chair.

169. That is, the House, the entire of the division lobbies, the rooms behind The Speaker's chair, and the Vote Office?—Part of it.

170. And the House lobby?—Yes.

171. And the Post Office?—The Post Office is included in all the drawings, but the smoke flue has not been carried into my flues, nor that from the door-keeper's room; the register of rooms includes every one in the angles of the lobby.

172. Have the goodness to specify by name the spaces which you ventilate?—The House, the surrounding corridors, the Cabinet rooms, the strangers' room, the House lobby, and the four rooms in the angle, but some of those flues, shown to be carried into the part appropriated to me, are, in their present state, in Sir Charles Barry's hands.

173. Mr. *Drummond.*] Have you the entrance to the cloisters from the House lobby?—No.

174. Or the entrance from the Library corridor to the House lobby?—No, neither of those.

175. *Chairman.*] Is the corridor behind The Speaker's chair ventilated by you?—No, there is a small communication connected with my air chambers, but practically it is not under my direction.

176. Nor any portion of the building to the north of that?—Not a single portion.

177. Mr. *Drummond.*] Is the passage to the Librarian's house and Sir Denis Le Marchant's house under your direction?—No.

178. *Chairman.*] Are the four rooms at the four angles of the

the House lobby under your urisdiction or not?—They were originally under my jurisdiction, but part of them are under Sir Charles Barry's, who has carried some of the fire-flues into his own flues; but they ought, according to the arrangements made with the Treasury, to be entirely under my jurisdiction.

179. Sir *D. Norreys.*] Is it the fact that, in some cases, certain parts of certain rooms are under your jurisdiction, and that some other portion of the same room is within Sir Charles Barry's?—Most certainly.

180. Mr. *Greene.*] When you say that, do you mean that certain portions of the rooms in question ought to be under your control, or that you actually are both at this moment jointly ventilating the same room?—It is absolutely a practical fact, from the want of effective communication. I will instance the Post Office. At the present moment the Post Office is ventilated by me, but the smoke flue goes into Sir Charles Barry's flue. Yesterday, when I wanted, after all that has taken place there, to take the flue into mine, as originally intended, my arrangements were stopped by the clerks of the works, Mr. Quarm and Mr. Lamprel, Mr. Quarm having desired Mr. Lamprel to prevent my connecting the fireplace with my flue, after arrangements had been made with the latter that the smoke flue might be led to a proper channel.

181. Is it distinctly understood whether the ventilation of the Post-office belongs to you or to Sir Charles Barry?—It is distinctly understood by me, whether rightly or wrongly, that that was put into my hands; that I should have all those angle rooms, they being so immediately in connexion with the Lobby; but the flue has been taken from my smoke-flue, and instead of joining mine, where the corridor flues join, it goes into a flue of Sir Charles Barry's.

182. *Chairman.*] How long have you had possession of those portions of the House, which you have now described, for the purpose of putting your system of ventilation into effect?—Nominally, I have had it since the winter of 1847, but practically never in the manner in which I agreed to do it, on the basis of the terms upon which I came to London; and hence it will be found that from 1846 down to the present moment I have never acted for a moment at the Houses of Parliament, except under protest.

183. But in the present state of things you have undertaken, as well as you can, to ventilate the House and arrange your apparatus for that purpose under protest?—Not exactly.

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exactly. I am in a state of compulsion. I am responsible for what I have done under the restrictions imposed upon me.

184. In consequence of many Members making complaints of the bad ventilation of the House when the Members took possession of the new House this year, the House issued an order to you on the 11th February to report upon such measures as were required for the health and comfort of the House; you received an order to that effect?—I did. I do not admit that the system of ventilation was bad, though I fully admit the intolerable effects produced, arising from causes unconnected with that system, which have been specified by me.

185. In consequence of that you presented a Report, which was printed and distributed among the Members on the 16th of March this year?—It was.

186. In the course of that report, you stated certain things which you considered necessary to be done, in order to improve the ventilation of the House; will you take that report in your hand? The first requirement you stated, is the proper paving of the vaults of the House of Commons, and the cementing the sides where the plaster has been washed down by the infiltration of bad water from the exterior. Will you inform the Committee why you desire to have those vaults properly cemented, and what is their state at the present moment?—My desire to have those properly cemented is because they are not at all finished as such vaults ought to be, and I know no Member who has visited them (as Members have done) who has not in an instant been sensible of a very bad smell; this smell did not become so notoriously apparent as it is now till after some rains that we had not long before the House opened, but when Lord Seymour inspected the vaults the day after I was at the Bar, he instantly gave me authority to close up a portion of them; and I must say that I can show hundreds of feet of surface covered with bad water coming in from the sides. Paved vaults were made at the House of Peers, and those are thoroughly cemented in many places, and the atmosphere is a most wholesome one. I state in my report that I ask no more for the House of Commons than what every one can see in a moment has been done for the House of Peers.

187. Will you inform the Committee whether you draw your supplies of air for the ventilation of the House through these vaults?—Through some of them I do at times; but I am compelled then to use chlorine, or muriate of zinc.

188. If,

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188. If, however, these vaults were such as you desire them to be, the use of those chemicals would not be necessary?—Most certainly; and it is a great disadvantage to be compelled to use chemicals.

189. Do you derive a portion of your supply of air from the Clock Tower?—At times we do so; but it is beset by numerous sources of nuisance which are around the Parliament Houses playing upon that point.

190. Does the air from the Clock Tower pass into those vaults before it enters the House?—It must; it has no other course; but hitherto the state of the vaults has been such, that I have never used the Clock Tower but once: that was yesterday.

191. Have the goodness to inform the Committee whether you have made application to the architect, or to anybody else, to have those vaults put into a proper state of repair?—I have constantly pointed out individually, I think, to Mr. Ashby, or through those in my office, that I could put my foot through a slate in many places, and I have done so where I think the slate was not injured previously, and that generally they were not in the condition I wished; but I must say that, till those rains poured in, and till I distinctly traced, some time in December or January, towards the opening of the House, an infiltration from New Palace-yard, when I discovered that the water did not come from any individual local part, but that there was an actual infiltration from Palace-yard, I did not ascribe so much importance to any moisture which I had previously seen there.

192. Since the time when you made this report, have you made any official application to the architect to have this evil remedied?—I have not, because I considered that I was in the hands of the House, and because I blow all that air away, using a plenum impulse; and therefore, until the question was taken up generally, I thought I should be merely adding uselessly to the correspondence to enter upon a question of that magnitude. But when I found it in that condition, I demanded admission to the vaults of the House of Peers, where I had not been for six years, and I was utterly astonished to find the total difference of the admirable finishings there compared with what had been given to me.

193. You still consider this absolutely necessary to be done in order that the House should be properly ventilated?—Most certainly, or to shut up the vaults and render them as useless as they have been hitherto, except on blowing into the

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the central one. Here is a plan of the river, the Abbey, and the Houses of Parliament—(*producing the same*),—and every dot which you see here shows some nuisance in the neighbourhood which can render the House uncomfortable for the night. Every dot shows a factory, or other source of nuisance; so that if the wind happens to set in from the direction indicated upon the opening where we get our supply of air, we shall have a smell from muriatic acid at one time, from putrid bones, oils, or rags at another, from potteries, or from grave-yards, &c. We are guided in part by this as to the channel at which we should take in air; hence the immense importance of a tall tower for the admission of pure air. Whenever the wind is in a direction to bring in one or other of those nuisances, we instantly shut up certain openings, one after another. I have known in a steady easterly wind the air blowing in one direction for nearly three weeks opposite the Penitentiary; and whenever the bone manufactory is in full operation there, if you have prisoners at Millbank in a particular condition, their lives are not safe, because an atmosphere of that particular quality is exceedingly injurious to certain constitutions. Independently of that, when the barometer falls, the fetid exhalation from the surface of the river is universal.

194. The next measure to which you draw the attention of The House is for obtaining a better supply of water, which you say has been altered or suspended during the last 12 months; for what purpose do you wish a better supply of water, and in what way has it been altered or suspended during the last 12 months?—The arrangements for water were placed on a footing of this kind; we were to have water from two sources; from the river for certain purposes of cooling, and from another source in order that we might use this purer water for other purposes; but it so happens that the purer water is subject to an immense pressure. When we turn on the communication so as to get this purer water, we have found that sometimes it almost comes with the force of a pistol-shot upon the pipes; therefore it acts too severely. I think the pressure is 124 feet, or something of that kind; we wish therefore to have the supply of water put upon a better footing than it is at present. Secondly, we were to have water from the river for the steam engine; the pipes are carried down to the river. Under a paper, signed by Sir Charles Barry, and agreed to by the Commissioners, every arrangement connected with that was in progress, though an engine was taken away in consequence of

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of my objecting to it on account of the noise it produced; we must either have a supply from the river for the engine, or we must have an equivalent quantity from some other source. This engine is a high pressure engine, and will not use so much as others; but still we are deficient in a proper supply of water for general purposes as well as for cooling.

195. Do you wish to have this water for the purpose of cooling the air, or for the purpose of supplying water to the steam-engine?—For every purpose; we think that the arrangement for the supply of water from a great altitude is not desirable. We wish to have a simple intermediate system, which I believe has been, in a great measure, authorized; the place has been selected, and a tender has been received for the cistern.

196. Then with regard to the two other requirements which stand at the head of your list, do you apprehend that there is no very great difficulty, according to your experience, in having them complied with?—None whatever; I have never heard of any material objection to them that I can mention. It is only fair to state, that the point connected with the water has been rendered more urgent by my finding that the high pressure of the water upon the pipes produces a greater effect than is desirable; a kind of percussion from the action on turning the stop-cocks.

197. The third matter to which you draw attention in your Report is the total removal of the oil paint from the floor. Will you explain the manner in which that interferes with the ventilation of the House?—Those who are in the habit of looking into chemical facts, and into subjects of natural philosophy, will be aware that a grain of musk has been known to perfume a room for 20 years, and yet there has been some musk still remaining. Now there are some persons (if I thought fit I could mention names, but I can mention them to any Member individually); there are some persons who are never sensible of one air being worse than another. There are others, again, who are sensible of nice distinctions, and peculiar appreciations, and to whom anything in the shape of oil, especially of a particular quality, is offensive. Now the floor-plates are open, and there are innumerable meshes there——

198. Will you describe to the Committee where these painted plates are to be found?—On the floor; they form the substance of the floor on which the Members walk. Suppose we have some thousands of feet of surface covered with

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with a certain quantity of paint, and that it has been laid on thick, and that it has dried, and is as free from objection as paint generally may be, still it is porous in many places, it is spongy, and it is subject constantly to processes of cleaning and wear and tear. Now, from the nature of the oil used, that paint will be always in process of oxydation till it disappears; it will be like a body on the ground; it is organic matter, subject to the laws of all organic matter, and every now and then, whenever it receives moisture, that moisture is subsequently expelled. Now, let us take the case, that we wish to put the House of Commons into the condition of the old House, where, for 15 years, by the use of caustic potash, there was never a drop of oil upon the floor that we did not remove. Here we have an immense surface covered with paint, which produces the carbonating effect of slow combustion. Besides, when there is a very humid atmosphere, moisture condenses upon those plates, and when that comes to dry again, off goes the moisture. The quantity may be infinitesimally minute, but it obstructs all our operations. The ventilation may be either upwards or downwards, or it may be partially up and partially down. Take this case, that it is a very cold day, and I am anxious to heat the House as much as possible, and then to equalise the temperature all over it before the Members come in. While that is being done, this paint is oxydising the whole time; and instead of having a fresh air to go round, I am sending round air which has touched this paint. Now, it is a question for the nostrils, practically, whether that is offensive or not. I find it so, and I always declared it to be so at the time they were putting it down; and I say, after the enormous sums which are spent upon the House every year, why refuse me a clean surface where it touches the air?

199. Do you consider that this amount of oil painting upon the iron floor really occasions any of the evils of which the Members complain?—Most certainly; it affects the air, and it gives out a heaviness. I can show that it is contrary to my practice for 15 years.

200. How long is it since it has been painted?—I should imagine about two years.

201. Are the Committee to understand, from what you have stated, that it is indifferent to you how long a time has elapsed since it has been done, but that whether it has been done for a longer or a shorter time, in oil paint, there will be perpetually going on a process of oxydation?—Oxydation and abrasion by cleaning. The moment Lord Seymour came,

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came, on the 12th of February, he authorised a number of things to be done at once, without waiting for the authority of The House. One of the first things I did was to take off some of the paint; and I have seen very few members who have not admitted that there has been a very considerable change since, and part of that change has been owing to my having removed that oil paint at the parts where it was most important.

202. Your complaint as to the oil paint is not made now for the first time?—No; I have spoken often about it. More than a year ago I said, "If I am not supported in removing it, those who do not support me must take the responsibility."

203. Did the Commissioners, Lord Grey, Mr. Greene, and Sir John Burgoyne, make any inquiry into it?—Yes, most certainly.

204. Did they give any direction about it?—I showed in what manner it could be done, and I believe there was an understanding at one time that it would be done; but no sooner did I remove one objection than a fresh objection occurred; and finally, though I cannot say whether it was the Commissioners, or the Commissioners of Works, or in what way the result was brought about, yet the result was practically that I did not get that authority. Mr. Greene, who was present, and can correct me if my statement is inaccurate upon this point, knows the earnestness with which I urged it.

205. Has any part of the paint been removed?—It has, without lifting a single plate.

206. Do you know what the expense of removing the paint from the iron floor would be?—Taking into consideration what is done, I think it would not exceed 100 *l.*; much will depend upon the facilities which we may get by practice. I gave a larger estimate before, but from the practice we have had lately, I think the work could be done at a lower rate than, without a previous opportunity of trying, was mentioned.

207. Your next recommendation, with regard to ventilation, is No. 6, "The immediate adoption of measures for removing vitiated air from the kitchen and refreshment-rooms, the flues there not operating satisfactorily, is urgently required;" those kitchen and refreshment-rooms are not under your jurisdiction?—They are not.

208. Then how is it that they interfere with your ventilation?—In the same way as the passages; they unfortunately

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tunately send out bad air; I had an opportunity of pointing that out as I was entering the House yesterday, at the Strangers' Gallery, where the air was so bad; we were inundated with bad air from one of the flues, which is not air-tight; the vitiated air from the flue, connected with the flue from the kitchen, passes near the House of Commons, and when it comes into the surrounding district it may fill the whole House with the products of the kitchen, as it has repeatedly done.

209. In consequence of that flue passing through portions of the House where your ventilation operates, you conceive it to be injurious to the ventilation of the House?—Its present management is injurious; when our ventilation is on we can prevent its entering the House, but we cannot have the same resources of ventilation; for whenever we consider it desirable to have a vacuum movement on, then any leakage from that district may come down stairs into the House, and it will require a different arrangement of doors to prevent air from this flue passing into the House of Commons passages; it will also require that the flue shall be made to draw fresh air into itself, instead of sending bad air into the external district.

210. What remedy do you propose for this evil?—I should immediately bring the central tower into operation upon it, which is comparatively useless at present; that central tower may be made to act most efficiently upon numerous sources of bad air.

211. You have made an estimate of what the works you propose will cost; in that estimate is any sum included for these alterations?—Yes; I have allowed a small sum for making an opening, and a certain amount of improvements in the discharge.

212. Would that effectually remedy it?—Unless it is different from all other flues it would be effectually remedied; but so long as Sir Charles Barry does not allow me to see the drawings it is impossible for me to show what is done in altering my flues; I must send a man to measure and examine everything.

213. Does the same statement apply with respect to No. 7 of your requirements?—Yes. I think that is most important; take the reporters' stairs; those stairs have been, to my certain knowledge, filled repeatedly with smoke; I took six Members one day to see it pouring out into them.

214. Where did it come from?—It came from a fireplace which is not in action, at the bottom of the stairs, which

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which I tried to get shut up, but at present it is not shut up; that is one source of smoke; the Post-office is another; the doorkeeper's room another, and Mr. Pasquin's room is another, and also the reading-room at the cloisters; some of those have lately had shafts brought to bear on them, and are so far remedied.

215. No. 8 is, "The more thorough examination of fire-flues in the walls of the House, from which products of combustion have been proved to pass into the House at the galleries, the measures adopted for repairing them not having stopped all leakage from this source;" you complain that you cannot get the drawings from Sir Charles Barry, which are necessary for you to have in order to suggest efficient remedies to this particular class of evils?—To enable me to complete them without excessive loss of time, I am quite prepared to suggest what is necessary, but details require measurements. With respect to the smoke, I have stated the fact, that at one time a cloud of smoke came in, arising, perhaps, from some accidental communication between one flue and another where architectural alterations had been made; the smoke-flues were driven through the ventilating flues, and some of them the bricklayer so neglected that he left the separating work very imperfect; a thing which often occurs; they have been repaired since the House met. I have sent men into the passages under the galleries since they were repaired, and it is in places where they still perceive a leakage which may come upon us, that I intimated my wish to have the wall stripped, and to have them thoroughly examined, because we are subject to the infiltration of carbonic acid to a certain extent.

216. How long have you had the lighting of the New House under your charge?—I cannot say that I have ever had it under my charge, since my plans for lighting were rejected, till the lamps introduced by Sir Charles Barry were, very recently, placed by Lord Seymour under my direction, though as yet I have only had the opportunity of preventing accidents and escapes of gas.

217. Is not the lighting of the House at this moment under your charge?—It is under my charge; the lighting has been three times in my hands, and three times taken out of them; now the fourth time it is put into my hands.

218. What are the alterations which you would suggest with regard to lighting the House; do you consider that the present lighting of the House interferes materially with its good ventilation?—Most certainly; especially also from the use

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use of gas which produces such intense heat as the common gas does.

219. Will you state your reasons for thinking so?—My reasons are essentially these: they have reference to the light, to the effect of the direct heat radiated. I consider that the lights are not at such a distance as to permit with impunity the use of such strong burners; in the next place, those lights, instead of being ventilated in such a manner as would rapidly withdraw the steam and carbonic acid, have in reality a mass of metal-work connected with them which becomes a condenser, and all the latent heat of the steam is given out to the metal; hence you have not only a mass of heat radiated and direct visible light, but you have an accumulation from the latent heat of the steam condensed in the metallic apparatus. The tubes should have been very different, so as to have poured out the products of combustion without permitting them to deposit so much heat within the materials constantly exposed in the rooms. Then the position of the lights is not that which is desirable; ever since the first experiments made with respect to lighting the House under my direction in 1838, when I only had 24 hours for bringing in the gas and everything, I have endeavoured to advocate one uniform system, that is, to remove the lights and put them near the ceiling, or outside the window, or both; at the present moment we can scarcely get the men employed for the lighting out of the House, the number of attendants is so great, and they are sometimes till two o'clock working away at the lights, and all that time the gas is leaking in every direction from the lighting of the House; then that brings a mass of heat to a low level, independent of that which exists above when they are in full operation. I do not know how far the Committee would like to hear further observations on this head.

220. The Committee wish that you should give a full statement of your objections to the present system of lighting, and any proposal you may have for the purpose of remedying it?—The first point I should state with respect to the lighting is, that after a series of experiments, made before 50 members of the Royal Society at Edinburgh, I endeavoured to show that even a small argand, at a distance of from three to 10 feet from the brow, produces a radiating effect, which to some is intolerable, even within those distances, from the heat which the brow receives; and that, generally speaking, where large and powerful lamps are placed, the irritation of the nervous system

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system dependent upon the application of heat to the brow, alters the feelings throughout the whole constitution; and it demands a double or treble ventilation compared with what would otherwise be necessary. I can give the most satisfactory proof that that is an accurate statement, if the House be tried on Wednesday, when there is no such light, and the effect then be compared with the effect at night, when there are lights. Then, believing that the radiations of the lamps may include many things besides heat and light, which are very objectionable, I have always endeavoured to try to produce an imitation of daylight for a public building; that is to say, a gentle diffusion of light throughout the building. As a substitute for two or three inches or feet of incandescent materials, I would have thousands of inches of mild luminous surface, the lamps being concealed, so that it should have as much as possible the effect of the emission of daylight, instead of visible artificial light. At the same time there are many points connected with the decorations and general style that might render it desirable not to push this too far. I think therefore that with the conjoint use of the ceiling and the sides I should be able to take away, if not the whole, yet at least perhaps 99 per cent. of that unpleasant feeling which is dependant upon excessive local light, accompanied by excessive heat.

221. Your object is to prove that it is possible to remove the lights entirely out of the House, and that consequently it will be unnecessary to have any attendance inside the House to conduct the lighting?—Certainly, that is one object.

222. For the purpose of rendering the light more agreeable to the House, and more suitable to good ventilation, you propose to light the House if possible from the exterior?—Entirely from the exterior of the usual line of vision within the House; either from the windows, or from the ceiling, or from both.

223. Was it under your direction that the old House of Commons was lighted?—Not generally.

224. Therefore the species of lighting which you would propose for the present House, is not exactly that which was adopted in the late House?—I will state in a few words the general arrangements connected with the lighting of the old House. When I was called to the old House of Commons, I was not allowed to touch the lights; they said "Do what you will for the acoustics and the ventilation, but take it as a fixed and settled point that wax candles remain." This went on for some time; at last on one occasion, I was with the late

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Sir Benjamin Stephenson and the late Earl of Bessborough, and on my reminding them of the anxiety I had repeatedly expressed to have it on a proper footing, and saying that I could never manage with the lights, such as they were, so well as I could otherwise, they said, "Well, then, what do you say as to gas?" I said, "If you will give me 24 hours, I will demonstrate to you what I can do." They gave me those 24 hours, but after I had worked two, the party who had contracted gave up everything. I took a cab, got 40 men together by 12 o'clock at night, and at half-past three in the afternoon, the first experiment of external lighting was made; but the lights had no proper burners. The next stage in the process was a recommendation of Mr. Barry's, that Mr. Gurney should be employed to light, upon which a communication was addressed to me. I replied, that I did not think that anything would come up to gas, but if he should guarantee what he proposed to guarantee by the oxygen and oil, they should at least give him an opportunity of trying it. Thus on recommendation came the Bude light, which was oxygen and oil; after that the gas came in, and an arrangement of burners was used identical, so far as ventilation existed, with that previously shown by me in the papers of the House of Commons; it was different in the employment of the burners, concentric rings were used. Then this immediately altered the ventilation, because we had great heat upon the brows of the members; but still, on the other hand, we had the lamps thoroughly ventilated. Lamps were then introduced outside; the arrangements for ventilating all those lamps were again prepared under Mr. Gurney's name, but I made these arrangements, and did everything possible to facilitate the experiment. After that another series of arrangements was made in 1844. Then, when it was considered desirable by Sir Charles Barry himself that the House of Commons should see the practical system of lighting then recommended by me, and that they should express an opinion upon it, in 1844 I put up what I consider the final arrangement, after numerous preliminary experiments, from 1844 to 1851; when the House was pulled down, those arrangements were there; but I never had an opportunity of once getting them used during the sitting of the House. That is my connection with the lighting.

225. Then, in point of fact, although the arrangements in part passed through your hands, the lighting of the late House was according to Mr. Gurney's plan?—It was.

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226. The plan therefore that you now propose for the lighting of the new House is not a plan that has ever been tried before?—Yes, it was tried in the House for some time, but never with the burners recommended by me. In the discussion which I had with Sir Frederick Trench and Mr. Greene I recommended that Mr. Gurney's Bude light of oxygen and oil should be tried. I said that without trying it; it was impossible to know whether he could do what he proposed to do; and I believe that if the original letters are still existing, my recommendation will be found that it should be tried, but at the same time I expressed my belief that they would come to gas, as Mr. Gurney did come.

227. Has the system which you propose for adoption in the new House been sufficiently tried to enable you to pronounce positively as to its effect?—Most certainly, so far as I am entitled to give an opinion, from what I have seen here and elsewhere.

228. A part of the lighting of the old House of Commons was from the outside, and a portion of it was inside the House?—Yes.

229. The difference between that and your proposition is, that you would propose to take the entire lighting outside the House?—Not only that; the great difference between my lighting and that which was used in the old House would be this; that my light would never come through curved glass. I consider that the great beauty of wax candles arises from the light never being refracted and twisted; but in a large lamp, where the light goes through large portions of curved glass, there are practically beams here and there, so that you have a reticulated texture of light throughout the whole building; now my object is to avoid all that. Instead of having concave surfaces, where a reflector is used, I should have a convex surface of plaster of Paris tinted, dispersing and equalising the light. Instead of the light passing through large portions of glass, refracting beams here and there, I should have either glass absolutely plane in surface, or no glass at all; I prefer having no glass at all. I have got here the "Illustrations referred to in Dr. Reid's letter to Viscount Dungannon in March 1838" (*producing the same*). The Committee will find that though there have been patents upon patents taken out since for ventilating lamps, they are all in principle included here.

230. Your great object in proposing this alteration is, that the light should be external to the House, and should pass through flat glass?—Or none at all; from thousands

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of observations I think the light infinitely less trying to the eye when it does not come through glass.

231. Then your proposition would involve the removal of the present stained glass in the windows, would it not? —Certainly, if it is lighted at the side; if it was lighted from above alone, then that would not be necessary; but I should not consider it desirable to lose the lateral light. I think the lateral light upon the countenance, instead of perpendicular light alone, is an object of infinite consequence in a house of assembly, particularly when there is so much black in the clothing, and so much green upon the floor.

232. You propose to substitute for the present enamelled panels glass panels, as far as you desire that they should be of glass?—That I should wish to be able to show. I have arrangements altogether peculiar for those illuminated panels in the ceiling, which hold out a completely new field of architectural decoration. I should propose that, without touching a portion of the ribbed work, the plain panels should be taken out, which could be very easily done by unscrewing below. We should then have a very subdued light, like the light from a candle, and secure the absorption of heat; there being certain materials which are known to absorb heat to a limited extent, and not to absorb light. I should use those as far as practicable.

233. Do you conceive that, if The House were to determine upon this species of lighting, the change would involve either any very great difficulty or any very great expense? —I can imagine no difficulty. I have gone over and over again through every detail as to the expense; and I have estimated generally, as far as time will permit, the whole of these works, and I make the amount under 3,000 *l.* And I would observe further, as to the experiments with the lighting, the expense would be principally labour and materials; the materials being valuable for any other purpose, even if The House should not eventually approve of the alterations.

234. Do you imagine that any experiments in this matter of lighting could be made without going into any very great expense, such as would satisfy the Committee or any small number of Members as to the merits of your plan?—I have no doubt that experiments could be made with the ceiling with one or two lights. At the same time, considering the immense importance of the matter, and the trifling additional expense, of a mere temporary removal of the panels, I should strongly urge that the experiment should be done throughout.

throughout. I estimate the removal of panels in the ceiling at about 10 *l.*

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235. The panels could be removed without injury, and returned if the alteration was not approved?—Perfectly.

236. Mr. *Stephenson.*] Did I correctly understand you as saying that you consider the air at present coming into the House of Commons to be vitiated from three sources; first, the damp vaults, secondly the oil paint on the floor, and thirdly leakage from flues?—Those are the principal sources; but those are only three of the sources; I have a whole list of others which I can point out.

237. But you have referred to these three as the principal?—Yes; but I would state others which are nearly equally important.

238. With regard to the oil paint, that is easily removed?—Perfectly.

239. With regard to the damp vaults, that difficulty has been overcome in the vaults of the House of Lords?—Certainly; and I only wish that the vaults in the House of Commons should be put into the same state as those.

240. With respect to the leakage from the flues, do you think that by any care that could be taken in making the flues it will be possible, when they are working with a more rarefied air within the House than the external air, entirely to prevent the occasional vitiation of the air from the smoke coming down the chimney?—Yes, by the arrangement proposed with the central tower in full operation.

241. But the leakage from the flues you attribute in some measure to the atmosphere inside the House being more rare than the atmosphere outside the House. Is it not so everywhere all over the House?—It may be at times partially so, but the complaints of smoke that I make are those that recur so frequently.

242. Do you usually work with the atmosphere inside the House more or less rare than the external atmosphere?—Not more, when our apparatus is in full action. We prefer a plenum impulse when the apparatus is in full action.

243. Is that your ultimate intention?—It is, certainly.

244. Then in that case would not the leakage from the flues be entirely obviated?—Not always, for this reason: admitting that there is a plenum impulse, occasionally in kindling a fire, you have a sharper ascent than the contents of the flue for the moment may contain, and at times there may be a slight outward leakage; but excluding that minor case (which I do not wish to stand on), undoubtedly it would be so.

Edward Dawes, Esq., a Member of The House; Examined.

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245. *Chairman.*] HAVE you attended the House frequently since the meeting of Parliament?—Almost every day.

246. Have you been inconvenienced from the ventilation of the House?—I have suffered very much in consequence of the excessive glare of the gas; I have experienced constant oppression upon the brain after sitting in the House two or three hours, and I have been obliged to go out to get relief; and on going home, I have been obliged to sponge the forehead with Eau de Cologne, or something of that kind, to obtain relief from the excessive oppression of the brain. On the 12th of this month I was taken very seriously ill and obliged to go out of the House, and I was confined to my room nearly 10 days, in consequence of what I should term nervous fever, which I trace immediately to the effect of the foul air of the House, and to the excessive glare of the gas lights, which I found intolerable. I came up in a perfect state of health when Parliament met, but I have found my health gradually getting worse in consequence of my attendance upon the House.

247. Do you attribute it entirely to the glare of the gas light, or to the atmosphere itself being bad?—I attribute it partly to the excessive glare of the gas lamps, and also to the smell of gas; I have gone several times into the gallery to see the effect of it there, and I found it utterly impossible to live in a state of health for any number of hours in the galleries, in consequence of the disagreeable smell of gas, and the bad state of the atmosphere.

248. Do you feel it as bad in the body of the House as in the galleries; or do you make a decided distinction between the two?—I make a distinction between the body of the House and the galleries; the body of the House is much better than the galleries; I do not consider it possible to live in the galleries so as to maintain one's health at all for any number of nights. During the last Session of Parliament, I sat in the House constantly night after night during very long discussions upon the Papal question, and never received any injury beyond the natural fatigue arising from being kept up late constantly night after night. I was often in the House till one or two o'clock in the morning, but I never experienced the slightest inconvenience to my health,

health, more than the ordinary fatigue of sitting up; but it is very different in the new House.

249. Viscount *Ebrington.*] You, like many other Members, have heard very numerous complaints from other Members to the same effect?—I have heard several complaints; one Member mentioned to me that he was obliged to save himself by getting away into the country; he thought otherwise he should have fallen into a dangerous illness.

250. *Chairman.*] Have you felt draughts of air much in the House?—Yes, I caught cold one evening by encountering a very cold blast on going out of the door, a tremendous current of cold air which cut me up completely; I caught cold in consequence, and since the 12th of March I have been constantly ill from the effect of the gas and the glare. I am scarcely sufficiently recovered at this time to attend to my business.

251. Mr. *Deedes.*] Were you ever before subject to living in a room heated by gas previously to coming into the present House of Commons?—No, I was not, but I have been accustomed to be in rooms lighted with gas, and I never felt any inconvenience. It appears to me that the glare is too great for the brain to bear; it produces an excessive pressure upon the forehead; sometimes there has been a swelling of the forehead, so that the heat has become very painful and disagreeable. At other times, after sitting in the House two or three hours, I have felt a sort of apoplectic sleep come over me, which I felt it impossible to shake off, and I believe that if any one had shaken me it would have been impossible to have shaken off that sort of apoplectic sleep.

252. *Chairman.*] From what you have stated, it appears that the remarks which I made in describing the ventilation of the House will very accurately describe your own feelings?—Most accurately; I stated to my friends on reading your observations, though I did not happen to hear them, that you had described the thing very accurately.

Veneris, 26° *die Martii*, 1852.

MEMBERS PRESENT.

Mr. Cochrane.	Mr. Greene.
Mr. Deedes.	Mr. Henry Drummond.
Mr. Ricardo.	Viscount Ebrington.
Viscount Palmerston.	Sir Denham Norreys.
Mr. Henry Hope.	Mr. Bankes.

LORD ROBERT GROSVENOR IN THE CHAIR.

Lord *Charles Russell*; Examined.

Lord *C. Russell.*
26 March 1852.

253. *Chairman.*] YOU are Serjeant-at-Arms of the House of Commons?—I am.

254. Your duties require you to be in your place almost continually during the sitting of The House, do not they?—They do.

255. Has the temperature or the ventilation of the House been agreeable since the Members took possession of their new premises, or what have been your feelings with respect to it?—The Committee are probably aware, that during the sitting of the House of Commons I am the usual medium of communication, as respects the ventilation, betweeen Dr. Reid and the Members. I must state, that the old House appeared to be infinitely more under the control of Dr. Reid, as regards its temperature, than the present House does; in the old House, whenever I had to desire an alteration from Dr. Reid in the way of lowering or raising the temperature, it always appeared to be within his power to accomplish it within a very short space of time; it has not been so during the present session, especially during the early part of it. Dr. Reid appears, as far as I can judge, to have had more control of the temperature latterly than he had in the first instance.

256. The object of the question was principally to ascertain what have been your Lordship's own feelings?—My own feeling during the present year has been one of suffering.

257. Can you describe in what way you have suffered?—In the early part of the session I suffered from a very high temperature,

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temperature, which Dr. Reid was unable to control; frequently, hour after hour, I have requested him, at the desire of the Members, and in accordance with my own feelings, to lower the temperature; he appeared to be unable to do so; it sometimes increased rather than diminished during the progress of the evening; the consequence of that was inconvenience, which we all experience from so high and close a temperature. On all occasions during the sitting of The House in the present Session I have been subject to headache, which I ascribe to my being immediately under a lamp; my reason for thinking that that is the cause of my headache is, that I am not conscious of it during the morning sitting on Wednesday; I have also tested it by the thermometer, and I find that the thermometer, exposed as my head is, is four degrees higher than it would be if it were covered.

258. The Committee gather from your evidence, that you have not only yourself felt inconvenience from the atmosphere being hot and overpowering, but that you have also heard from Members of Parliament repeated complaints of the same description?—I have; the complaints this year have been infinitely more numerous than they have ever been before.

259. You stated that you have suffered from the condition of the atmosphere; have you suffered from currents of air at any time?—Very little, hardly at all within the last three weeks; at the beginning of the Session, currents of the air were evident when the doors were opened, but that has not been the case within the last three weeks.

260. Do you consider the state of the ventilation to have been improved since the commencement of the Session, and to what extent?—I should say the ventilation has been improved since the commencement of the present Session; in the first place, there is an absence of draught, which I was conscious of when The House first began to sit this Session, but which I am not conscious of now; and again, the atmosphere appears to be more under the control of Dr. Reid than it did at the beginning of the Session.

261. Do you consider the ventilation at the present time to be satisfactory?—I myself do not experience any inconvenience except from the dryness of the atmosphere, which produces an inclination to cough.

262. From the peculiarity of the air you breathe?—Yes, I imagine so.

263. Especially you suffer from what may be termed the lighting of the House?—From the lamp over my head; I do not

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not wear a hat in the House, and I have no covering to my chair; I feel a sensation about the temples, which generally ends in a headache very shortly.

264. Have you ever been sensible of any bad smell in the House?—Members have complained to me of bad smells, but I do not remember that I have myself been conscious of them.

265. Was the dryness of the air which you speak of perceptible to you in the old House or not?—No.

266. Mr. *H. Drummond.*] Last night the temperature was much better than it has been on other crowded nights, was it not?—I was not there late in the evening.

267. Mr. *Deedes.*] Were you present at the morning sitting on Wednesday last?—Yes.

268. Were you sensible of any peculiar smell on that morning?—There was one day when there was a strong smell of chloride of lime throughout the House, which Dr. Reid accounted for; I am not sure whether it was last Wednesday, but I think it was; if it was the same day, I think several Members remarked, after I had explained to them Dr. Reid's solution, that the air was more agreeable to breathe, though they were conscious of that smell of chloride of lime.

William Ayliffe, called in; and Examined.

W. Ayliffe. —

269. *Chairman.*] YOU belong to one of the Divisions of Police, do not you?—I do.

270. Is it your duty to attend in the House of Commons?—It is.

271. In what portion of the building?—In the Cloisters.

272. At what hour do you come in the morning?—At 10.

273. By that time are the doors opened, or do you open the doors?—I open the doors leading into Westminster Hall.

274. Will you inform the Committee whether you experience any peculiar sensations upon opening the doors?—Very great.

275. What are they?—Enough to suffocate you almost; till the doors are wide open there is hardly any remaining in the place between the two doors; the deal bar of the door, which goes across leading into Westminster Hall, is quite hot from the heat; it is quite suffocating at that time.

276. The deal bar which you take out in order to open the door, you say, feels hot to your hand?—It does.

277. What

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277. What door is that?—The door which divides Westminster Hall from the Cloisters.

278. Do you feel the heat in Westminster Hall, or does the heat come from the inside?—From the Cloisters.

279. After opening that door, and proceeding a little further, do you find the heat very great?—I do.

280. How far is it your duty to go?—Into the room which is now used as the cloak-room.

281. Does the feeling of suffocation still continue as you advance into the Cloisters?—Yes.

282. For how long a time does that suffocating sensation continue after the doors are opened?—Not above five minutes; as soon as the doors are opened it all appears to go away; we can feel the fresh air come in.

283. Do you remain there the whole day?—I do.

284. Till what o'clock?—Till 10 o'clock at night.

285. Do you find in the course of the day that the temperature is agreeable?—Sometimes it is cold; I have been very cold there.

286. Has that been the case since the commencement of the Session?—I noticed the cold last week; in fact, I have had a cold ever since I have been there, which I caught there; I have been seven years in the Police, and I never had such a cold on me before.

287. There is a very great variety of temperature; sometimes it is cold and sometimes it is hot?—Yes.

288. Is it better now than it was when first Parliament met, or is it the same?—It is better towards the evening, but in the morning it is just the same; when I opened the doors only the morning before yesterday it was just the same.

289. Mr. *Greene.*] Have you found any difference since the glass doors were placed at the end of Westminster Hall?—The glass doors are always open, or one of the two is.

290. Has the placing those doors there produced any alteration?—If the doors are kept shut, the Cloisters are very comfortable, but when the door leading from the Hall is shut there is a suffocating heat.

291. Mr. *Deedes.*] You said the temperature of the Cloisters was better after the fresh air came in; how does that fresh air come in?—Sometimes I open the little green door to the left, and let the air in. I mean the little door which opens into a courtyard right opposite the glass doors. I very often open that door a short time, to get a little air myself.

292. Are there any windows which open into the Cloisters?—No,

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—No, not one; if there were windows which opened there it would be better.

293. Mr. *Cochrane.*] Have you felt any ill effects besides the cold which you have spoken of?—No, only a little cough and spitting in the morning, which I have had ever since; it is much better now.

Thomas Blackman, called in; and Examined.

T. Blackman.

294. *Chairman.*] YOU are one of the Servants of this House?—I am.

295. In what part of the house do you perform your duties?—In the cloak-room.

296. How long have you performed your duties there?—I commenced this session.

297. At what hour of the morning do you first go there?—About seven o'clock.

298. For what purpose?—To clean the rooms.

299. From what part of the House do you get at the cloak-room?—From the lobby.

300. Do you come through Westminster Hall?—Not the first thing in the morning; the door is not open then; I come from the lobby of the House of Commons.

301. In what state do you find the air when you go there?—It is very hot the first thing in the morning; so hot that we are troubled to bear it.

302. How long does it continue in that state?—I generally stop there about an hour and a half or two hours; when I come back about one o'clock it is not so bad then.

303. During the whole time you stay there it is very bad?—The first thing in the morning it is.

304. To what hour do you remain there at night?—Till The House is up.

305. Describe whether there is any difference between the temperature at one o'clock and at the time when you leave late at night?—It has been much better since the doors have been put up in the Cloisters; it has not been so bad since then.

306. How long have they been put up?—I should say the doors have been up about a fortnight.

307. Do you feel draughts of air there?—Occasionally we do.

308. It is better you say since the commencement of the Session than it was at first?—It is better now than it was at first.

309. But

309. But the state of things in the morning remains the same?—It was not so bad this morning. *T. Blackman.* 26 March 1852.

310. To what cause do you attribute its not being so bad this morning?—I do not know; I went on purpose to see whether it was so bad. There is one particular place where the heat comes up very badly, just by the Westminster Hall door. I went there this morning, and did not feel any ill effects.

311. Do you know whether any alteration has been made there?—Not that I know of.

312. Viscount *Ebrington.*] When you speak of the heat do you mean merely that the air is hot, or does its quality appear to you to be altered in any way?—It comes up from those places in the Cloisters.

313. Without any perceptible smell or deterioration of the quality of the air that you are aware of?—I do not smell anything very nauseous.

314. Is the air fresh?—It is not very pleasant to be where it is.

315. Is it unpleasant only on account of its heat, or on account of the quality of the air in other respects?—On account of the heat.

The Right Honourable The *Speaker*; Examined.

316. *Chairman.*] YOUR duties lead you to be present whenever the House of Commons sits; you are constantly aware, therefore, of the nature of the air and the temperature of the House. Since the Members have taken possession of the new House, what have been your sensations with regard to its ventilation?—I think the ventilation has been very imperfect; occasionally I have felt a current of cold air in the chair, and at other times I have been exposed to a current of hot air. Last night the temperature was exceedingly oppressive; there was also a great dryness in the air. I sent once or twice to Dr. Reid to beg that he would make some change in the state of the air, for it was so dry that it caused an irritation in the throat, and I could hear the Members coughing all round me. Right Hon. The *Speaker.*

317. You suffer inconvenience from heat and cold, and from currents of air, and also from the peculiar sensations caused by the dryness of the atmosphere?—Yes.

318. Do you think that any improvement has been made in the ventilation of the House since the commencement of the Session?—Once or twice the ventilation has appeared to be

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be much improved; I think on Wednesday week last it was far more agreeable than it has been at any other time; I hoped it would be found that the lights had some influence upon it; and that it was owing to the increased heat caused by the lamps that we suffered more in the evening. Last Wednesday, however, I thought the atmosphere exceedingly oppressive and disagreeable.

319. The Committee understand that you have not perceived any very great improvement, nor much difference between the state of the air in the morning and in the evening?—Very little.

320. Have you suffered from bad smells in the House?—No, I have not perceived them.

321. Comparing the state of the ventilation in the former House and in the present, are you of opinion that the ventilation of the former was much better than that of the present?—The ventilation of the old House was very much better than the ventilation of the present house. At times I suffered very much from draughts in the old House when the door was opened behind the chair, and the windows were opened in the division lobby behind. This caused a rush of cold air into the House which made the House exceedingly cold; and I have once or twice suffered very much from that circumstance.

322. In your opinion, was the quality of the air which you used to breathe in the Old House of Commons the same as the quality of the air which you breathe in the new House of Commons?—I think the air we breathe in the new House of Commons is far more oppressive than that which we used to breathe in the old House.

323. Do you find a decided difference between the two?—Certainly. Occasionally I had to complain of the air in the old House, but very rarely.

324. The atmosphere in the present House is more oppressive, and there is a dryness about it which causes a cough to yourself, and you perceive other Members coughing at the same time?—Yes.

325. Viscount *Ebrington.*] Do you find that, apart from the quality of the air, the nature of the light renders it more disagreeable to be in the House in the evening than in the morning?—I stated that on Wednesday week when the House was not lighted up the air was far more agreeable, but on Wednesday last I found the air quite as oppressive as it has been on any night, and I do not think the lamps produce the effect which I imagined they did when we were sitting without

them

them on Wednesday week. I consider, however, the lighting of the present House is far more agreeable than the lighting of the old House. Right Hon. The *Speaker*. 26 March 1852.

326. *Chairman.*] Did you ever turn your attention to the nature of the light in the day time from the stained glass windows?—No.

327. You have not perceived any effect from them?—No.

328. Mr. *Ricardo.*] Do you find a great difference in the state of the atmosphere in a full House, and when there are very few Members in it?—When there is a very full House the heat is much more oppressive. In the old House there was less change of temperature than in the present House. The ventilation was under better management, and I experienced less discomfort from Members going out of the House. A more equal temperature was preserved throughout the whole evening. This does not seem to be the case in the new House.

329. Do you find that these alterations of warm air and cold air are more frequent when the House is very full than when it is comparatively empty?—No; I have not experienced any difference in that respect.

330. *Chairman.*] Were you aware that there was a leakage of gas last night?—No; I did not perceive it.

David Boswell Reid, M.D., further Examined.

331. *Chairman.*] IN the course of your evidence yesterday you explained to the Committee more in detail than you have done in your report, some remedies which you propose to bring into operation for the evils which are now complained of. In reference particularly to the bad smells, do you consider that they are attributable solely to the leakage of gas?—By no means. There are many other sources of bad smells. In the first place, the House was totally unfinished when it was first occupied. I have known the varnishing of a single panel to be the subject of debate in the House of Peers, month after month; and till the very day that the House was occupied, the men were painting right and left, up and down stairs, on every side; so that The House entered into an apartment which may be said to have been newly painted. Secondly, a large number of workmen were engaged there, both on the Sunday and the Saturday previous. I was there on the Sunday myself, as well as Sir Charles Barry, and the number of men working there was so great that many parts of the floor of the House were literally a compound of lime, dust *D. B. Reid*, M. D.

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dust and candle grease, and broken glass. You could pick them all up together in many places. Thirdly, the whole of the lobbies are being covered with a peculiar composition of India-rubber and cork. That is a matter which is subject to perpetual abrasion, and like paint, is continually giving off, when not covered with water, a certain oily smell. Further, it is laid down and cemented at the edges, piece to piece, and also to some parts of the floor, with a solution of India-rubber, in naphtha or oil of turpentine. A more offensive solution to many is not known. I am not now speaking of what may be the permanent effect, but both at the time of the first meeting of The House, and for some time previously, and since, this has been in process of being laid down, and at the foot of the stairs to the strangers' gallery, where it is exposed to heat, it has been actually softened and partially melted. I took the liberty of calling your Lordship's particular attention to this circumstance lately, because here you have a specimen of those obstructions which I have perpetually met with. I desired the men on no account to put any of it near the fire, if they had power and authority to put it elsewhere; at least I asked them not to put any near the fire; yet it was done. Further, I have even noticed it in the closets at the corridors pasted down within an hour of the sitting of The House. Whoever experienced the first evaporation of that material was sure to feel its unpleasant effects. Another cause of smell is connected with the air channel which supplies the Cloisters, and also supplies other places. The air has to my nostrils a most decidedly unpleasant earthy smell, and further it passes through channels which are utterly inaccessible both to the eye and to the hand, and in some place even to any instrument. Since I have had any thing to do with the Houses of Parliament, I have often given the advice that they should rather have no channels for air at all in particular places than have a channel which cannot be inspected and cannot be cleaned. Some houses have even been pulled down before parties have found out the cause of long continued offence, such as dead animals in particular places.

332. One of the Members who has given evidence to the Committee, considered that he had traced bad odours to the proximity of the urinals; what is your opinion on that subject?—I have noticed that many of the urinals have been finished only since the House was completed. The offence from them is very considerable. Some of the adjustments in the angles are not even yet completed, and there are windows there which it is impossible to shut, so that often the cold air is blowing through

through those places into the House. I do not consider those arrangements at the urinals as at all complete. The basins in the urinals have in many places only been put up since The House met, and the supply of water is often insufficient. *D. B. Reid, M. D.* 26 March 1852.

333. Is it your opinion that those bad odours may, in fact, be traced to the urinals?—Certainly, at times; I have also noticed an infiltration from depositions of kitchen rubbish, and bad air produced in stairs and other places, in consequence of the want of urinals for workmen. I have noticed from that cause a very great amount of offence; it would require people to be perpetually on the watch to prevent it.

334. Sir *D. Norreys.*] What channels are those which you have spoken of as communicating with the Cloisters?—I mean the air channels which permit the access of the air through the small openings which may be seen under the stone seats; these may be seen at the sides.

335. Those openings communicate with the air which is in the area around which the Cloisters run?—I understand they do; I have traced one to the crypt, where the mummy was found.

336. Were not the openings of which you now speak, openings left for the purpose of the admission of air from the area into the cloisters?—They may be, but not having the drawings I cannot give a specific answer to that question; I am not aware of the details of their connection; I know that there is one large channel which leads from the crypt, and in the vicinity of the crypt between St. Stephen's Hall and the Victoria Tower, there is an immense mass of rubbish in many places.

337. Was that the particular channel which you referred to just now, as being inaccessible for cleaning?—No; I do not say that that one is inaccessible for cleaning in the lower cloister; but if it be connected with those which I have seen in the upper Cloister, those portions of it which terminate in the upper Cloister are inaccessible for that purpose.

338. Do those air channels of which you complain, communicate with any peculiarly bad source of air, or are they foul in themselves, so that they render foul the air which passes through them, which is the ordinary air surrounding the general building?—I cannot answer that question, from the want of information as to the structure, in the precise manner in which I ought to answer it; what I do know is this, that those channels are visible as we walk along the

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upper Cloisters; further I have not traced those upper channels; in the lower Cloister there is a channel which I believe can be cleaned from its size, but that communicates with the crypt, and generally with the district where at night I should say there is offensive air.

339. By the crypt, you mean the former Speaker's dining-room?—Yes; there is an opening there through which a man can pass.

340. What use is now made of that crypt?—I am not aware to what purpose it is to be applied; but there is an opening extending from one side.

341. Supposing an opening to exist between the Cloisters and the crypt, if the crypt were in a proper state, and pure air, or at least air as pure as surrounds any other part of the building, were admitted into it, would that be any great defect, in your opinion?—Not there; but it would be a defect if the air from that source terminated in any place in channels which could not be inspected.

342. *Chairman.*] In what way does that channel communicate with any of your ventilating machinery?—It does not directly communicate with it; but whenever the wind sets in that quarter, it will necessarily contaminate the air in the House; it will come to the lobby.

343. That air, I presume, must pass through the cloisters, and get into the lobby of the House of Commons?—Yes.

344. Whereabouts is the crypt you speak of; is it under the Cloisters where the Members' cloaks are kept?—No; the crypt is under St. Stephen's Hall, in which the marble statues are placed.

345. You will doubtless have remarked that several witnesses have stated that, besides suffering from the effect of the gas-lights, they have been much incommoded by the inequality of the temperature, and by strong currents of air; will the remedies which you have suggested in your report abate those evils, or have you any others to suggest?—Most certainly the remedies will abate those evils; and I think it is admitted, at least I entertain the opinion myself, from the observations I have made, that they are abated. But till the system of ventilation can be introduced in full, we shall not have a diminution of those currents to the extent which is desirable, except we send in more air through the House than we should wish to do.

346. What do you mean by the system of ventilation being introduced in full?—The ventilation is only partially in operation at present; I consider that it can be put effectively

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tively in operation at present, if not counteracted by other causes; but the entire supplies of air from the roof are arrested by the intense heat from the burners. I have the means of giving a supply to the galleries from above; and if that supply be given from above, I can force in air there to such an extent as, without altering a single arrangement below for the Members individually, would assist me in giving a plenum movement, so that we should have much less draught at the doors.

347. I understand you to say that the principal obstacle at present to the satisfactory ventilation of the House by your means is the existence of those burners?—Yes, in their present condition.

348. Is that which you have just mentioned, in reference to the burners, an opinion which you have always held, and have you also published it?—I have not only held it, but published it in many different ways; and in the book in my hand I have given very specific illustrations connected with it. In page 13 of "Illustrations of Ventilation," published in 1844, which was addressed to Members of both Houses, I showed a burner and a large pipe from it taking away the products of combustion, so as not to permit a particle of vapour to condense. Below, to the very source of the light itself, you see a double casing, the object of one casing passing inwards being to supply cold air. In this case the plan illustration was not made for the purpose of lighting alone, but also to take away the heat from a wooden beam in the vicinity.

349. Mr. *Hope*.] Is it the case, that independently of the burners themselves, the iron work connected with the lamps gets exceedingly heated?—So hot that you cannot touch it; therefore, though not luminous, it is a mass of heated matter.

350. And there is a very large bulk of that iron work connected with those lamps which is brought to this intensely hot temperature?—I should say about five or six hundred weight. The total weight of the largest lamps, lamp and tube, has been said to be seven hundred weight.

351. Every burner has a separate tube, has not it?—I allude to the central tube proceeding from the congeries below.

352. Each burner, according to Professor Faraday's system of burners, has a separate chimney, has not it?—It has. There is the gas tube and the other tube.

353. And every one of those tubes becomes intensely hot in

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in consequence of the circulation of the fumes of the heated gas through it?—Yes.

354. Every one of the burners has three glasses, has not it?—Yes.

355. So that the light which comes from those burners is very small in proportion to the heat which is produced by them?—It is diminished by the glass considerably.

356. Therefore we may conclude that the light which the House obtains from those lamps is nothing in proportion to the inconvenience which is produced by the heat?—That is my opinion, particularly considering the quality of the gas which is used.

357. Sir *D. Norreys.*] In fact, in driving down fresh currents of air from above, instead of driving cool pure air down, you would be driving down a mass of air heated and destroyed by the radiation of the lamps?—I should.

358. Is not the power of driving down a current of fresh air from above at times an almost necessary incident to your system of ventilation?—It has always been an almost necessary incident to the system as applied to this House. It is not necessary where I have certain facilities of supply below, but from the limited nature of the supply below, I found it essential to combine with it a certain portion of descent from above.

359. The quality of the air has been complained of, it is said to be dry, as if it contained dust, so as to create an irritation in the throat; may not that, to a certain extent, proceed from the current being always upwards and the floor cloth not being sufficiently cleansed from the dirt contracted during the week?—I cannot imagine that to be the case to any very objectionable extent.

360. May not that dry and dusty effect also be produced from your cold air chambers below, not being in that perfect state in which you would wish them to be?—Every precaution is taken, and I see no trace of dust there, except that which may come from the floor.

361. Have you examined at the latter part of the evening the pendents in front of the gallery, and seen that they are covered with a thick coating of the finest dust, which appears to have been carried up during the course of the evening?—I am not aware of that fact; at the same time 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. If there could be accorded to me a sufficient ingress of air from a perpendicular surface, I should never take any portion from a flat horizontal surface

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surface which the foot touches; but when I am driven to take that or to have nothing, then I must act under the restrictions imposed upon me. I am exceedingly anxious to make these points about the draughts, and about the ceiling, and the moisture, as specific, as it is possible to do, and if the Committee will allow me, I will say a word or two upon them. In respect to moisture we have had observations made daily for the last 15 years, and recorded every hour. There is a large bundle of papers on the subject which Honourable Members can see if they choose, and my experience derived from that source is that when there is a difference of 5° between the dry thermometer and the wet bulb thermometer next to it, then I have the least number of complaints. But the difference between Honourable Members in respect to the amount of moisture which they like is as great as the difference in respect to their preference for a particular temperature. The difference also before and after taking refreshment is very great, as I think will naturally be obvious, so that if a body of 500 Members shall be detained late during a debate, they will generally prefer before dinner a moist atmosphere, but after it a dry atmosphere; that is an invariable fact; a dry atmosphere promotes evaporation but a moist one prevents it; my impression is that we have the power to give anything, from the driest atmosphere that the air affords, to an atmosphere saturated by steam and evaporation. I do not think there is anything so perfectly under our control as moisture, in respect to adding it when the air is dry. It is more difficult to take away moisture when it exists in excess, though we can add moisture when the air is dry to any amount; but we never can hit the individual tastes of every one, and, of course, we never attempt it, but we try to work to an average. The next point to which I wish to refer is the currents of air at the door; if the Committee will allow me to suppose this room to be the House of Commons, and further that it is desired to give air in such a quantity that it shall leak outwards at every door, and, therefore, that practically there shall be no current inwards, unless the violent slamming of the door, or a violent north, south, or east wind is permitted by the opening of the door to enter. That of course I cannot control. Supposing I have arranged this, and that it is all working to my satisfaction, then to a certain extent I am compelled, in order to produce that plenum impulse, to send in such a quantity of air that the ordinary apertures will not discharge it all. If the ordinary apertures did discharge all the air there would be none to leak out at the doors; I am

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obliged to send in such a quantity of air that the ordinary ventilating discharges will not let it all out as the valves are set; if the ordinary ventilating discharge did let it all out, then there would be no superfluity to leak out at the doors. With a perfectly homogeneous atmosphere, a little excess striking upon the ceiling generally throughout the room and recoiling a little, does no great harm; but if that ceiling be charged to a high degree with excessively hot air perhaps 6°, 8° or 10°, or immediately over the lamps 20° or 30° above the temperature of the rest of the atmosphere, the greater the recoil downwards by the sides of the galleries, the less facility have I to work my plenum movement so as to produce a leakage out of the doors, unless I run the risk of bringing down some of this superior warm air to the level of the leaking doors. If there were no obstructing cause from the excessive heat at the ceiling, I could at all times send in air of a particular temperature, that would descend so far as the supply of the galleries goes, while the Members would have that continuous movement upon the floor which we are all anxious to obtain.

362. Mr. *Ricardo.*] You were understood to say, that your great dependence for the supply of air to the House of Commons is upon sending it down from the roof, and that you are prevented from availing yourself of that resource because of the gas-lights, which change the temperature of the air when you have forced it in?—That states the proposition in a more strong and exclusive manner than I should speak of the supply of air from that source; we have a great source of supply below. There are three levels or stages at which air has to be supplied—the floor, the gallery, and the upper gallery; it is often a matter of convenience, particularly in a building where some of these have been added after the foundations were all laid, to take in a certain limited supply at times from above. Suppose I have supplied the body of the House, and that there is no complaint there, that there is an equal action, but it is too hot in the gallery, I could let in a certain amount at the top, which would supply those in the gallery, without in any way altering the position of affairs below; and this would be a great facility and assistance; it would give me another source to assist me in my plenum movement.

363. What means would you resort to to force the air down?—There is an engine, and an instrument lying ready for use at the present moment in the roof.

364. Once in the House of Commons, I presume you have

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no further power over the air?—Once in the House of Commons, we have a steady power of taking away by a shaft a specific quantity from the whole House under the most perfect control and regulation.

365. That takes it up again?—Yes.

366. How is it conveyed down?—By its own gravity from the temperature which is given to it, and also by the draught which is pressing upon the shaft.

367. Then the means of getting it down from above is by creating a draught to bring it to the floor of the House?—The draught regulates its quantity, but its own temperature would bring it down; that is, there being cold at the sides, it would descend to a certain extent.

368. Mr. *Greene*.] Were you in the habit in the old House of Commons of bringing any supply of air from above?—Never; the old House of Commons was always worked as the present House has been worked since it opened, except once or twice. We did try that central descent once or twice for a little while, but we found the air so warm that I was obliged to shut it up at once.

369. In producing the current from above you brought down some of the foul air into the House again, did not you?—I cannot say that I did that; I can show in a burner many thousand currents within a quarter of an inch; and I think I can show that in general in a building, if you can throw in at every available source, as far away from the people as possible, a certain amount of warm air, and take away from other fixed parts the foul and vitiated air in the proper quantity, the greater the surface through which the gentle impulse of air comes the better. For example, in a certain state of the atmosphere in winter, when Members are irritated by colds, or have been much exposed, I should use air from above alone if it were available for me. But if you take a case in the summer where Members have been exposed, for two or three weeks perhaps, to a warm sun, riding out at times, then the whole frame gets into a different state, and I should never use a descending current at all. I should have my universal diffusion carrying off the air rapidly from every part.

370. Mr. *Ricardo*.] I understood you to say that your supply of air came from the level of the Cloisters?—That is an occasional and accidental supply, which annoys us.

371. You account for the bad smell partly in that way, do not you?—That is one source of it. I have found again and again a smell there as if the ground had been newly dug; that

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that may be connected with new works and with the new state of the building.

372. Do you obtain the same air for the supply which you give from below as for that which you give from above?—No; we should be very glad if we could. If we could have taken it all from the Clock Tower or the Victoria Tower we should have preferred it.

373. That from above comes from a different source?—Yes; it comes from the river front, except when the effluvium from the bone factory sets upon that opening, and then it is shut up, and the air is taken from the opposite side.

374. *Chairman.*] You mean to take the supply as much as possible from the top of the Clock Tower, do not you?—Except when a particular chimney occasions a current of bad air to set upon that tower.

375. Sir *D. Norreys.*] Have you gone through all those causes which you consider disturbing causes in respect to the equal temperature which you would wish to keep up in the House of Commons. For instance, are the passages which pass the Public Bill Office and the Journal Office, which communicate by a staircase with the outer air, under your control, or under that of Sir Charles Barry?—They are not under my control.

376. Have you ever had reason to complain of a violent cold draught rushing through the doors into the Commons' lobby, which is under your control, from those passages?—Repeatedly; last night the carpet was blown open; a heavy leaded carpet was blown open at each of those doors, and a strong current was passing.

377. *Chairman.*] Which doors do you refer to?—The doors leading to the Journal Office and to Mr. Dorington's office, on each side of the Commons' corridor; that is the corridor between the central hall and the Commons' lobby.

378. Sir *D. Norreys.*] Is it possible for you to carry out a system of perfect ventilation, when you are always liable to have it deranged by violent cold currents, such as arise from those communications with the outer air, which are not under your own control?—It is absolutely impossible. Permit me also to mention, in connexion with this point, as a mere illustration of the subject, that though certain progress has been made in building double doors, yet really they are comparatively of no effect in many places, from what is done being only half sufficient to meet the objects required. Take Westminster Hall, for instance. Instead of the old large door, which had a small wicket in it, there are now several large

large doors, one of which, as the Committee heard stated by the policeman this morning, is always open. I have been constantly surprised to find out that that is the case; therefore the thing is exactly in the same condition as it was before. Next, if you will take the door of the House of Commons itself, where the door-keeper stands, I do not think they ever keep it shut; at least, it is very rarely shut. The door is unwieldy; there ought to be a wicket to it; it is impossible for the door-keeper to attend to it in its present condition, to open and shut it. I am for a completely different arrangement as to the doors there, by the introduction of a new double door between the door of the House and the outer door, at which the door-keeper attends. I have some models, which at a future period, perhaps, the Committee will do me the favour of inspecting; they illustrate that point.

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379. Mr. *Greene*.] Did the current of air which you complained of as going towards Mr. Dorington's office last night proceed from the opposite lobby, or from any other point?—It came from Mr. Dorington's office to us, not from the lobby to Mr. Dorington's office.

380. Mr. *Hope*.] With respect to the rooms above the Commons' Division Lobby, are those under your control?—So far, but the angles at every one of those places have only been completed since The House met.

381. I am speaking of the rooms communicating with the Members' gallery of the House of Commons, which are above the division lobby?—Many of the arrangements there, for instance the basin stands, have only been put up since The House met.

382. Those rooms are under your control?—They are.

383. What means do you adopt for warming those rooms?—We have an apparatus which warms an iron floor under the central portion of those rooms; but in consequence of the excessive heat in the galleries, we have kept those rooms at a temperature probably five or six, or seven degrees lower than that of the galleries. We have shut off that apparatus, so that it has never been in action except one or two days at the commencement of the Session, for we found it was agreeable to those who were exposed to the intense heat within to retire there occasionally.

384. Is not there a constant operation of cooling the air going on in those rooms, in consequence of the large size of the glass windows, and because the roof has nothing between it and the external air?—There is an operation of cooling going on to a certain extent at the windows, but there is a great

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great deal between the ceiling and the open air. There are the chambers in which the vitiated air passes from the upper and lower corridors. The floor is heated also by the warm air coming from the corridor, and the upper part is heated in the same way. Then, also, in ventilating the House of Commons, we proceed in this way. When the House adjourns at night all the doors are thrown open, and during the whole of the night the heat is so kept up that the warm air passes from the House into the upper corridor, descends to the lower, and comes back again, so that we warm the substance of the walls. Lastly, were the temperature to fall below a certain point, we should put into operation that warming apparatus which is there.

385. In consequence of your not using the warming apparatus in those rooms, must not the result be, that whenever the doors of the galleries of the House of Commons are open, a rush of cold air passes from those rooms into the House of Commons?—Not necessarily, unless they are set open wide for a time, because we often have to blow out the air from the House into those rooms; but if we were working with a greater power of discharge upon the House than upon the corridors, the movement would be as the Honourable Member mentions.

386. What you call your vacuum would produce that rush of air from those rooms into the gallery?—Yes.

387. Which would have the effect of producing those uncomfortable sensations of cold which Honourable Members complain?—Yes; at times when there has not been a single Member sitting in either gallery, the vacuum movement has been put on. Our experiments have been made upon the vacuum movement, when there was no one there. But at other times when there were many Members there, we have put on the plenum movement. At the same time, I must say, we often work with a vacuum at present, and must continue to do so till we get the power in the central portion above into full operation.

388. Am I wrong in supposing that there is a continual operation going on, having a tendency to cool the air from those large glass oriel windows?—No; but it is necessary for me to add here, that there are a number of windows in the angles of the stairs which I am for closing entirely. Those windows are often open, and cannot be conveniently closed; they are like those in the Cabinet Ministers' room, to which I was called by Sir John Pakington last night; I have no means of closing them, and they remain open; it is a purely architectural

tural question. If it were one which I had power over, I should close them at once; if there are any of those windows open, and the air sets in that direction, the current of course will be very strong. *D. B. Reid, M. D.* 26 March 1852.

389. Viscount *Palmerston.*] In the last House of Commons, it often happened to those who were sitting near the table, that at a particular hour of the evening, generally between ten and eleven, or after ten, there came up a most intolerable stench, such as might be expected to arise from a drain which was open. Once or twice in the present House, at the end of the last Session of Parliament, the same smell was perceived in the morning sitting, as well as in the evening sitting; can you account for those occasional smells?—I do not know that I can account for all, but I think I can account for some of them, both in the old House and in the present. On one occasion, when they were carrying on some draining operations opposite the Westminster Hospital, some part of a house gave way; there was an old privy which had been used at the workhouse, all the contents of which were thrown into the street; I believe the Members almost in a body rushed out of the House one night, but they found the smell worse outside than inside. On another occasion a very singular proceeding took place. I had with great care, for many years, put a ventilating apparatus upon the drains, so that wherever there were gully holes in the street, those gully holes instead of letting out the bad air drew down the air from the street; but suddenly by some operations which were conducted under the Board of Health, they cut off my air-drain. Immediately the whole district of the drainage, particularly at the Law Courts of Westminster, which had been formerly subjected to a vacuum power, leaking inwards, lost that action; but further, no fresh air passing into the drains, the drains became worse and worse, and with such intensity, that there were discussions in the courts about it without end. Everything was then opened, and it was found that there was a drain several hundred feet in length, leaking under the whole of those Courts which had been previously controlled by my apparatus.

390. The occurrence of the smell which I have alluded to seemed to depend upon the peculiar state of the tide; it was supposed by many persons to arise from the bad air from the bed of the Thames coming into your ventilating drains; do you conceive that that was any part of the cause?—I do not think it was possible it could come into them directly, but I

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am satisfied it might have come into them indirectly from the streets.

391. Do you conceive that by your present arrangements that inconvenience is not likely to recur?—I have not that full satisfaction with the present state of the arrangements which would be desirable. I have asked for drawings of all the drains in the vicinity, but for the last six years I have seen little or nothing of them. In the original plan for the drainage there were provisions made for drawing the air from the drains to central flues, I objected to some of the arrangements for drains at a very early period; but latterly I have known little or nothing about it. I consider it is an important point, and one which I cannot lay too much stress on, and I have applied for drawings accordingly.

392. In your evidence given before the Committee which sat some years ago, and upon whose Report the great central tower was determined on, you stated it to be your intention that all the air which was to be supplied to the Houses of Parliament should be drawn, not from apertures on the level of the ground, but from the summit of one of the two extreme towers; is not that the case?—Yes, it was the intention that there should be two towers for the supply of air.

393. The central tower was to be the chimney for discharging the bad air of the whole building?—It was so; I hold in my hand the diagram which was used for illustration before the Committees of 1841 and 1842.

394. Are there arrangements now made which will enable you to carry that system into operation, and to obtain from the summit of one of those towers all the air which you require for the purposes of ventilating the House of Commons?—Those arrangements are partially in operation, but instead of having the use of the channels provided for both Houses at the Victoria Tower, we have only the use of the Clock Tower at present for the new House.

395. Will not that Clock Tower afford you the means of providing all the air which may be required in the House of Commons?—I should never be satisfied with it, for this reason: if it be admitted that there is to be only one legitimate source of supply of fresh air, then, if by any accident there should be a drifting current of air from any manufactory, or from any of the large shafts within the Houses of Parliament themselves, you might have the manufactory, or one of those large shafts within the Houses of Parliament themselves, sending their impure atmosphere upon the very

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point adapted for the reception of fresh air at the Clock Tower; whereas if you had the two towers communicating with the central chamber according to the plan proposed, if one of them were damaged by an emanation from any local source of vitiated air, you could then take the other to windward of it. It was with that view that the two towers were considered indispensable to secure a supply of pure air. *D. B. Reid*, M. D. 26 March 1852.

396. Do you propose to abandon the plan of taking any quantity of air from the low level of the ground?—I do not propose to abandon it; we have openings there, but I should never use them except when compelled to do so.

397. Mr. *Cochrane.*] Do you think the difficulties of ventilation are increased from the fact of the new Houses being situated so near the river?—No; I do not think they are, as compared with the old Houses.

398. Do you think that any bad smell arises from the river?—Certainly. We sometimes have the river covered at night for miles with oil from the gas works, independently of all the effects which accompany the fall of the barometer. Whenever the barometer falls there is an emanation upon every side.

399. Do you think the river itself exhales a bad atmosphere?—I am certain of it.

400. Viscount *Ebrington.*] And St. Margaret's churchyard also?—To an immense extent. A person in my employment at the Houses was attacked with sickness in crossing that churchyard.

401. Mr. *Greene.*] You have now a supply of air from the Clock Tower, you say?—We have one from the Clock Tower.

402. You bring the air from the summit of that tower down through the vaults, do not you?—Yes.

403. Have not you a basement supply from the central hall towards the south-west?—We have a supply from the central hall towards the north-east, but that is not the original supply which was contemplated. The supply from the central hall should have been fed from the Victoria Tower.

404. Have not you two supplies from the central hall?—There may be a small supply on the other side; but the one we look to is the supply on the north-east.

405. Have you a supply from the Commons' court towards the west?—We have doors which we could use in the Commons' court.

406. Have you also a supply from the roof of St. Stephen's porch, towards the south-west?—We have; that is above.

407. Have not you also a supply from the roof of the central

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tral portion of the river front?—Yes; those I consider to be a mere make-shift, and not to be compared for a moment with the supplies which I am deprived of from the Victoria Tower. One of those sources may be subject to emanations from the river, and the other from the churchyard.

408. At the same time you have sources of supply from different sides, according to the state of the wind?—Certainly.

409. Is there more than one access for the air into the Clock Tower?—No; only one at the high level, but I have never seen the details for the finishing of the top of the Clock Tower. They ought to be shown in time to admit of proper arrangements being made to take advantage of the air there.

410. Viscount *Ebrington*.] Do you mean that drawings of the drains have been refused you, and also drawings of the flues and passages proposed to be made in the Houses of Parliament?—Certainly; I have been refused access to drawings under what I consider to be very extraordinary circumstances.

411. Are you at all acquainted with the arrangements for the drainage of the Houses of Parliament?—I have not been so since 1846, except from what I have seen incidentally.

412. You have given a good deal of attention to the subject of drainage and sewerage, have not you?—I have, and I have written some reports connected with the Houses of Parliament since that, but entirely upon limited points.

413. What was your opinion of the plan and arrangement of those drains at the time you saw them?—At the time I saw them, they were so unaccountable, that if I am asked my opinion of them, I can only state that I began to think it was time to see whether I should continue any longer at the Houses or not. I did object to them strongly. When, however, it was agreed to construct ventilating flues that would give me the power of acting upon them, then I said, this will be some remedy at all events, though not so desirable as another system of drainage.

414. Are you aware of the areas of any of those drains?—I know the areas of the first series of drains generally; but not having given any specific attention to the subject for many years, I do not know that I can state them with minute correctness.

415. Is it your opinion that they were unreasonably large, or defective as to their slope and arrangement?—The objections which I entered on were those which were connected with my department. The point which I considered was, whether they would affect the ventilation or not. I did not

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so much look at the size of the area or many other points, as to the question whether they would injure the ventilation. If the Committee will permit me to refer to the drawing for a moment, I find, at the river front, a drain formed in the general direction of the courts. It traverses my principal air passages, and was brought across a part where we were very much limited for space. I considered that the central portion of the drain, which was not necessary, might be left out altogether, because they could have a fall both ways; and thus, without traversing a portion of the space where it was wanted to have good ventilation, the drain might have been entirely excluded.

416. Is it a fact that a drain does pass through one of your principal air chambers?—It is so; I understand your Lordship now to refer to the question connected with the whole of the Houses. I gave a specific diagram in respect to the drainage which I wished to be followed out, but it was not agreed to.

417. Of what area was that drain?—Between two and three feet wide, and I should imagine five feet deep.

418. Was it the main drain of the whole building?—The main sewer of the whole building.

419. Do those dimensions appear to you, from the attention you have given to the subject, at all reasonable for the drainage of such a block of building as is comprised in the Houses of Parliament, with the very small number of persons who are at any one moment inhabiting it?—I do not permit myself to form an opinion upon a point connected with the area of the drains, because the subject was never discussed with me how far they were to accommodate the drainage of the building alone, or the backwater during high tides, or a system of pumping connected with them.

420. *Chairman.*] Your attention was only drawn to the drains, as they might interfere with your system of ventilation?—That was the only point, so far as the Houses of Parliament were concerned, in which I was permitted to interfere.

421. Viscount *Ebrington.*—It is your opinion, is not it, that a large brick drain of considerable area, and wide at the bottom, would be likely to cause noxious exhalations by exposing a greater surface of fetid matter to the action of the atmosphere, than smaller drains of more smooth and even material, through which a more rapid flow could take place?—Certainly; it is not only a matter of opinion, but that very drain referred to was a constant source of nuisance to the Houses

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Houses of Parliament during the sittings in the temporary Houses.

422. It was something like an elongated cesspool in its action, was not it?—Yes.

423. *Chairman.*] You have stated that you have not been allowed access to the drawings of those drains?—I have not had those which I have last applied for.

424. Do you consider that your usefulness as the superintendent of the ventilation of The House is impeded by your not having those drawings?—I should never undertake to do anything in any building where I had not the control of the drains, or a perfect knowledge of what was to be done.

425. To whom have you applied for those drawings?—The last application, I think, was made to Lord Seymour.

426. When?—Very recently; but I have never been satisfied with those drains. They have been the subject of dispute all along.

427. Did Lord Seymour refuse to give you the drawings?—No.

428. Viscount *Ebrington.*] Did he give them to you?—I have not got them yet. I do not understand that access to the drawings of the drains will be refused me.

429. Had you previously applied for them to anybody else but Lord Seymour without getting them?—Not recently; I have applied for numerous drawings; I consider myself to be in a position in which no man ought to be for a day, and many times I really give over attempting to carry points in consequence of the obstacles I meet with.

430. *Chairman.*] You made this application to Lord Seymour, and you expect that eventually it will be complied with?—I have never heard that it will not.

431. Mr. *Cochrane.*] Was there any answer made to your application?—I have had none as yet.

432. Was there no acknowledgment of your letter?—It was partly in conversation, and there was a memorandum afterwards; but there have been such innumerable letters and documents of late, that I should rather, if the Committee will allow me, bring them further information with respect to it on a future occasion.

433. Are you aware that in all the public buildings in Paris, and on the Continent generally, there is no such thing as an elaborate system of ventilation attempted to be carried out?—I am not aware that that is the fact now; I had 15 years ago an opportunity of going round the Chambers of Deputies with Monsieur De Laborde, and over various other

places,

places with Count Flahault, and there were many places in which they were introducing a very extended system of ventilation. With respect to the Chamber of Peers in 1843, both by directions of the late King of the French and of Count Montalivet, I had occasion to present a whole series of illustrations, though I have not had an opportunity of seeing what was done. As regards the Tuileries, I was requested by the late King of France to give a report; he took me up to the top of the Salon des Marechaux, where the effects of 3,700 lamps and candles, and of the respiration of 5,000 people in it and the adjoining state rooms, were very manifest, and had led to the desire of introducing plans such as were seen here and in Her Majesty's yacht, the "Victoria and Albert."

434. Are you not aware that, generally speaking, they have never adopted any of these elaborate systems of ventilation on the Continent?—I am not aware of it; 15 years ago I made for the Emperor of Russia a set of drawings, for plans to be introduced at a school at the great works at Alexandroski, and generally I can quote from papers, which I have here, arrangements which are in progress all over different parts of Europe, and for introducing such a system; they are of recent date, no doubt.

435. *Chairman.*] You are probably aware that complaints have been made of very strong currents of air in the Reporters' Gallery; can you explain to the Committee from whence they have proceeded?—Certainly; the Reporters' Gallery, like the ground-floor under the House, is a place which has been altered without the slightest communication with me, or intimation to me. One of my reasons for speaking with respect to these points is, that it is impossible to transact business, when after one plan is settled another is introduced, without communication. Some weeks before the occupation of the House, I saw some alterations in the Ladies' Gallery. After what had passed as regards the whole of the proceedings which were laid before the Commissioners last year, I thought this was so extraordinary that really it was very difficult for me to say what to do; but I attended to every thing as far as possible, and endeavoured to get double doors and curtains there. Those draughts, however, are still produced, and will always continue to be produced, so long as the external wind can blow into the corridor above, the communicating doors through the Ladies' Gallery being at the same time open. There is nothing whatever to interrupt the free progress of air from the corridor to the Ladies'

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Gallery and to the House itself, whenever the communicating doors are thrown open. The passage of air from this source is the cause of the complaints which are made, and those complaints are very justly made. There are also windows within the passages of the Ladies' Gallery which are sometimes thrown open, and those may produce the effect, even though the outer doors are shut.

436. Are not those corridors under your controul?—Those corridors are not under my controul.

437. Will you explain to the Committee what particular corridor you mean?—The corridor is one which is parallel with the corridor behind The Speaker's chair, and above it; there is a long corridor behind The Speaker's chair; the corridor in question is parallel with that corridor, and above it.

438. Sir *Denham Norreys.*] Are there not several direct communications with the external air in that corridor?—Yes; and at one period there were doors communicating with the roof, from which we have traced the descent of smoke in large quantities.

439. *Chairman.*] You attribute this inconvenience which is felt by the Reporters to a communication between that portion of the House which is under your controul, and another portion of the House which is not under your controul?—Yes, and to the want of efficient doors; it affects not only the Reporters, but it affects every Member on either side of the gallery at the north end of the House.

440. You have stated that you have great command over the air in making it moist or dry, but especially that you can make it moist to any extent you please?—Till it is saturated.

441. How can you account for the universal complaints which have been made, that the air is a great deal too dry?—I have not found those complaints to be at all general. Many complaints have reached me at times that the air has been very dry, and I have often desired that it should be moistened; but I should apprehend, giving a mere opinion upon the subject, that the effect of heat upon the brow, and the presence of gas and other noxious products, greatly increases the sensibility as to the quality of the air.

442. From the diagram you have produced it appears that your intention, at the time when you were giving your advice as to the ventilation of the whole building, was to draw the air from the two extremities through the whole of the building, to be discharged up the central tower?—Certainly.

443. One

443. One portion of the building being taken away from you, do you consider that the working of your system is impeded in any other way than that which you have stated, namely, that in certain instances you are obliged to draw air from the Clock Tower when you would have drawn it from the Victoria Tower?—That is not the only impediment. That is an impediment so far as it goes, which would simply affect The House in this way, that we cannot give to them air from the Victoria Tower.

444. What other obstacles are there to your putting into operation your entire system?—In the first place there are a whole series of shafts of vitiated air introduced at different parts of the building, which under certain circumstances will blow down into the courts; and therefore whenever fresh air has to be taken from those courts, that fresh air will be destroyed by those minor discharges. I look upon those minor discharges as deteriorating the air generally throughout the whole building, and of course as deteriorating any local supply taken from the level of the House of Commons in particular states of the wind and the weather.

445. If your plan in its integrity had been adopted, there would have been none of those minor discharges, because the whole would have been discharged from the central tower?—Yes; there would have been no bad effect arising from them. A reference to the evidence in 1841 and 1842 will shew, that with the most scrupulous care I deprived myself of the opportunity of using steam power at any time for the purpose of ventilation, because the questions by Sir Robert Harry Inglis, and by every member of the Committee, were to this effect, "Will there be anything visible from your tower?" Instead of carrying all these products away to a great height, from which they may be discharged for ever, they may now loiter, as they are seen to loiter at times, around the different courts. This must deteriorate the quality of the air, and be a source of great expense in the ultimate management. It is just as if you were to divide the stream of the Thames into eight or nine little branches.

446. Where are those discharging shafts?—There are many around the central tower at present.

447. Are they discharges from what is under your control, or under the control of Sir Charles Barry?—Both; there is very little discharge from anything under my control, with the exception of the ventilating shaft of the House of Commons. I have only half of a turret as a discharge for other purposes.

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448. Where are those minor discharges which you speak of?—Some of them are in the small turrets around the central tower; others again are at one of the angles of The Speaker's house, and of the Black Rod's house. If the Committee will refer to page 9 of a document which was laid before the House of Commons in 1848, they will see that Sir Charles Barry had not then made up his mind as to the number of shafts which were to be employed. His words are—"The principal, if not the only places of discharge, are stated above; but inasmuch as the mode of discharging the smoke of numerous fires through one shaft is novel, as applied to public buildings and dwellings, and has been forced upon Mr. Barry by the arrangements made in the building, under the direction of Dr. Reid, for discharge of the smoke and other vitiated air from the entire building through the central tower, the number of smoke shafts to be provided ultimately will depend upon the success or failure of the shafts already enumerated, which, however, it is hoped and expected, will be sufficient to accomplish the desired object."

449. Sir *D. Norreys.*] Those are smoke flues?—Yes; but they affect the purity of the air.

450. *Chairman.*] What is the date of that statement?—The date of that letter is the 6th of January 1847.

451. You directed the attention of the Committee to the vitiated air, and said that there were certain discharges of vitiated air which were left about the courts, and were injurious to your system of ventilation; where are those discharges?—Those discharges are at the places which I have mentioned; around the central tower corner, at the corner of The Speaker's house, and of the Black Rod's house. There are also others in different parts of the building, some of which I understand have been erected since the House met, and there are others shown in different places in the drawings which are not executed; but having had no information as to the drawings generally, or as to what is intended since 1846, I do not think I have it in my power to answer the question more fully. There will be more, I presume, when the new line of building is completed.

452. Did you intend to have discharged the whole of the vitiated air and the whole of the smoke through one central tower?—Most certainly.

453. Do you consider your system to be essentially interfered with in consequence of that not being carried out?—I do not consider that it is essentially interfered with, making due

due allowance for the inferior quality of the air which will occasionally from that cause be supplied to the House.

454. Mr. *Greene.*] In fact, if you had entire charge of the ventilation of both Houses of Parliament, and had the double sources of supplying air of the Clock Tower and the Victoria Tower, and could discharge the foul air from the central tower, would not the supply to the House of Commons be principally drawn from the Clock Tower?—Not necessarily so; it would be principally drawn from the Clock Tower and the Victoria Tower; because, according to the arrangements of the central vault there, it would be treated exactly in the same way as the courts are treated at Liverpool, where you have two buildings precisely parallel fed from a central vault. Both Houses could have the benefit of either tower: if the air were bad at the Victoria Tower, the supply from the Clock Tower could be rendered available for all; and if the air were bad at the Clock Tower, by a corresponding change that from the Victoria Tower would be equally available for all.

455. Viscount *Palmerston.*] Supposing you had had the management of the whole building, would you at any one time have supplied different parts of the building with air from both towers at once, or would you invariably have employed one tower alone, according to the direction of the wind, for the supply of the whole building?—We should have alternated in those different modes according to the state of the weather; in hot weather we should have been glad of both, in cold weather one might have done; but if during hot weather one was besieged by foul air, we should rather take a less supply of good air than a larger supply of indifferent air.

456. Mr. *Ricardo.*] What are the causes which could make the air from the one source good, while the air from the other was bad?—The setting in of a particular current. If we watch a chimney top, as I have often done, we may see the smoke from it setting in a certain continuous line for longer or shorter periods; if we imagine some of that current to strike upon the tower, and envelope the aperture at the top, we might have a great deal of bad air at one source and none at the other.

457. That can only apply to the distance between the two towers?—Certainly.

458. What is the distance between the two towers?—Rather more than 800 feet.

459. *Chairman.*] I believe at St. George's Hall, at Liver-

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pool, you have been permitted to carry out your plans exactly in the way you desired?—At the two courts I have.

460. Have they a central discharging shaft like the circular tower here?—No, they have four discharging shafts; they were to have had one in this way: it was originally intended to have combined with the structure of the present building another building for the daily courts; then every flue, whether for vitiated air or for smoke, was to have gone to the other building. The tower there was made an architectural feature at the end of the street; the railway is on one side, St. George's Hall on the other and this building was to have been in the centre between the two. Afterwards the corporation said they would not expend money upon daily courts; that they would do without daily courts; then the plan was so far altered, that we had four shafts within the building instead of one at a distance.

461. Did you propose to take the vitiated air from every committee-room, and from every private house, in this great building, and to discharge it all through a central shaft?—From every one.

462. Did Sir Charles Barry make an objection that it would be impossible to do that with due regard to the stability of the structure?—I never heard a single objection from him until I pointed out a rent in the building, and until the effects of the water through the concrete were shown to him by me.

463. Did he object on that ground?—He never objected to me.

464. As far as you are able to give an answer, do you believe that a building of this magnitude could be constructed with channels, leading from every portion of it, to a central tower, so as to carry on the ventilation in that manner?—Certainly; the arrangements at the old House of Commons were absolutely, in that respect, a model upon a one-eighth scale of the new House. In that case 200 communications had been in full operation for many years.

465. Will you refer to your report under the head of "Probable cost of works;" in the second paragraph you will observe this statement, "In giving this estimate I have proceeded on the assumption, that works for which estimates have already been passed, or recently authorized and still in progress, will be completed, and that it is unnecessary to refer to them in this report;" are those works works for the purpose of completing any portions of the House which would assist

assist you in the ventilation?—Certainly they are; they are partly for apparatus and partly for water; they refer, for instance, to water for the engine, to pipes which were authorized to warm the corridor, which have been only recently passed, and for which authority was requested last November.

466. Have you reason to believe that those works are in progress?—I know most of them are in progress, and I have no reason to doubt that the others will be completed in due course.

467. Have you discovered in the place where the gas-meters are situated any considerable annoyances to the ventilation of the House of Commons?—I have; I have never been in the room where the gas metres are without smelling the gas; I should not object to that if it were confined within the room, but I do think that a flue must be arranged so long as those metres are there, to take off the amount of leakage which occurs. On one occasion, on a Sunday, there was an alarm that the gas had escaped greatly; the parties sent to me; we had all the lamps extinguished, and I went round with the foreman of the clerk of the works, and we had reason to believe that the gas had been escaping from the Saturday night till the Sunday afternoon; nor have we any direct means of controlling it or of knowing when the gas leaks and when it does not, for there are some of the tubes which are actually plastered into the wall and totally inaccessible.

468. Had you seen that gas chamber and estimated all those inconveniences when you made this report?—Certainly; at the same time in making the report I looked to having the control of all the materials in the shape of fixtures there; I did not look to have the control of any individual burners, but certainly I did with respect to all the large apparatus, such as the gas meters and the fixed mains.

469. In order that you might place them in the position which you desired?—Yes.

470. Does this estimate of the cost include such alterations as those which you have now referred to?—It does; at the same time I must mention that I had but a short time to make it; I am quite certain, however, that I could do it within the sum, having the use of the materials.

471. Had you sufficient time to prepare your means of ventilating the House, so as to get them into a tolerably perfect state before Parliament assembled, or were there many portions of your machinery at that time in a very incomplete state?—Many portions of the machinery were incom-

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plete, but not the arrangements for the actual ventilation; I had ventilated the House previously, but I had never had an opportunity of testing the arrangements properly, from the number of workmen who were continually present. In 1836, when the old House was finished, the authorities introduced 400 of the Guards, and allowed me to operate upon them till the currents were checked; but in consequence of the occupation of the House by workmen it was impossible to have any such opportunities on this occasion.

472. Do you remember whether, when you first got the ventilation of the old House into good working order, there were many complaints made that Members were suffering from bad ventilation?—I recollect that there were many complaints, but none but what were found to arise either from local causes, which could be well accounted for and suppressed, or from a difference of feeling. I remember the first two Members who spoke to me on the subject, when I was standing at the bar, said this; one of them passed by me, and said, "This house is intolerably cold; I can bear it no longer;" and after he had passed, another said, "I am suffocated with heat; I cannot stand it."

473. There were no such serious evils complained of as induced any Member to bring the subject under the notice of The House?—There were serious complaints made in the winter Session of 1837. On reading the account in the papers I came to London. I found that the House had not been cleaned for a fortnight, and that the carpet had been entirely changed. Lord Besborough sat at an investigation which continued for five hours, and at the end of those five hours his words were, that I had been unfairly dealt with, and that there had been causes of complaint which I could have no possible control over, and he desired me to rectify them. That is the only serious case of complaint which I know of, except during the time of the operations connected with the drains, when I felt so satisfied that there would be innumerable cases of disease unless I called the attention of the House to the subject, that I published a lithograph, in order to show what was then going on.

474. Have you now stated the whole of the reasons of the imperfections in the ventilation, which are giving rise to so much more serious complaint now than was ever made in the old House; or have you any other reasons to assign for the extraordinary difference between the two cases?—I think the main reason is the system of communication, which is such as utterly to deprive me of any reasonable facilities for applying

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ing my plans properly, and which is entirely in opposition to the course which was laid down by the Committee of the House of Commons in 1846, of which I think your Lordship was a member. I ask for nothing more than that, so far as the present plans are considered, but I have asked for it in vain since 1846; I have never since that time had the system of communication placed on a proper footing.

475. Viscount *Palmerston.*] What do you mean by the "system of communication?"—I mean communication with the architect as to the works. If the Committee will look at the necessities of the case, it will be obvious that, in transacting business connected with such a work, either the architect must design a room that will suit my system of ventilation, in order that it may succeed, or I must design a system of ventilation that will suit his taste so far as it is to be brought into operation. If the architect be both ventilator and architect, then he as ventilator knows very well what he will accord as architect to himself; but I having no knowledge of what he will accord, or what he will not accord, there must be an endless system of writings and communications instead of a record of things agreed upon, if a proper system be not enforced, so that it is impossible to proceed satisfactorily with the work. Hence the Committee in 1846 recommended that there should be an individual to communicate between us. I have never had that carried out which the Committee recommended.

476. *Chairman.*] By a want of communication you mean a want of communication between yourself and the architect, in order to obtain such spaces and configurations as you desire?—Yes, or some substitute for that through proper professional persons, such as were recommended by the House of Commons' Committee in 1846.

477. The Committee are to understand that your difficulties have arisen from this want of communication between the architect and yourself?—Most certainly. I should certainly never have undertaken the work on the system on which it has for some time been carried on.

478. Your present difficulties arise to a great extent from that circumstance?—Not my present difficulties alone, but the difficulties at the outset also. You are obliged to carry on an endless written correspondence, no one having an opportunity of putting a question to the other.

479. Do you consider that in the present state of affairs you have the means of putting your own system into operation

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tion in such a manner as to give comfort to the Members of the House of Commons?—Most certainly, if those things are carried out which have been represented.

480. Viscount *Palmerston.*] What is the practical impediment which at present prevents you from ventilating the House of Commons in a manner consistent with the comfort of the Members, and which you say arises from that want of communication of which you have complained?—In the first place the entrances for air in many other places might be adjusted in a better manner were there any opportunity of communicating with a professional architect of Sir Charles Barry's standing. I might have arranged special places for the introduction of air which might be subjected, if Sir Charles Barry disagreed with my proposal, to the consideration of a board or committee, but then I should have the assistance contemplated, when I left Edinburgh, of a professional man.

481. Is there any existing impediment to the good ventilation of the House of Commons, which you conceive to have arisen from the want of communication of which you have complained?—There are impediments connected with the mode in which the supply of air is given at many places, which might have been improved had there been mutual opportunities of consultation. Secondly, the drawings connected with the approaches have been entirely withheld from me for successive years, though I have represented, from the commencement, the absolute and indispensable necessity of knowing what was to be done with respect to those approaches, and of controlling them where necessary. Thirdly, there are many little details connected with almost every part of the building, as to which, instead of having facilities such as I have had on the Continent, and in every part of this country where I have been professionally engaged, I have had to communicate, first with one clerk, then with another, and then with a third; and obstacles have been placed in my way, as in the case which I gave by way of illustration, with respect to the Post-office. I do not now wish to attribute any fault to any one. Those charges I have made, and therefore I avoid them here, but I wish to state practically the effect that when I, believing the chimney flue was under my direction, and thinking, as it had failed so many times, it was a case where I ought to enforce the application of my plan, the individual who went to put it right was stopped by another, and being stopped by another I heard nothing of it except by mere accident. There is a want of proper organization in the system of

of communication between Sir Charles Barry's office and my own.

482. Is the Committee to understand that the difficulties which you experience in properly ventilating the House of Commons arise from your ignorance, by reason of your not having seen the plans of the manner in which the channels and apertures are arranged in parts of the building over which you have no control?—It is so in part.

483. Or is it that you are ignorant of the arrangements intended to be made in parts not yet completed?—It is both; if you take a view of all the questions connected with the Committee rooms, as for instance, in the appropriation of the central tower, I have no information upon that point.

484. Your difficulties would be much removed if you had access to those plans?—Certainly; it would save to me infinite personal labour and expense, and also to others in my office.

485. *Chairman.*] You stated, in a previous answer, that you had the means of putting your system of ventilation satisfactorily into operation if certain things were carried out which have been represented. Are you to be understood in using that expression to refer to the things which you have stated in your report to the House of Commons, and the comments which you have made upon it in this Committee room?—Certainly.

486. Are there any drawings which you cannot obtain access to now which are essential to your ventilating arrangements and to your promoting the comfort of The House?—Not for the immediate comfort of the House of Commons itself, if the question refers to the space occupied within the House of Commons and the corridor.

487. The question refers to the whole space which is under your control?—I do not require drawings in respect to the space marked out to me, except those already explained and connected with the drains. I require drawings in respect to the Committee rooms and other places that may give out smoke, and in respect to approaches or flues from which bad emanations may come.

488. Will you have the kindness to make out a list of any drawings which you wish to inspect, and submit that list to the Committee?—I will take care to do so. There is one important point which I should wish to mention, and that is, that I have no proper control over the workmen, who execute various works at the House of Commons from time to time, and who have done so since the opening of The House.

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For instance, sometimes the men working in my flues will encounter others who have penetrated them from the gas flues. At one time we found the vitiated air flue connected with the fresh air flues. At other times we have found openings knocked in the wall and the flues re-arranged in connexion with the gas operations, and all this during the sitting of The Houses, without any intimation being given to me.

489. Are you aware that that portion of the House which is under your control has been given up by the architect to the Board of Works?—I have only recently heard that stated.

490. If you have any difficulty in regard to the works, are you aware that the proper authority for you to apply to for redress would be the Board of Works?—Certainly, if it is in the hands of the Board of Works.

491. Do you practically find any inconvenience from the workmen employed not obeying you?—No, not as respects those who are under my direction; but we have constantly inconvenience from others coming in and working at times which are not suitable, to the serious impediment of the ventilation.

492. Mr. *Ricardo.*] The Committee understood you to say, that you had applied to Lord Seymour, when he was at the head of the Board of Works, for certain drawings; have you received no answer whatever to that application?—I have received no written answer, but I understood that the drawings were to be given; it has been repeatedly said in reference to that point, that certain requisitions would be complied with.

493. Viscount *Palmerston.*] Your application was verbal, was not it?—My recollection is, that a written memorandum was sent in after the verbal communication; it was at a time when I was exceedingly occupied, and the exact wording of it, without referring to the document, I could not give.

494. Mr. *Ricardo.*] Have you ever had access to those drawings for which you applied, though you may not have had possession of them?—I have seen some of those drawings; I think they came from the office of the architect, and I may have portions of them shown and indicated in some of my drawings, but I have no complete series showing the beginnings and terminations of the air channels, and what leads into them.

495. *Chairman.*] Practically, do you apprehend that you will have any difficulty in obtaining such drawings as are necessary for carrying on your present operations?—Certainly;

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tainly; I have difficulties in referring to the drawings of the Committee rooms, but not in respect to that portion of the House which is included within the original boundaries. Those I have and have had all along.

496. Sir *D. Norreys.*] What do you mean by your difficulty in getting a plan: suppose, for instance, you were requested to remedy a defect in the fire-place in this room, should you have any difficulty in doing so without referring to such a plan?—Not if the fault lay simply in the fire-place; but if that flue travelled 400 feet, in one place being narrower, and in another wider, and perhaps communicating with 20 others, I should.

497. Do you suppose that Sir Charles Barry has a correct plan of the width and direction of every flue in this building?—I certainly think it would be very strange if he has not. I had them myself up to the year 1846. I should only ask for those additions which have been made to my own flues, as it were; and I know further, that drawings do exist to the number of thousands.

498. Is it to plans of that description that you wish to have access now?—Certainly. For instance, if 50 flues in the river front smoke, they fill the central hall and other places with smoke, every morning; and if I have to empty so many places of 20,000 or 30,000 cubic feet of impure air, either my report must be delayed or I must have access to the drawings of those flues which I know exist in the office, and which my assistants have seen. Permit me to explain the peculiarity of the case with respect to access to such drawings. I think if any neglect in this world entails more loss of money than another, connected with public buildings, it is this, that there is not lodged as the property of the public in an iron case a drawing of every executed work. The architect should never be asked to give all details of his own investigations, but with respect to a building which is executed and becomes public property, I say that the drawings of it also become the property of the public, and if they were always properly deposited there would be thousands of pounds saved.

499. Mr. *Hope.*] You mean that the moment the building passes into the hands of the occupier of the building, that occupier has a right to be in possession of the drawings?—More than that; I have always advocated that whenever a great portion of a public work is executed, you should secure duplicates of the drawings, one copy to be deposited in the office, and the other to remain upon the works; and those duplicate copies should be considered public property.

500. Do

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500. Do you go to the extent of saying, that before the architect hands over the building to the person on whose account it is erected the drawings should be deposited?—Most certainly; otherwise you can never check a single expense or a single alteration. Another point which I should wish to advert to is this: when Sir Charles Barry was appointed to this building, he did not receive it as an ordinary building; but Parliament and the Government had previously said, "Architects in general do not study acoustics and ventilation to the extent we desire: let us have an investigation upon the subject." The architect then comes into my confidence for nine successive years; sees everything I have at Edinburgh; sees everything I have at London; obtains the result of those years of experience, and now he says, "I will not show you the additions and alterations I have made in your own flues."

501. Sir. *D. Norreys.*] Did the Committee correctly understand you to say, in a previous part of your examination, that you had not the entire control of that air channel through which you derive your principal supply of fresh air from the Clock Tower to the House of Commons?—I do not desire to say that; practically speaking, however, it is of no value to me when it is in a bad condition. I take this view of the question, that that should be put in a good architectural condition; and, if it is so, I have nothing to say but to use it.

502. *Chairman.*] What you stated in a former answer was this, that the tower not having yet arrived at its full height, you have no information as to what will be the ulterior construction of the shaft?—That is the case; I have the former drawings, but I have not those minute drawings from the architect of the intended arrangements, which I think ought to be shown me now.

503. Sir *D. Norreys.*] The channel by which you derive your principal supply of fresh air from the Clock Tower is not in the state, in respect of staunchness, which you would consider necessary for obtaining entirely pure air?—Certainly not.

504. Have you, who are responsible for the procuring of fresh air for the House of Commons, any power to order that that channel shall be put into such a state as you think essential for that purpose?—None whatever; I have represented the necessity, but have no power to order.

505. *Chairman.*] You have represented that in your report?—I have.

506. Have

506. Have you made application to the Board of Works?—No; I spoke to Lord John Manners upon it, and asked him what course I should take; he said it was not in his control; that Lord Seymour had handed it over to The House, and that I should apply to The House. I believe that to be the general impression, that while his Lordship would give me every facility on every local subject, he does not consider himself as controlling the works in the same way as he would have done otherwise.

507. Did you not state on a former occasion that you had applied to Lord Seymour on the subject, and that Lord Seymour had himself visited the House with you; and in consequence of his finding one of those valves giving out bad air, he had at once given orders to have a portion of it blocked up?—Yes.

508. Lord Seymour you think, therefore, must have been authorized to give orders, in concurrence with your opinion, as to an improvement of the air channel?—He was; but that was previous to the resolutions of The House.

509. *Chairman.*] The House of Commons passed certain resolutions, requiring you to make certain reports; from whom did you receive an intimation of those resolutions?—I received it from Sir Denis Le Marchant.

510. When you required access to any particular place, or permission to do any particular thing, in order to assist you in making your report, to whom did you make application?—I applied to The Speaker, and he referred me to Lord John Manners.

511. Mr. *Cochrane.*] Lord John Manners has referred you back again to The House?—He does so practically; he gives me certain facilities; but as regards general questions, he considers them under the House of Commons since the resolutions were passed.

512. Sir *D. Norreys.*] Were not those resolutions communicated to you previously to Lord John Manners coming into office?—They were.

513. When Lord Seymour was in office, did you apply to him for facilities to carry out your report?—I have applied to him, but I do not remember that I have made a specific application to him since that period.

514. Was not his impression that, The House having taken the subject into its own hands, he was himself released from all responsibility?—Certainly that was his impression, and I understood Lord John Manners to state the same.

515. Mr.

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515. Mr. *Hope*.] Who represents The House in this matter?—That is what I am unable to find out.

516. Mr. *Greene*.] When you speak of the infiltration of water into some of the vaults below, are those vaults part of the air-passage into the House?—Certainly they are; they would be in use now, were they not excluded at present by a brick wall that Lord Seymour authorized.

517. *Chairman*.] Will you refer to page 10 of your report; in the last paragraph but two you say, "If authority be given to me to fit up a single room in this great building, on the model of that room which was the original cause of my being called to the House of Commons in 1835, this will do more by the example it will give of what is practicable to save unnecessary expenditure, as well as to add to the health of the Members, than any other plan that I can suggest." What makes you desirous of having such a room fitted up?—Because were a single apartment fitted up according to the principles which I have advocated, it would at once explain to every one the difficulties under which I labour, and the total impossibility of introducing my plans with the full advantages of which they are susceptible, except where I meet with cordial support; and because it would also show to Honourable Members what is the actual cost, and what is the capability of a well-ventilated room. For instance, putting aside everything but the actual fact of the case, the result will be seen from this plan of a room at Edinburgh; at my own expense I fitted up a series of rooms with a view of showing the immense importance of universal diffusion. If it be true that I was called here in consequence of what was known as to my class rooms, and the rooms I had constructed there with a view to sanitary improvement, how hard is it that I should not be allowed to show one single specimen, in a building where there are 800 rooms, of an apartment ventilated by universal diffusion; in which, for instance, I should have the most ample facility for giving any quantity of air I chose without regard to appearances. The result of this being seen, and its effects tested, The House would be better able to judge how far such a system could be economically applied, and that might be taken as a basis or guide as to the extent to which decoration should interfere with it.

518. The principles upon which you would ventilate the House have not been changed, have they?—Certainly not.

519. You are not experimenting at the present moment in your method of ventilating the House, but you are merely putting

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putting in practice principles which you have always advocated, and which you have now brought to a great degree of perfection?—Certainly.

520. Then what is the object of fitting up such a room in order merely to exhibit what was exhibited before, when you do not want to introduce any novelties into the present system of ventilation, or any change into the configuration of the House as it at present stands?—It would apply to the whole of the present Committee rooms, to every room complained of to a certain extent, and above all it would apply to the whole range of building yet to be executed.

521. It would apply to it supposing the whole to be under your direction, but it would not apply to it as matters now stand, a portion only being under your control, and a portion under that of another person?—I should submit, independently of any reference to individuals, that it would be an important point as connected with the investigation of a question which has attracted so much attention.

522. It would be important as a matter of philosophical research, but would it very much aid you in introducing and carrying out any particular change in the ventilation of the House of Commons?—Not of the House of Commons, but it might as regards many of the contiguous apartments. I can show the Committee many arrangements which are not under my control, by which the ventilation has been entirely altered since the commencement of the Session, and I believe that that has been in consequence of acting on principles which would be illustrated in the way which I suggest, and which would give to many a new view of the question, which I have not hitherto had an opportunity of carrying out.

523. Beyond giving these elucidations to particular theories, would it assist the Members of the House of Commons to any great extent in proposing any new scheme for the ventilation of the House?—No, it might not; but to take an illustration, it would entirely alter, I should imagine, the disposition of many of the arrangements of individual rooms, where you have only a very limited supply of air. Members who should then try the effect of that room, would see what it is to have an unlimited supply of air with the greatest possible diffusion, whereas I suppose now the diffusion does not attain to one-twentieth part of what is practicable, if it even approaches that point in many of the Committee rooms.

524. You would apply that more to spaces which are not under your control, than to spaces which are?—Certainly.

525. Mr. *Ricardo.*] You have stated that there is no

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insuperable obstacle to your providing a remedy for the evils which are now complained of by The House of Commons?—I know of no obstacle if authority be given to me to overcome them.

526. Are there obstacles proceeding from any Board, or from any individual, which would prevent your remedying the evils which are complained of?—I cannot say that that is the case. I am totally ignorant of how far there may be obstacles on the part of the architect, or any one else, in respect to these points. I have been accustomed to obstacles for 12 years now, and I should not expect to get rid of them at once.

527. The Committee have understood you as representing that the reason why the ventilation is so far unsuccessful in the House of Commons is, that obstacles have been thrown in your way which prevent your carrying out your plan. Do those obstacles still exist, or could you fully carry out your plans now, supposing you were to undertake them?—Those obstacles exist to a certain extent, but if I had authority to remove them, I could certainly very easily effect it.

528. What are those obstacles which now exist?—The lighting, the state of the approaches, the leakages of gas, the bad air from drains, the workmen coming in to the roof during the meeting of The House.

529. Those you assign as the causes of the evils which are complained of; is there any obstacle to the removal of those causes on the part of any individual, or of any authority in the House?—I am not aware of any obstacle on the part of any authority in the House; but whether the architect or any other person takes an interest in another view of the case I am not prepared to say, if reference is intended to the architect in the question which has been put.

530. Do you require any plans which have been refused to you?—I have complete plans of all the district which has been assigned to me; I have not plans of the other districts which convey bad air, in which there are smoky chimneys, and from which air of an objectionable quality is discharged in consequence of the materials put down.

531. Then you have not all the plans which you would require in order to remedy the evil?—I have not all the plans which are required for the approaches and the other districts. I have plans of all within the House itself, excepting the drains below, but I have not those plans which it is desirable for me to have in respect to the outer portions of the building; I refer to those beyond the lobby and beyond The Speaker's corridor.

Lunæ, 29° die Martii, 1852.

MEMBERS PRESENT.

Mr. Henry Drummond.	Lord John Manners.
Mr. Henry Fitzroy.	Mr. Greene.
Mr. Henry Hope.	Mr. Bankes.
Viscount Palmerston.	Viscount Ebrington.
Sir Denham Norreys.	Mr. Deedes.

LORD ROBERT GROSVENOR IN THE CHAIR.

Sir *Augustus W. Clifford*, Bart.; Examined.

Sir *A. W. Clifford*, Bart.

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532. *Chairman.*] YOU are the Usher of the Black Rod?—I am.

533. You have been good enough to attend to-day at the request of the Chairman of this Committee?—I have.

534. The duties of your office naturally compel your attendance in the House of Lords almost constantly during the time of its sitting?—They do.

535. I believe their Lordships have had possession of their House for four or five years?—Since 1847.

536. During that time have you frequently observed what the state of the ventilation of the House has been?—In general I think it very satisfactory. I have heard complaints from different Peers now and then of blasts coming in from different parts, but as a whole, I should say the ventilation is very equal and very agreeable.

537. Was it so at the very commencement of your sittings there, or has it altered since?—I think it was so at the beginning.

538. You do not think much alteration has taken place since that time?—I do not.

539. It was nearly as good when you first took possession of the House as it is now?—I do not think there is much difference. The chief complaint has been of draughts from the Reporters' Galleries, when the doors were opened by people coming in; sometimes there were great draughts also between the Throne and the wainscoting, but doors have been now fixed which have removed the objection.

540. There were complaints, and since that time means have been taken to obviate them?—Yes.

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541. Do you recollect whether complaints were made both of inequality of temperature and of draughts, or was it felt that the House was sometimes too cold?—The complaint was simply of draughts; the general temperature varies very little, I think. It is usually 63 degrees or 64 degrees.

542. The principal complaint was of currents of air?—Yes; even this Session I have heard Peers complain of them.

543. Have you ever suffered from bad smells?—No, I do not recollect doing so on any occasion.

544. You have not had a single complaint of that nature?—Not one. We have two engineers and two ventilators who attend to the ventilation. I desired them to be in attendance in case the Committee wished to ask them any questions.

545. When any complaint is made of the ventilation, that complaint is made to you, is not it?—Either to me or to Mr. Pulman; one of us is always there.

546. Are the servants under your direction and control?—They are.

547. By whom were they originally appointed?—They were selected by Sir Charles Barry, but their appointment is from me.

548. Mr. *Drummond.*] The draughts which you have spoken of as having been matters of complaint, came, you say, from the corridor?—From the gallery chiefly; when the doors were opened to admit reporters or strangers, very great draughts came in.

549. Subsequently doors, you say, have been put up?—Not so much there; there were partitions made between the Throne and the wainscot at the end of the House of Lords.

550. Before those doors were put up, the draughts were very disagreeable?—Yes.

551. After they were put up the complaints ceased?—Yes.

552. Mr. *Fitzroy.*] There are no side entrances in that part of the House of Lords where the Peers sit, are there?—The two first doors opposite the Throne are now closed. The access is now from what was the Robing Room, the room at the back. There are side doors at each end. There are two doors on each side at the upper end, and two at the lower end, besides the approach from the House of Commons. Those at the upper end are closed; those at the lower end are open at all times. The temperature of the Robing Room, I should say, is very comfortable at all times.

553. *Chairman.*] There are two doors from the Robing Room,

Room, and two doors at the House of Commons end, one into each corridor?—Yes, there is one at each side, besides the approach to the lobby.

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554. Mr. *Bankes.*] There has been an alteration, has there not, in the gallery appropriated to the House of Commons, on the right hand side?—There is a temporary staircase there.

555. Probably your attention has not been called to that particular part of the House?—No, I have not heard any complaints with respect to it.

556. Mr. *Fitzroy.*] There is some considerable distance, is there not, between the doors which open at the lower end into the gallery and the body of the House of Lords?—Twenty or 30 feet perhaps.

Mr. *Herman Mulhenkamp*, called in; and Examined.

Mr. *Herman Mulhenkamp.*

557. *Chairman.*] YOU are employed in a portion of the House of Lords, are you not?—In the Reporters' Gallery.

558. How long have you been there?—I have been there since the Peers first began to sit in the present House.

559. Have you always been in the same position?—Yes.

560. Have you ever heard complaints of the ventilation there?—Very seldom indeed; the gallery feels very comfortable.

561. Have you heard any complaints at all?—I heard some complaints in the autumn of last year, but they were very trifling; it was altered.

562. What was the complaint?—There was a little draught in the gallery, but very trifling.

563. Was the ventilation as good when the Lords first commenced their sitting in their present House, as it is now?—It feels much pleasanter now than it did at the commencement.

564. What were the complaints which were made at first?—Not any particular complaints; they said they felt a little draught.

565. Mr. *Bankes.*] The Reporters' Gallery was brought a great deal more forward, was it not?—Yes.

566. And since that time the draughts have not been felt?—No.

David Boswell Reid, M.D., called in; and Examined.

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567. *Chairman.*] IN the first paragraph of your report you state you have been refused access by the architect of the new

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Houses of Parliament to drawings of works connected with different parts of the House of Commons that were taken out of your hands six years ago, and that without such access it is impossible for you to obtain all the information requisite. In asking for those plans, was it for the purpose of reporting upon that portion of the House which is under your especial control, or for the purpose of reporting upon that which is not under your control?—Both upon the one and the other, so far as they affect the health and comfort of the Members.

568. It appears that the order of the House requesting this report from you was dated the 11th of February?—It was.

569. The application which was made to Sir Charles Barry is dated the 10th of March, which is a month afterwards; how came so long an interval to elapse before any application was made to the architect?—Because I had full employment in my attendance at the House, in pointing out the danger of the chandeliers, which has been taken away, by the report of the engineers, and because I was not aware till then that I should have a real difficulty in obtaining access to drawings, which my assistant had seen every day almost, in Sir Charles Barry's office, when it was his duty to go there.

570. What period are you speaking of?—I am speaking of the period between the date of the resolution, and the date of the letter to which your Lordship refers. The question of lighting also was one of great magnitude, and I devoted the utmost attention to that subject, being often in my engagements connected with it, and connected with the keeping away of bad smells, from the leakage of gas and from the drains as much as possible, twenty-two hours in the House without leaving it. Permit me to add, that I considered the great and pressing evil to refer to the House itself, and I had full and complete drawings of every department connected with the walls of the House, and until I could satisfy myself as to what I should say with respect to the lighting, it was unnecessary for me to travel beyond that limit.

571. The plans which you wanted from the architect referred more to the libraries, committee-rooms, refreshment-rooms, smoking-rooms, and cloisters, than to that portion which is more immediately under your control?—They did, but particularly to all approaches affecting the quality of the air in the House, and to the Central Tower.

572. Is not it the case that for some time after you received that order, you rather doubted whether the order applied merely to that portion which was under your control, or whether it applied to those rooms which were enumerated in

in the last question?—I cannot say that I doubted much myself; but I heard very various interpretations given by different Members; I looked upon it in this light, that if the House had desired that my investigation should be restricted to the space within the walls and the corridors of the House, it would not have been expressed in the general terms which the Resolution embodies, "the health and comfort of the House;" therefore, taking everything into consideration, interpreted it as referring to the health and comfort of the Members who used any part of the House, and that the library, passages, kitchens, corridors, and adjuncts were as much part of this great building, the House of Commons, as any entrance, library, parlour, passage or kitchen is part of a private house.

573. The Committee are to understand that you applied for those plans quite as much for the purpose of that portion of the House which is under your own superintendence as that which is not under your own superintendence?—It would be difficult to say that I applied for them precisely as much with the one view as the other, but certainly I did to a great extent for both; for if the Committee will take the fact that the central hall and the whole of the corridors of the committee-rooms above have been repeatedly filled with smoke, it will be obvious that, unless the smoke of those corridors be controlled, and also the discharge of vitiated air from lamps which are not ventilated, it will be impossible for me at times to prevent such air entering the House when the currents without are stronger than the plenum impulse within.

574. You state that your attendant repeatedly saw the plans in question at the office of the architect?—Certainly; they were the subject of continual communication and reference.

575. Subsequently to the order of the House being given to you?—I could not exactly say that; but my assistant has been in the habit of mentioning that to me.

576. The question refers to the time subsequent to your receiving the order, and previous to your giving the report?—I could not specify, without inquiring from my assistant, whether he has seen those plans in the office since the resolution of the House was made; but this I know, that I asked him only to-day on the subject, and his statement was, that he has constantly been in the habit of seeing those drawings; and lately when he was in the office Mr. Gurney was looking at some of the drawings on the table, to which, if I understand rightly, I am refused access.

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577. My object in asking you that question was to ascertain whether he afterwards saw those plans in reference to the report which you were about to make to The House?—No, he did not; he saw them when he was there upon general business.

578. Your reason for having allowed a month to elapse before you made any formal application for those plans, was that you were engaged upon some other more important business?—No other business than that, which was the first portion of the business demanding attention.

579. Some other business more important in connexion with the report?—Yes; the interior of the House itself was my first object of attention; and having the drawings connected with that, it did not occur to me to make application for the others before I wanted them.

The Committee having proceeded to inspect the arrangements and machinery for ventilating the House, the examination of Dr. Reid was resumed.

580. *Chairman.*] The Committee having inspected the whole of the apparatus and channels by which you obtain air for the supply of the House, is it in point of fact merely putting in operation the same system upon which you ventilated the old House of Commons, or has there any material change taken place since that time which you would desire to mention to the Committee?—There are several material changes, which I have reason to believe may be put into operation in the present House, as compared with the old House. In the first place, in the old House I was tied down to the use of a certain system of lighting, namely, by wax lights; the lighting introduced subsequently was never accompanied by any power of recasting the ventilating apparatus, so as to show what might have been done with an improved upward, mixed, or downward current. There was an estimate some ten or twelve years ago requested from me as to the cost of a downward current; but with the exception of one occasion, that was never tried in the House of Commons, nor were any works executed to put the system on a complete footing which would have given such a downward current. In the new House arrangements were proposed and authorized, in 1841 and 1842, for the introduction of a plenum movement; no plenum movement was ever introduced into the old House under the circumstances in which the experiment was made.

581. What do you mean exactly by a plenum movement?—A plenum

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—A plenum movement is one by which the air is forced in, so as to have a greater density within the House than in the surrounding passages; hence when a door opens, the air leaks outwards when the plenum movement is in operation; under ordinary circumstances, when the House is ventilated by a shaft, it leaks inwards.

582. The Committee understand you to say that for the purpose of putting your plan into perfect operation, you desire to have the power of introducing both a downward and an upward movement?—Certainly, at various times.

583. At present you are prevented doing that by the state of the lighting of the House?—And the leakage from the gas. I ought also to state that though I am quite ready, with the assistance of manual labour, to put the apparatus into full operation, yet there are many of the arrangements and details which are not completed, and there are many places where the temporary arrangements at present in force will be superseded.

584. Do you consider the present state of the lighting an absolute impediment to your putting in operation the downward movement?—Certainly, with the heat of the present lamps in the House. I had only an opportunity of seeing the lamps in operation once, and that but for a limited time, previously to the opening of the House. The lamps out of the House are, I believe, not thoroughly completed at this moment. At all events, there were no less than 24 which had to be put out on Friday, black smoke having been deposited, more or less, on each.

585. About what length of time do you imagine must elapse, supposing due diligence be used, before your system can be put into full operation, with the means which you now possess?—It will entirely depend upon the facilities which are given in the architectural department. If complete facilities are given in that department, and no misunderstanding between the clerks in the one place and in the other takes place, I should say in a very few weeks I could have it entirely in operation.

586. What do you mean by "complete facilities"?—I mean an arrangement such as the Commons' Committee reported in 1846, when on seeing the state of matters and the unwillingness of Mr. Barry to meet me face to face, which he has never done till he has been brought here on this occasion, there was a professional gentleman recommended to be appointed, in whom I could have confidence, and with whom I could

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could consult and act upon any point that it might be important to me to press forward.

587. Are the Committee to understand that much communication with regard to architectural arrangements and decoration is still necessary?—I can only state that though I do not consider it absolutely necessary, yet during the last three months flues which I have arranged and prepared with the utmost care for the House and passages, which I have considered completed, have been pulled up and torn to pieces for the introduction of gas pipes, electric telegraph wires, plumbers' apparatus; and in short, the Committee could not have any conception of the crowds of people who have been undoing what I have finished at different places, unless they had actually seen them. Can it be considered fair and proper for any person to touch my channels without communicating with me, or without giving notice that that which has been in operation many years is about to be done away with? I very often do not find out what alteration has been made till it is noticed by my clerks on the works: that I am prepared to point out as a cause of great injury to the ventilation and of great delay.

588. You speak of plumbers' apparatus, and of the presence of workmen; those are probably merely temporary?—No; I presume they are for permanent work. If plumbers are fitting up some lead pipes, and gas-fitters others, and the electric telegraph people others, and they come and knock into my channels without saying a word to me, and if workmen from my department, working in my channels, find other people mining into those channels, and occasionally the two meeting together, which is an absolute statement of what has taken place, I feel that I have not a moment's certainty that my operations will not be interfered with.

589. You put your answer in a hypothetical form; you say if such and such a thing takes place. Do you mean to say that it does take place at the present moment?—I mean to say that it has taken place till within the last few days.

590. Has it taken place in such a manner as seriously to interfere with your operations?—Most certainly. We have found the fresh air flues connected with the vitiated air flues. We have found places in the corridor where walls, which should have been bricked up, have been knocked down, and not repaired. There may, no doubt, have been an intention to repair them. Many things have always to be done in a large building like this, that are not completed at once.

591. Has anything been done already which absolutely interferes

interferes with your operations?—Nothing has been done that cannot be put right, or remedied; but, as in the case of the door in the roof, which I pointed out to the Committee, what security is there for the proper regulation of my currents through the House, when the external atmosphere can flow through a door which is constantly left open?

592. Is the lighting now entirely under your orders?—It has been put under my direction, but I never asked to have the lighting of those lamps put under my direction, though I have patiently attended to them in the best manner I could since they have been put under my direction. Till Friday night I have always endeavoured to give every possible facility for the lamps in the corridor being perfected; but when, after repeated intimations, I find leakages of gas everywhere, and the glasses of 24 lamps blackened at one time to a greater or less extent, as I pointed out to Lord Seymour and Lord John Manners, and other Members, I have given instructions that those corridor lamps be not lighted for the future, until I shall be able to see that there can be some guarantee that there shall be no leakage of gas, and no blackening of chimneys, such as was observed on Friday night. The lamps, no doubt, sometimes are blackened in consequence of an excess of gas, there being a deficiency of air to ensure its combustion. When an excess of gas occurs, from whatever cause it may have arisen, then that charcoal which cannot get oxygen to consume it is deposited upon the glass. On Friday night some were blackened throughout, others partially.

593. Sir *D. Norreys.*] Is that the fault of the gas-fitter, or of the arrangements of the lamp itself?—It may at times be dependant upon the carelessness of the attendants. It may be dependant upon the impossibility of getting sufficient light in those lamps without pushing the supply of gas too far, so that in giving a sufficiency of light they may approach too near the boundary of the consuming power.

594. Is the defect one which can easily be remedied?—I cannot say that it can be easily remedied, in connexion with the supply of a sufficiency of light. There is no doubt a greater power of draught could be put on, but whether the burners will admit of the amount of gas being consumed which is requisite to give a sufficient illumination, may be another question.

595. *Chairman.*] The Committee understand your objection to the present lamps to be, that the tubes, under any circumstances, will become so hot as to interfere materially with the ventilation

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ventilation of the House?—That is the case in the House. In the corridors the objection is less, but in summer it will prove very inconvenient.

596. Sir *D. Norreys.*] You have stated, that by your system of ventilation you are able to produce an upward current and a downward current; could you so manage that ventilation that there should be a certain stratum of pure air extending to a given depth below the ceiling, which should by its own gravity continually descend and mix with the lower and warmer stratum of air, thereby continually reviving it by its coolness, yet without draught?—I could do that in a house constructed for the purpose.

597. In the present House of Commons, as it is constructed, could you effect that?—With so much difficulty to the whole House, that I should not recommend it to be attempted; but I would constantly do it in particular states of the atmosphere and particular states of the attendance at the House, so far as to have a supply below for the Members, while I would retain a sufficient supply for the galleries from the ceiling. Thus we should have a certain amount of air descending from the ceiling and supplying the galleries, while with our instrument below we give that which would be sufficient for the body of the House.

598. You could so manage the state of the atmosphere in the House, that there should be a plenum, as you have termed it; that is to say, that the air should flow out from the House through the doors of the galleries above, and should flow from the lobbies into the House below?—That might be managed, but it would be very difficult to prevent any plenum movement given in the House above not also acting on the House below. It is, however, a curious fact, that in innumerable cases we have a plenum in the upper gallery when there is a vacuum below in the body of the House; but when I have the power of giving a plenum both above and below, then I can secure with much less current inside among the Members a plenum everywhere. At present, the extent to which external currents, entering by doors or windows, interfere with the movements dependant solely on the ventilating apparatus, are the principal cause of the apparently anomalous movements under consideration.

599. Do not you propose to throw light into the House by the removal of the painted glass, by placing lights behind, and reflecting that light into the House?—I do.

600. Do you consider that a plain flat reflector would have the power to project a sufficient body of light into the House

to

to be effective across the House, or must not a curved form be given to the reflector which would be used?—I do consider that it would be possible; at the same time it would greatly facilitate the arrangements to have a certain additional power from the ceiling.

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601. Have you ever carried into practical operation your present proposition of lighting a large room by reflected light?—I have repeatedly done it by experiments on a small scale, and to a certain extent in the House, but I have never had an opportunity of doing it completely in a large room such as the House of Commons, where the light was not seen.

602. Can you give the Committee any idea of the proportion of light which would be required, taking a system of reflected light and of direct light, taking into consideration the size of the room you are about to illuminate?—I find a difficulty in answering that question, unless I am allowed glass of the finest possible character; with certain thin glass for the interior glazing of the windows, I consider I have produced that effect, with about double the quantity of light, when the burner was not seen; where you allow the light to be seen a less quantity may suffice.

603. Do you wish the Committee to infer that simply doubling the amount of light would be sufficient to illuminate a room from a flat reflecting surface as would be required if the light were to operate directly?—Not exactly so; I could only determine the precise quantity by experiments.

604. Have you not tried the experiment?—I have not tried it in every possible detail; but I find that the thickness of the glass through which the light permeates is a very important element in the consideration of the question.

605. In order to obtain an amount of illumination from a reflected surface equal to that obtained by a direct radiation from a single point, would not it be necessary that there should be such an amount of light on that reflected surface, that the reflected surface itself would become nearly as painful to the eye as a single point of light?—I cannot imagine that to be the case, because we all know that when we look at a visible light the glare is sometimes extremely painful, whereas if you look at a surface illuminated by a light much more powerful, but which may present a thousand times larger surface perhaps, you may have an equal body of light without pain to the eye; the intensity being less though the absolute quantity may be greater. It is exactly the same as you find to be the case with respect to water. I may put my hand

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hand into boiling water and be scalded. If I have only a pound of boiling water, I have much less heat in that pound of boiling water than I would have in ten pounds of warm water at a lower temperature, into which, however, I might put my hand without injury.

606. Viscount *Palmerston.*] If you had a downward draught for the purpose of ventilating the House, you would get rid of the inconvenience which is now produced by the dust which rises from the floor, would not you?—I should, so far as that is a source of inconvenience.

607. That inconvenience would be remedied?—It would.

608. On the other hand, you would draw down to the level of the Members, the bad air which they have breathed, and which at present rises by its temporary warmth?—Certainly.

609. How would you avoid that inconvenience if you had recourse to a downward current?—By a mixed movement, which is one of the peculiarities in the present House; we have a part of the floor, and I think I can point to many portions besides the large central part, which I more particularly refer to, from which practically no dust can escape. The texture may be made so open, that in fact the chamber below may be the true floor, not that which the Members walk upon. Supposing so much air to be ascending there, while at the same time there is a descent at a certain portion of the ceiling where it is least objectionable, a continual ascent being maintained at the four great angles of the ceiling by a fixed power, I could have in this manner a greater surface of diffusion than in almost any other way; and I should then attain practically the greatest possible movement, with a complete discharge of air; the breath always going upwards to the places from which it might be taken off, and the air coming in, where it ascends through the floor, being limited to places selected on account of there being there no objection from the dust. In the old House, before I had anything to do with it, the surface of the floor was continually covered with dust; there were no arrangements for cleaning the Members' boots. Here a very complete arrangement has been carried out, which may be still further extended, and were arrangements made so that no Member should touch with his boot certain portions of the floor opposite the table, except perhaps on state or public occasions; we could then introduce air very largely, with the least possible introduction of dust, if indeed any dust should enter there at all.

610. Mr. *Fitzroy.*] Is the Committee to understaud that the

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the only existing obstacle to your introduction of the downward current is the state of the lamps in the House?—It is; we have used the downward current once or twice to a limited extent; but we were instantly obliged to shut it up from the intensity of the temperature above the lamps.

611. How long do you imagine it would take to arrange the system of lighting the House in the manner you propose?—I do not think I could complete it from outside under the time mentioned, probably about five weeks altogether; we could begin at once, and execute the works in a fortnight, if we had two or three weeks' previous preparation; but it would be quite easy to carry the work on during the sitting of the House.

612. Supposing the system of lighting to be so altered as to enable you to introduce the downward current, do you think that you should very much improve the ventilation of the House by doing so?—Certainly; a limited amount of that downward current would be invaluable.

613. Brought as low as the body of the House, or only to the galleries?—It would be principally brought to the galleries, but part would at times extend below.

614. Mr. *Greene*.] Do you mean that the current of foul air would be in the centre of the ceiling, the additional fresh air being introduced at the sides?—That would be the case; at present the entire ceiling is divided into several great compartments, all of which are accessible by different doors. Some of those compartments could be connected with the shaft; those connected with the shaft would draw out the vitiated air, and they would always draw out the hottest and most vitiated.

615. Mr. *Fitzroy*.] Would the plan of lighting which you propose at the ceiling present any difficulties to the transmission of the downward current?—Certainly, in that particular spot it would. The fresh supply of air must then be taken on either side of the central panels; it would not be impracticable, however, to have the descending current in the centre, even though the products of combustion ascended from the lights; by special arrangements that mode could be adopted.

616. Your proposal is to diffuse light all over the ceiling?—Over the central portion of the ceiling, and along the outside of the windows.

617. *Chairman*.] Do you propose the substitution of glass in some shape for the present panels?—Not of glass, unless I were compelled to adopt it.

618. What

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618. What would you propose to substitute?—Plaster-work, which might be tinted to any extent.

619. How would the light pass through the plaster-work?—It would not pass through it, but from it. Supposing this sheet of paper, which I am holding in a horizontal position, to be the panel of the ceiling, the burner would be beneath it, and if below that there were a plaster ornament such as I should recommend, you would not see the burner, but only so much of the light as was permitted to pass through, and which would be reflected from the panel above.

620. Mr. *Fitzroy*.] Is it not the fact that the present state of the lamps in the House affords the only obstacle to carrying out your complete system of ventilation?—No; not the only obstacle to a complete system of ventilation. It is the great obstacle to the partial use of a descending current from the ceiling.

621. Supposing that obstacle were done away with, and you were enabled to use this descending current, your system of ventilation would be complete?—No; there are many other arrangements which it would be necessary to bring into operation; as, for instance, the cleaning of the vaults below.

622. Are there any others besides those which you have already mentioned to the Committee?—No; there may be many little details connected with them. The angles of the corridors, the basins and urinals, have scarcely been completed yet, and there would be the proper adjustment of all the valves and the discharges to be seen to. The House with its numerous doors and corridors is like an enormous pneumatic instrument. Some doors have not actually been completed so as to give me an opportunity of trying this instrument in proper action, in order to adjust the valves.

623. Sir *D. Norreys*.] Are the Committee to understand, in reference to the light which is to be produced at the ceiling, that it is to be entirely a reflected light?—As nearly as practicable.

624. Do you mean as nearly as consistent with the not producing a strong shadow from the light itself?—Certainly; but I would add more than that; I desire as much as possible to have only a reflected light.

625. Then you would conceal the light itself, as far as possible, by some ornament below?—Yes, but it might so happen that in the working out of the details of that ornament, some small portion of the light, perhaps of the size of a candle or otherwise, might be conveniently and advantageously introduced.

626. In

626. In order to avoid the shadow?—In order to avoid the shadow, and also to give a larger body of light there; therefore if I reduced the visible light, either altogether or to such a degree that it became totally unobjectionable, I should then attain the desired object. *D. B. Reid*, M. D. 29 March 1852.

627. But still the same body of heat which you complain of in the present system of lighting, would exist near the ceiling in your proposed plan, and would to that extent interfere with your ventilation, would not it?—I believe I have the power, by means of the materials used, of diminishing the intensity of the heat there; the amount of heat would be far less than in the case with the lamps used at present, because we would have so much at the sides, and also a better quality of gas.

628. Would not you in order to get a reflected light of sufficient intensity to illumine every part of the House, be obliged to use very large burners, and to have at least one if not two, under every division of the panels in the present ceiling?—I should certainly be obliged to use burners that would give a considerable power of lighting.

629. Would not you be obliged to multiply your burners to an almost indefinite extent, in order to be able to obtain from a reflected surface the same amount of light as you now obtain drectly from the gas-lamps?—Not to an indefinite extent; because if I have burners which are not visible from below, or which are nearly invisible from below, and if the heat from them does not emanate from a focal point in its passage to the House, but is diffused over a broad surface, the intense effect which it produces upon the brow at any given place will be proportionately reduced.

630. The radiation will be less, but still must not a greater body of fire exist near the ceiling to disturb your ventilation than exists at the present time?—I do not consider that that will be the case, because those lamps will be all placed either on the line of the ceiling or near it, so that the intensity of the heat from them will be at once removed.

631. *Chairman.*] Will those lights which you are now speaking of be managed by persons outside the House, or must people come inside the House for the purpose?—Entirely outside the House, beyond the visible window, or above the House, beyond the visible panel.

632. Sir *D. Norreys.*] Would there be any possibility of your obtaining precise information within a short time as to what proportion of light would be obtained for the purpose of illumination from a single point by direct action, as compared

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pared with the amount of reflected light which would be obtained from the plastered surface which you speak of?—Yes, certainly. Such an experiment, however, must be tried in relation to the House, in order to tell accurately upon the House, where the colours of oak, and green, and black so much predominate. We require an amount of illumination far beyond what would be required in a mere experimental apartment.

633. *Chairman.*] Do you propose that the ornament you speak of shall prevent the light being seen from the Members' Gallery, or the Strangers' Gallery?—I propose to have it entirely invisible, if I can get such a light. I have lighted a public building temporarily where the light itself was invisible, and where you only saw the soft mild whiteness of an illuminated plaster surface.

634. What building do you refer to?—I refer to a court at Liverpool. I have not, however, had an opportunity of permanently carrying it out.

635. Mr. *Fitzroy.*] Do you propose to remove the whole of the present ceiling of the House?—I propose to touch none of the rib-work, but only the flat panels of the ceiling, and that only in the central portion of the ceiling.

636. You say you do not propose to replace them with panels of glass?—No; with panels of plastered work, that would be tinted to any pattern, so as to represent oak, with ornaments, the rose being in the centre as at present, or anything else that might be considered desirable.

637. Do you imagine that that would produce any effect upon the facility of hearing in the House?—I consider that it would have a slight effect upon the hearing.

638. Beneficial, or the reverse?—It would take away a certain amount of reflecting power from the ceiling. I consider it would improve the hearing so far as it tended to diminish the echo, but that it would take away to a certain extent from the strength of the sound.

639. *Chairman.*] Are the Committee to understand that that system of lighting the courts at Liverpool, to which you referred, has been continued or not?—It was only an experimental illustration.

640. The Committee are to understand that it has not been continued?—I never tried any system further than to show to the committee there the effect of certain arrangements which I suggested.

641. Were those arrangements approved of?—There has been no permanent lighting apparatus fitted up at present; they

they are only temporarily lighted now, so that whether it may be approved of finally I cannot say.

642. Is there any addition which you desire to make to any part of the statement which you have already given to the Committee?—I was asked a question relating to the differences between the present House of Commons and the old House of Commons. I had proceeded so far as to mention that a plenum movement had been contemplated in the new Houses of Parliament since 1841 and 1842. The means of it exist and it would introduce a very great peculiarity. Secondly, the experience I have had in the last House, has enabled me to see that if certain arrangements as to lighting were carried into effect, I could bring in on some occasions with advantage, a complete descending movement from the ceiling, the discharge being entirely from the floor. On other occasions I could introduce a mixed movement, the conditions of the House being so exceedingly variable in respect to the numbers attending it, and the numbers generally present being so very great compared with the attendance in the House of Peers. In the fourth place, a minute examination of the subject has enabled me to see that I can obtain the advantages of an upward movement to carry off the products of respiration, combined with a certain small amount of descent at those places which are most touched by the boots and shoes, diminishing to the greatest possible degree every chance even of the ingress of dust from any objectionable source. Fifthly, there are arrangements made to a greater extent than were introduced in the last House, for the convenience of certain individuals. If you have a Minister desiring to give an important speech that all the country may be looking for, he may have now the same amount of convenience that was only allowed to the Speaker and to the Serjeant-at-Arms in the old House. Sixthly, the lobbies are placed in such a position that there can be a plenum movement diffused in all the lobbies and corridors surrounding the House, provided the extreme force of the external winds be cut off. There are many minor details which I might mention, but I do not know that it is necessary to trouble the Committee with them. There is only one point which I should wish to add, that there being scarcely a meeting of the House at which there are not some Honourable Members who would like the temperature of the House to be at 55 degrees, and others at 70 or 72 degrees, there have been certain arrangements made in this House which were never contemplated in the other, for giving in

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some of the contiguous chambers different temperatures, so that any Honourable Member may retire there for a short time, and enjoy either a cooler or a warmer atmosphere.

643. You stated during our walk round the premises that you are very often embarrassed in your operations by the ingress of smoke, for instance, from parts of the House which are not under your control, and draughts and smells prevail, against which you can make no effectual provision?—It is so.

644. Mr. *Drummond.*] You were asked with reference to your system of lighting, whether it would make any difference in the power of hearing in the House, which is at present very bad; is there any analogy between the laws which regulate the transmission of sound and the reflection of light?—I believe there are differences, but there is a certain similarity too; for instance, we can throw sound into a focus, and we can disperse it.

645. You cannot tell whether the proposed system of lighting would increase or diminish the present power of hearing distinctly in the House?—No; my impression is, that the change in the panels alone will make very little difference, on these grounds, that the sound continues long in the House, and that from the quantity of wood brought down laterally, if I took away a certain amount of wood, which gives a reflecting power, I should also take away the prolonged reverberation from that part of the wood which is most distant, where the echo or reflection comes latest upon the ear of the speaker.

646. No experiments in another building could be considered as affording an example with respect to the House itself, unless it were so coloured as to absorb as much light as the House does?—Certainly not; but it would be very easy to colour it.

647. So that in any chamber which was fitted up for the purpose of trying this experiment, it would be necessary to colour it as deeply as the House is coloured?—Yes.

648. Sir *D. Norreys.*] The room in which we now are is one which there would be more than ordinary difficulty in lighting. Suppose by two or three lamps placed at the south end of the room, I could by direct light read a print of a certain size at its northern end, and you were to try what number of lamps would be required to enable me to read the same sized print at the same spot simply by reflection, would not that be a fair test of the different amount of light which would be required in the way of direct action and of reflection?—

tion?—It would, generally speaking, be a fair test; by means of the shadows, perhaps a nearer approximation could be obtained.

649. Is there any means by which the experiment could be more easily tried than in that way?—No; the experiment would be of the same nature as that which I have described.

650. Your impression is that not more than twice the amount of light would be required to produce the same illuminating effect, by reflection, as would be required where the action of the light is direct. Allow me to ask you whether you do not think it would require ten times as much light in the one case as in the other?—What I state is this, that under certain conditions, twice the amount of light may be required. I should be sorry to tie myself to that amount as respects the House of Commons, unless under specified conditions.

651. Before you recommend the House to adopt any system of this kind, which you say you yourself have not practically carried into effect, would not it be right for you to try some experiments, and to report upon them to some future meeting of the Committee?—I have tried the experiment again and again as to the general fact. With respect to whether I should use one or two gas lights more or less, that is the only point on which there is any difficulty.

652. That is to say, your difficulty is whether you would require more or less light?—Yes; whether I shall require to have three instead of two gas lights in the chamber outside. That would be the only practical point.

653. Mr. *Greene.*] The side lights are to be entirely shut off from all communication with the House?—Yes, entirely.

654. Those in the ceiling will be in perfect communication with the House?—There would be the draught to interfere. The ventilating power would entirely prevent all return of the products.

655. They would not interfere with your downward current?—No; because there is a superior power placed upon such lamps.

656. Mr. *Fitzroy.*] The nature of your proposed system would not permit of an experiment on a small scale in the House of Commons, would it?—I do not consider that those experiments on a small scale are satisfactorily interpreted, except under peculiar circumstances, and by those who give much time to the subject.

657. You would require in fact to have the whole number of panels removed from the ceiling which you wanted eventually to remove before you could ascertain the effect of the

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proposal?—Not before I could ascertain the effect, because for seven successive years I had an apparatus fixed in the ceiling of the House of Commons which produced a similar effect, and was shown to Commissioners and persons connected with Parliament, and to bodies of people from all parts of the country, as well as to numerous Members. Therefore I have had seven years' experience as to what the effect is.

658. Were the circumstances of the former House the same with respect to lighting? Was the colour of the last House the colour of the present one?—Generally. In the present House there is a green carpet instead of a brown one. That will make a difference, and so will the different form of the House; but so far as the experiment could be tried in the old House, it was shown there, being placed there after certain resolutions passed by the Commissioners, authorized by the Commissioners of the Treasury in 1844.

659. Sir *D. Norreys.*] The experiment to which you have referred of placing a light on the line of the ceiling in the former House, was by direct action through the glass, and not by reflection; therefore the instance you refer to would not be a sufficient guide to the Committee?—There was no glass used in the experiment now referred to.

660. Still it was by direct action that the light illuminated the House?—The Honourable Member is referring to a different series of experiments to those which I am mentioning.

661. In a previous part of your evidence you said you had tried the experiment of giving light from the ceiling in the old House of Commons; that you were not aware yourself of the effect it produced, inasmuch as you were at Edinburgh, but you believed it was good; was not that an instance of direct action by a series of jets above the glass of the ceiling, illuminating the House by direct action, and not by reflection?—The Honourable Member is referring to two different series of experiments; the series of experiments in which the light came through the glass were commenced in the winter of the year 1837, and I only had 24 hours to arrange them; but if the first series of experiments are referred to which I mentioned, it will be seen that the arrangements for them were made in the House of Commons subsequently to the letter from the Treasury in 1844; they have never been shown to the House during its sitting, though they had been shown again and again to Commissioners and Members. In this latter series there was no glass used.

662. Mr.

662. Mr. *Fitzroy.*] There would be no means of temporarily adopting your process of lighting from the ceiling, so as to make the experiment, would there?—Certainly; it would be quite easy to take out the panels in the present ceiling, and preserve them, and then introduce the other arrangement. We touch none of the fixed ribs or structures, except so far as it may be necessary to unscrew a portion to remove the panels.

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663. *Chairman.*] Do you mean the side lights to be visible?—I should prefer their not being visible, but I think a certain lateral view of them to a limited extent would economise the heat and light, and might not be objectionable.

Martis, 30° die Martii, 1852.

MEMBERS PRESENT.

Mr. Fitzroy.	Mr. Deedes.
Mr. Greene.	Mr. Drummond.
Mr. Locke.	Mr. Bankes.
Mr. Stephenson.	Sir Denham Norreys.
Viscount Ebrington.	Mr. Hope.

LORD ROBERT GROSVENOR IN THE CHAIR.

The Lord *Redesdale,* attending by permission of the House of Lords, Examined.

664. *Chairman.*] YOUR Lordship attends here to-day in consequence of a request which has been made to you by the House of Commons?—Yes.

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665. Your Lordship is Chairman of Committees in the House of Lords?—I am.

666. And your duties lead you to attend the House almost constantly?—Yes; I have attended Parliament almost constantly, during a great many years, in all the Houses in which Parliament has sat during that time.

667. I believe you have been in possession of the present House about five years, have you not?—Yes.

668. During that time has it occurred to you that the ventilation has been good or bad?—I think the ventilation has varied

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varied a good deal. It was very bad at first, but it is improved now.

669. Were the complaints that were made at first from the alteration of temperature, or from currents, or from both?—From both; I think, to a certain degree, the complaint still continues. My own opinion is, with respect to the ventilation of the House, that it is too artificial. It is entirely carried on by the injection of cold air or heated air according as complaints may be made, or as the thermometer may show what the temperature is. Whenever that is done there is an unpleasant change in the temperature of the House, particularly to those who are near where the air is admitted.

670. Your Lordship is of opinion generally that when those changes are made they are sensible to the Peers who may be sitting there?—Very sensible to them; I am not so sensible as others are, but many feel it very much.

671. You have heard complaints, have you?—Yes, even latterly; I was not in the House when the Queen opened Parliament this Session, but I came down to the House at about four o'clock, just as the people were coming out, and the House then was in a very heated state, and in a very offensive state; it was so unpleasant that I called the attention of the persons who had charge of the ventilation of the House to it, and desired that they would take immediate steps to purify it before the Peers came down; to any person coming fresh into it, it was exceedingly unpleasant; they did put fresh air in, and it was very much improved by the time the House met at five o'clock. I mention that to show that either from the numbers who attended, or from the insufficiency of the means to keep up a proper temperature, if the House is exceedingly crowded, it had got into a state which was particularly disagreeable.

672. Have you suffered at all from bad smells, or only from changes of temperature?—I am not aware of any bad smells. The same complaint with regard to the manner in which the House was ventilated alternately with cold and hot air existed in the House we occupied before.

673. To a greater or a less degree than in the present House?—Perhaps rather to a greater degree, but it was less available for the purposes of ventilation than the present House.

674. Has your Lordship been in the habit of coming to the House of Commons sometimes?—I have been there, but not frequently.

675. You have no remarks to make as to any difference of temperature

temperature which you have perceived between the two Houses?—No.

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676. Do you feel that the air you breathe is sensibly different from the air you breathe out of doors, or in houses and rooms which are not artificially ventilated?—I consider it to be so, and that is what I object to in the temperature of the House; the feeling is, that it is too artificial.

Earl *Lonsdale*, attending by permission of the House of Lords, Examined.

677. *Chairman.*] YOUR Lordship is a constant attendant at the House of Lords?—I will not say very constant; I have attended during last Session and the present Session very frequently.

Earl *Lonsdale.*

678. You recollect the temporary House in the Painted Chamber?—Yes.

679. Do you think that the ventilation of the present House is satisfactory?—No; it is very disagreeable; last year it was sometimes over hot, and at other times it was very cold, with cold draughts in it. After I received the Chairman's message yesterday I looked at the thermometer; it was at 66 degrees when we came in; that was soon after five o'clock; about six o'clock it was at 70 degrees; there was some complaint, and the clerk at the table went to the regulator of the stoves, and then the thermometer fell to about 66 degrees at seven o'clock; 66 degrees for me is too hot and oppressive, and there is a fusty smell with it.

680. Mr. *Fitzroy.*] Do you often perceive unpleasant smells in the House?—I cannot call it a smell; there is a deadness and fustiness in the air.

681. *Chairman.*] Is your Lordship acquainted with any buildings upon a large scale which are not ventilated in the artificial manner in which the Houses of Parliament are ventilated?—The Post-office is ventilated in a way different from all other buildings. In the large sorting-room, where between five and six hundred clerks are engaged, and which is lighted with gas, and which used to be very oppressive, there is a little steam engine which pumps in cold air at the top, and that makes the temperature of the sorting-room at the Post-office as agreeable a temperature as any can be, though there are between five and six hundred clerks in it.

682. Is your Lordship aware under whose superintendence that system was commenced?—No; it was commenced soon after

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after the new Post-office was built; it was established, as I understood, by Sir Francis Freeling.

683. That, to your own knowledge, has answered very well?—Yes.

684. Do you think that that system, as far as you are acquainted with it, could be applied to the Houses of Parliament?—In the room at the Post-office there is a certainty that there will always be 600 people; in the House of Lords sometimes there may be 10, and at other times several hundreds. The sorting-room would be very cold, most likely, if there were only the same number of persons in it who attend the House of Lords on ordinary occasions.

685. When those clerks are present, and the gas is burning, is the air more agreeable to breathe than the air of the House of Lords when it is full?—It was so, certainly, when I was there.

The *Lord De Ros*, attending by permission of the House of Lords, Examined.

Lord *De Ros.*

686. *Chairman.*] YOUR Lordship has been good enough to come here at the request of this Committee of the House of Commons?—I have.

687. You are in the habit of attending the House of Lords pretty regularly, are you not?—Yes.

688. You have had opportunities of witnessing the effects of ventilation in barracks and various places allotted to a number of people, have you not?—Yes, and in military hospitals.

689. What is your opinion of the ventilation of your Lordship's House?—I think there is very little draught in it, and the air generally is good; sometimes there is a deadness in the air complained of, and the want of a sufficient change of the air; but you cannot avoid that, because the way in which I understand the evenness of temperature is kept is by the number of outer doors which you pass before you get into the body of the House. Those doors prevent all draught, but, on the other hand, the effect is to deaden the air.

690. Do you think the atmosphere of the House is agreeable?—Yes; I think it is very good upon the whole.

691. Comparing it with that of any other place, do you think any other system of ventilation is better?—The best ventilation I ever saw is at the great Marine Hospital at Chatham; I think it to be perfect; but whether that system would answer here or not, I do not know.

692. Have

692. Have you heard complaints made of the ventilation in the House of Lords?—I have heard complaints of the deadness of the air, but that I do not think can be avoided, unless you admit fresh air in currents. Lord *De Ros.* 30 March 1852.

693. As far as your Lordship is concerned, you see no particular objection to it?—I think it is certainly good upon the whole.

694. Mr. *Greene.*] Is your Lordship sensible of the deadness of the air during the summer months?—It is about this time of the year that the deadness of the air is most perceived.

695. At times when there is a certain portion of warm air let into the House?—Yes.

696. *Chairman.*] Are you aware under whose direction the Marine Hospital at Chatham is ventilated?—Under that of Sir William Burnett, who has paid particular attention to that subject.

697. Was not that hospital built under the auspices of Sir William Dennison?—No, it has been built about 50 years.

698. Mr. *Deedes.*] What is the principle upon which that ventilation is conducted?—I am not quite able to give the Committee that detail; but the effect of it is, that there is a general and uniform upward draught, and no lateral draught at all through the wards; in fact they do not separate infectious cases there from the others; they consider the atmosphere in so constant a state of change.

The Earl *Grey*, attending by permission of the House of Lords, Examined.

699. *Chairman.*] YOUR Lordship has been kind enough to attend here at the request of this Committee?—I have. Earl *Grey.*

700. You are constantly in the habit of attending the House of Lords?—I have been for the last six years.

701. What is your opinion as to the state of the atmosphere inside the House?—I do not think the ventilation of the House of Lords is bad; but at the same time I think it is very inferior indeed to that of the late House of Commons, with which I naturally compare it, having sat a good many years in that House.

702. Is it from alterations of temperature, or from currents of air, which you suffer?—I think the currents of air are very objectionable; I have often perceived them; for instance, last night the House was at one time very hot, and then there came a current of very cold air to one's feet.

I heard

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I heard Lord Lansdowne complain of the same thing; and generally I think the air is admitted in such a way as that you feel a very strong current of cold air upon your feet. I do not know how it comes in, but that is the sensation.

703. In coming into the House of Lords, and into the precincts of the House, do you feel at all that you are breathing different air from that which you habitually breathe in your own house and other places which are well ventilated in the usual manner?—I cannot say that I am sensible of that particular. In hot weather, in the summer, I think the House of Lords gets very oppressive indeed, perhaps partly from the sun being strong on the windows; I have often observed in hot weather, in the summer, on going from that House to the late House of Commons, a most extraordinary difference of temperature.

704. Is the lighting of the House of Lords agreeable?—I do not think the lighting at all disagreeable; I think it is hardly sufficient on the table without candles to read very comfortably, but it is light enough at other places.

705. You do not sensibly feel heat from any part of the lighting of the House of Lords, do you?—I do not perceive it, certainly.

Sir *Charles Barry*, R.A., called in; and Examined.

Sir *C. Barry*, R.A.

706. *Chairman.*] YOU are the Architect of this great building?—I am.

707. I will first call your attention to Dr. Reid's report made to the House of Commons on the 11th of February last. Dr. Reid states, that he is not able to make the report so complete as he would have done had he had access to certain drawings, which he believes are in your possession. Appended to that report there is also the correspondence, in which you appear to have declined furnishing those drawings; will you state what the grounds are upon which you declined to do so?—First, because I conceive they were not necessary to enable Dr. Reid to make his report; and secondly, because if he had the use of them they would probably rather mislead than give him the information which he requires; they are by no means perfect, and do not show all the arrangements which have been made for warming and ventilating; the only true mode of ascertaining what those arrangements are, is by means of an examination of the building itself, for which Dr. Reid was offered every facility, but of which he did not choose to avail himself.

708. The

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708. The application which Dr. Reid states himself to have made was for "the drawings of the air and smoke flues, shafts, and warming or ventilating apparatus connected with the Cloisters at the House of Commons, with the House of Commons' libraries, committee-rooms, refreshment-rooms, smoking-room, and also with the rooms between the Central Hall and the House of Commons' Lobby." Are there no such drawings in existence?—There is no complete set of drawings showing every one of those arrangements in existence; and as to those drawings which do exist, many modifications have been made in the execution of the work, so that the drawings themselves might lead to misapprehension. I state, as I stated before, that the only true method of obtaining an accurate knowledge of the arrangements, as they are now made, is to inspect the building, with the aid of the explanation of the clerks of the works, and others, who have carried into effect the whole of those arrangements.

709. Would there be any objection to furnish such drawings as you have to Dr. Reid, should he still require them?—I have the greatest objection to allow Dr. Reid the use of them, for several reasons, but particularly that which I have stated; namely, that they might possibly lead him into error, and not furnish him with the information which he requires.

710. Mr. *Fitzroy*.] I understand you to say that there is no complete set of drawings in existence?—That is true; there are some drawings in existence, but even those do not in all cases show correctly the arrangements which have been made.

711. Mr. *Locke*.] Would there be any difficulty in preparing a complete set of drawings, showing the actual state of the ventilation of this House at present?—There would be no difficulty in preparing a set of drawings, showing completely the arrangements which have been made, but it would be a work of very considerable labour to make them in sufficient detail, so as to trace every flue in this building from its commencement to its termination. There is no doubt a set might be prepared, but it would be necessary that it should be done by an examination of the building for the purpose.

712. Sir *D. Norreys*.] By giving your general plans to Dr. Reid, he would be able to trace the course of any of the flues, would not he?—I am not of that opinion. I think they would rather mislead him than furnish him with accurate information.

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information. The only true method of ascertaining what the arrangements are, is to examine the building itself.

713. By the aid of the original plans?—No, by the aid of the explanations which would be given by the clerks of the works.

714. *Chairman.*] Would not it be satisfactory to any one who wished to ascertain the course of flues, which might in some degree interfere with his own system of ventilation, to have an opportunity of inspecting any plans which there might be, and that with those plans in his hand, and accompanied by the clerks of the works, the building should be gone over by him, any deviations from the plans being pointed out, and explained on the spot by the person who accompanied him?—I do not think so. The application from Dr. Reid was not only for the use of those plans, but for permission to copy them, to which I decidedly objected, for many reasons.

715. Did your objection arise partly from the differences which have existed between Dr. Reid and yourself, or was it solely upon other grounds?—Partly so, but practically because I believe that the use of those plans would not furnish him correctly with the information which he requires. The only way, I repeat, of obtaining that information accurately, is to examine the building for himself, with the aid of such explanations as were offered to be given to him by the clerks of the works. The whole system of the existing arrangements is capable of being explained in the building most thoroughly.

716. Would not anybody, seeking the knowledge which Dr. Reid seeks, rather have the plans than not?—I think not, if they should not be complete and accurate. On this subject I may observe that Dr. Reid has already a complete set of plans of all the arrangements made for warming and ventilating this great building previous to his removal in 1846, and with the aid of such plans, and such explanations as could be afforded to him by the clerks of the works, he might, if he wished to do so by such means, ascertain every arrangement he could desire. I hold in my hand a set of plans showing all the leading features and principles of the ventilation of that portion of the building which is under my control. But though they exhibit the main principles of the system, in the details they differ from the mode in which the work is executed, and this set of plans might therefore lead to error.

717. Mr. *Locke.*] Would there be any difficulty in showing upon those plans which you have now in your hand such modifications as have been actually carried out in the construction

struction of the building?—I think there would not, if time were allowed for the purpose, but in the present state of the drawings they do not correctly show the arrangements made. Sir *C. Barry*, R. A. 30 March 1852.

718. Is the Committee to understand you that drawings have not been preserved of the alterations which from time to time have been made in the construction and in the arrangements necessary for ventilation?—Certain drawings have been made, and many of them have been altered by verbal instructions given upon the spot; other arrangements and modifications have been made from verbal instructions alone.

719. Some record has been kept of the alterations, has not there?—Yes; the parties who have issued the orders are also well aware of the whole of the arrangements, and they can easily be traced.

720. *Chairman.*] In another portion of his report Dr. Reid seems to imply that a difference has been made in the construction of the main air flues to the House of Lords and that portion of the structure which is under your orders, to the disadvantage of that portion in which he exercises authority; will you have the goodness to give a reply to that suggestion?—In reply to that question, I beg to say that the construction of the air flues of the House of Lords and those of the House of Commons is exactly upon the same principles, with this exception, that in the main air flue of the House of Commons an air-tight slate floor is adopted in lieu of the York paving laid upon dry rubbish, as in the House of Lords. That was done for the purpose of preventing the possibility of the rising of damp, and it has been done at a very greatly increased cost beyond that of the House of Lords, under the immediate and constant supervision of Dr. Reid himself, who never objected to it until the whole was completed, nor until very recently. With respect to the difference in the condition of those two main flues, if there be any in favour of that of the House of Lords, it is owing, in my opinion, to the degree of attention which is bestowed upon the cleansing and keeping it in order. In some respects the air flues of the House of Lords are not in so good a state in respect of infiltration through the walls as those of the House of Commons.

721. What do you allude to in speaking of cleansing and keeping those places in order?—The constant cleansing of the walls, which I believe is effected at least twice a week, the washing of the floor, and doing everything which is necessary to keep the flue sweet and wholesome.

722. You speak of constant washing; is that two or there times a week?—I think the floor is washed daily.

723. Does

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723. Does not that affect the air which passes over it?—It may affect the air, but it would not affect it injuriously.

724. There is a want of water of which Dr. Reid complains; is that in your department?—Not at all.

725. In point of fact, what portion of the House have you delivered up, as finished, to the Crown?—All those portions of the building which are at present in occupation. They are not delivered up as complete; they are only delivered up for the purpose of being under the charge and control of the Office of Woods during their occupation, and until the completion of the several rooms can be proceeded with.

726. In point of fact, are those persons who were employed by you any longer there?—They are no longer responsible. They are there, and are constantly carrying on works which are incomplete, but they are no longer responsible for the general charge and control of those portions of the building.

727. If any repair were ordered to be done in those portions of the building, would the order go through the Board of Works?—Any repair would be effected by the Department of Works. The completion of any portion of the building which is unfinished would devolve upon me.

728. In whose charge is the ventilation of the whole building?—The charge of the ventilation is at the present moment generally under my control, but with the assistance of the officers of the Department of Works. They have a general charge over the whole building, but until all the arrangements for warming and ventilating are completed, it was thought desirable that I should exercise the control, and have the management of them.

729. Do you consider yourself responsible for the ventilation of that part of the House which is not in Dr. Reid's hands, or would the officers of the Board of Works be responsible for it?—Having recommended to the Department of Works the establishment by which the warming and ventilating arrangements of the House of Lords are conducted, and having a control over the appointment and duties of those persons, I consider that I am to that extent responsible for the proper working out of all the arrangements which have been made; but it will only be so until the building is complete and those arrangements are finished.

730. Is the person whom you have appointed paid by the Board of Works?—He is.

731. It has been stated by Dr. Reid that various works have been performed, such as putting down gas-pipes and making

making smoke flues and other works, without his knowledge, which have interfered with the ventilation of that portion of the House of Commons which is under his charge; do you know anything of that?—I am not aware of any particular circumstances; all I can say upon that subject is, that my own clerks of the works have had special orders from me to afford him every facility, and to consult his convenience in conducting any works which may be necessary for the completion of the arrangements already commenced.

732. Have you desired them to inform Dr. Reid when anything was going to be done which was likely to traverse or interfere with his system?—I have.

733. Have they done so?—To my belief, they have.

734. Sir *D. Norreys.*] Dr. Reid has stated, with respect to the Post-office, that the fire-place there is under his charge, but that the flue is under your charge; is that so?—I think Dr. Reid has been under some error in that respect; if the instructions are referred to by which he was reinstated in 1846 for the purpose of warming and ventilating the House of Commons, &c., it will, I think, appear that the Post-office and the other rooms in the angles of the Lobby are not placed under his control.

735. Therefore you conceive that you have the Post-office entirely under your charge?—Entirely so.

736. *Chairman.*] With regard to the painting of the perforated iron plates, is that painting exactly similar in both Houses of Parliament?—It is.

737. Do you conceive that it affects the air which passes into the House of Peers through the bottom of the House?—I have not the least idea that it has any effect whatever upon the air of the House of Lords, and during the time that it has been employed there, which is now several years, I have never heard a single complaint of any odour which was supposed to arise from such paint.

738. Do you know whether Dr. Reid made an application to the Commissioners of the New Palace, requesting that that paint might be removed?—I am aware that an application was made by him to the New Palace Commission upon that subject, and that the Commissioners, after hearing everything which Dr. Reid had to urge respecting it, determined that the removal of this paint, and the substitution of japanning or galvanizing, was quite uncalled-for and unnecessary. It was admitted, I understood, by Dr. Reid, that the temperature of the air passing through those plates would

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be far below that which could have effect in producing any odour from the paint upon them.

739. In fact, the Commissioners declined to recommend that that change should take place?—They did.

740. You have heard the evidence of the several witnesses with regard to the state of the various offices appertaining to this House which are under your ventilating charge. In the Committee Clerks' Office they suffer both from smoke and from draughts from the windows; in the Votes and Proceedings Office they have one good room and one bad one, but there are strong draughts in one of the rooms; in the Journal Office, which has been occupied for two years, there is a great want of fresh air; sometimes it is too cold, at other times too hot, and there is no open fire-place; in the Public Petition Committee Room the same complaint is made; in the Public Bill Office, Mr. Dorington states the ventilation has been improved; that it was bad, but is now very much better. Will you state to the Committee, in regard to those various offices, whether you can account for the complaints which are made, and whether you conceive that you can remedy them?—Whatever defects may be complained of in those offices, I consider to arise either from arrangements which are yet incomplete, or from defective management. I feel satisfied that when the arrangements are thoroughly carried out and attended to, there will be no difficulty whatever in removing all such complaints, and making the system work perfectly. It was only upon the removal of the great mass of building in Old Palace Yard, during the last few months, that I was enabled to make some of the arrangements respecting the supplies of air which are now made, and which are not even yet complete; but when the whole of those arrangements are completed, I have every reason to believe that the operation of the system will be free from all complaint.

741. How soon do you imagine that those arrangements will be in such a state as you may fairly call complete?—They might be completed in a very short time, but during the sittings of the two Houses the work cannot be proceeded with, without inconvenience to the Members, and that will necessarily prolong the time; but if the building were entirely at my disposal at the present moment, I think the whole of what I am alluding to might be completed in the space of two or three months.

742. Do you see any reason why those offices to which I have alluded should not be as well ventilated as all the rest of the building?—There is this peculiarity in all those offices

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on the ground floor of the building, namely, that originally they were not intended to be occupied as offices, and, therefore, were not supplied with fire-places and flues. It was intended, according to the original design, that the whole of the ground floor towards the river should be occupied as a repository for papers, and for that purpose it was not considered necessary to provide fire-places; however, according to the arrangements made by the New Palace Commissioners, a different appropriation of the building has taken place, and those rooms are now occupied as offices, which were intended originally merely as store-rooms.

743. With respect to the Cloisters, where the Members' cloaks are hung, evidence was given by the policeman, and by the servant attending there, that nothing could exceed the foulness of the air in that neighbourhood in the early part of the morning; that in the early part of the morning it was so bad that both of them had been extremely ill from it, and that it was enough, to use their own strong expression, to suffocate them?—I was not aware that such was the fact; this is the first time I have heard of any complaint about the Cloisters; but this I know, that there are arrangements which were incomplete, and which have within these very few days been completed, by which I imagine all such complaints in future will be removed.

744. All the defects which have been hitherto noticed, you attribute to the incompleteness of the arrangements?—I do, and perhaps to imperfect management.

745. With respect to the committee-rooms of the House of Commons, several Members of the House have given a very indifferent account of the ventilation. One Honourable Member, Mr. Cornwall Legh, states that the ventilation of the committee-rooms is very bad; that sometimes they are very hot and sometimes very cold; that there are constantly draughts and inconveniences of that description. Mr. Wilson Patten, who is Chairman of the Committee of Selection and of Standing Orders, says the committee-room used by the Committee of Selection was so bad that it was abandoned, and that, generally speaking, the committee-rooms are in such a state that there is difficulty in getting delicate Members to attend upon Committees, and that although it is much better now, yet at the same time the evil is by no means remedied?—I must give the same answer to that as I have done to the previous questions, that there are certain arrangements connected with the committee-rooms which are not yet completed; but I think the Committee will

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observe, from their inspection this morning, that every arrangement has been made for the admission of air to the different rooms at any temperature which may be required, and means are also provided for the discharge of vitiated air. I believe one portion of the complaint is as to the coldness of the rooms. It was so in the case of Mr. Wilson Patten. The room in which that Committee sat was one of the oriel rooms, and consequently the coldest of the series of rooms during the late north and north-east winds. There is certainly some difficulty in the regulation of the ventilation of those rooms, owing to the coldness of the aspect, which is due east, also to the air and draught of the river, and to the large proportion of glass in the windows with reference to the cubical area of each room. I was in hopes that the ventilation would have overcome all those difficulties, but my opinion now is, that nothing short of a double glazing of the whole of the windows towards the river, which I was anxious to avoid on account of the expense, will be effectual towards the perfect regulation of the ventilation of each room.

746. Some Members have complained of the diamond windows, and have referred to them as one cause of the inconvenience?—Those which were at first employed were certainly not effectual. The draught is so great, and the wind so powerful at times, that they were continually blown open, and got out of repair. Those which have been added lately are upon a different construction, better calculated to resist the ingress of the wind, and much more efficient for the purpose. I still think, however, that there is scarcely sufficient power in the ventilator to resist the force of the wind upon those windows.

747. Do you find that glass and metal can be combined in windows so as successfully to keep out the air?—Yes, I think there is no difficulty in doing that whatever; I do not imagine the cold to proceed through the joints between the glass and the metal, but simply through the ventilators alluded to, which do not fit sufficiently tight.

748. By "ventilators," you mean the little diamond windows which open?—Yes.

749. Mr. *Drummond.*] Would not they shut closer if they were made of wood?—No; I think they require a more powerful pulley, or a screw, to draw them to and keep them close.

750. Mr. *Deedes.*] Does not the wind come in through other parts of the window, in consequence of the framework being of metal?—No, I am not of that opinion. The metal sash is

so prepared that the glass is let into a rebate, and that is puttied in the ordinary way as wooden sashes are; they are quite as air-tight as any other description of sash.

751. *Chairman.*] You have stated that a good deal of the inconvenience which is experienced in the committee-rooms must be attributed to the same cause to which you attributed the inconveniences in the offices, namely, the incompleteness of the present state of the building. When the Committee passed with you this morning through your ventilating spaces and came to the river front, they were there shown certain apparatus which is applicable to the ventilation of the committee-rooms; the Committee then understood from you that that apparatus was complete; how do you reconcile that with the statement which you have just made?—Because the apparatus which the Committee saw in their inspection this morning was apparatus confined solely to the supply; the power of discharge is by other means, and it is that which I allude to as not being complete. Unless the ingress and egress from every room can be properly adjusted to each other, it is impossible that the system can work perfectly.

752. That, I presume, is because as yet the Central Tower is not finished?—To a certain extent that is the case, but not wholly so; there are arrangements being made in the smoke-shafts which are not yet complete, and which would have a material influence in the discharge of the vitiated air from the committee-rooms.

753. How do you propose to discharge the vitiated air from the committee-rooms?—The discharge of the vitiated air from this room, for instance, is through a portion of the ceiling, which portion of the ceiling is in connexion with a general flue over the adjoining corridor, that flue terminating in one of the louvres or discharges either in the Royal Court or in the Speaker's Court, as indicated upon the plans which I have this day delivered in.

754. What is a louvre?—It is in this case an exit for vitiated air, such as those upon the tops of halls. In all the halls of mediæval times there was an open louvre for the discharge of smoke from the fire, which it was then the custom to make upon the hearth; those louvres you may observe in the Speaker's Court and in the Royal Court.

755. They are, in point of fact, shafts, up which the vitiated air proceeds into the open air?—Yes.

756. Do you propose to assist that draught by mechanical means?—No; but I have already done something towards it by means of rarefaction from a coil of steam pipes at the

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foot of each shaft. I find, however, that such power is not quite sufficient to meet all contingencies, particularly those arising from the action of high winds; I therefore propose to take other means to make the discharge more effectual.

757. Do you contemplate any apparatus for lowering the air from the tops of the committee-rooms similar to that which you now employ in the House of Lords?—Arrangements are now made for that purpose; and that portion of the ceiling which is not used for the discharge is used for the supply, which supply is conveyed by flues from the chamber below, which the Committee had an opportunity of seeing in their inspection to-day.

758. Are the Committee to understand that there will be in each committee-room a double ingress and egress similar to that in the House of Lords?—Yes; I should also say that the supply to each committee-room is not entirely from the ceiling, but from other parts also. I do not entirely depend upon the ceiling, but I depend also upon the skirting. Under the upper moulding of the skirting Honourable Members will perceive there is an aperture, which is for supply; and there are also means of supply from the top of the wainscoting round the room.

759. Mr. *Locke*.] Are those the only means of supply that exist at present?—Those are two of the three means of supply; part is supplied from the ceiling, part from the skirting, and part from the top of the framing.

760. Sir *D. Norreys*.] Is the supply of air from the ceiling to the committee-rooms dependent upon the same fan or propeller?—Yes.

761. Mr. *Locke*.] Will you give a brief general description to the Committee of your whole plan of ventilation?—For the supply of air to four-fifths of the building which are under my charge and control the only source is from the turrets of the Victoria Tower, which communicate with the chamber in the basement used for the purpose of moistening the air, or freeing it from any impurities previous to its entering the main air-flues or vaults of the building. From that chamber the current passes through the main air-flues in the basement to a central chamber under the Central Hall, into which chamber it is driven by means of a powerful fan. From that chamber it is distributed in various directions to the different portions of the building, being previously warmed, if necessary, by steam pipes; after being thus tempered in the central chamber, the air is forced into the main supply flues, and from thence, through flues in the walls, to the House of Lords,

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Lords, &c., and to each committee-room; which supply flues, I have already stated, communicate with the spaces above the ceiling of the House, and of each committee-room, and the vitiated air is discharged from the House and from each committee-room, as before stated.

762. Viscount *Palmerston.*] What are the dimensions of those air-flues; are they of a uniform dimension?—The centre air-flue is of a uniform width, as will be perceived by the plan; the others are not of the same width throughout.

763. What is the sectional area?—The sectional area of the three passages together would not be less than 140 or 160 feet.

764. Mr. *Drummond.*] Suppose the air to be originally at the temperature of 100 degrees, how much heat would that air lose by the time it arrives at the committee-room?—I am not prepared to say what it loses, but I should imagine the loss would be very trifling; I have no experiments to prove the amount of it.

765. You consider air to be a bad conductor of heat?—Yes.

766. And that it readily parts with its caloric all the way it goes?—It does, under certain circumstances; but in its passage the loss of heat should be considered with reference to the velocity of the current, and the temperature of its opposing surfaces. The air being set in rapid motion, has not time to lose much of its heat before it is delivered into the room to which it is forced; arrangements are, however, made for increasing its temperature, if necessary, before it enters each of the committee-rooms.

767. Mr. *Locke.*] No parts of the building, except the House of Lords and the committee-rooms, have this special provision of pipes?—No.

768. Mr. *Deedes.*] Is the air supplied to the committee-rooms generally re-heated?—In practice I think it is scarcely ever necessary to re-heat it.

769. Viscount *Palmerston.*] Does the same system enable you to give cool air in summer?—It does; for in that case the same flues are used for the transmission of air without the aid of the warming apparatus, and therefore the air is thrown into the rooms at the temperature at which it exists in the basement of the building.

770. Have you no artificial means of cooling the air below the temperature of those vaults?—It is proposed that means should be used for cooling the air by water and other contrivances,

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trivances, but until recently we have never had the means of making any such arrangements.

771. Mr. *Drummond.*] What is the number of individuals to whom you have made provision to supply fresh air?—Without referring to my original calculations I should not be able to answer that question.

772. Nor probably can you state off-hand the number of cubic feet which they are supposed to consume?—No, I cannot.

773. Have you ascertained at what temperature the heavy foul air begins to ascend?—Experiments have been made to ascertain the degree of temperature which is necessary to give an ascensive force to the heavy foul air; as I have not my calculations and memoranda before me, I am unable to answer the question.

774. That has been provided for, has it?—It has been provided for.

775. Have you ascertained whether, into the vaults below, any other gases than atmospheric air can enter?—My belief is that no other gases can enter, except possibly the leakage of coal gas, if that should take place, but every precaution has been taken to prevent it; and I am not aware that a single instance has occurred in which coal gas has leaked into any of the supply flues.

776. I did not speak merely of gas for lighting purposes, but every other kind of foul gas?—Every precaution has been taken to prevent the admission of foul air of any description, and I conceive it will be impossible that any can enter when the arrangements are completed.

777. Nor any miasma of any kind?—I believe not.

778. *Chairman.*] Does that answer relate to the whole of your sources of supply?—Yes.

779. And the channels through which the air passes?—Yes.

780. Mr. *Drummond.*] How do you account for the oppressive feeling which Members both of the House of Lords and of the House of Commons have complained of, if there be nothing present but pure warm atmospheric air?—The way I account for that feeling formerly in the House of Lords is, that, until the present Session of Parliament, we have not had the entire control over the management of the atmosphere of that House. It has only been upon the erection of the fan, or propeller, that we have had an entire and instantaneous command over the movement of the atmosphere of the House

of

of Lords; and I believe from henceforth there will be no such oppressive feeling experienced.

781. You have had the apparatus only lately?—Only during the present Session.

782. Have you made any estimate of the quantity of heat which is generated by the lights?—I have made several experiments by thermometers with reference to their radiation of heat, but it is very difficult, and in fact impossible for me to make such experiments satisfactorily without having the entire control of the warming and ventilating arrangements of the House. My belief is that the radiation of heat from the chandeliers, as they are now raised, is very inconsiderable in the Gallery, not perhaps creating a difference of temperature of more than two or three degrees.

783. *Chairman.*] Are you now speaking of the House of Commons?—I am.

784. Mr. *Fitzroy.*] Is the apparatus which you now have sufficient to supply ventilation to the House of Commons as well as the House of Lords, if the whole were under your control?—With the additional assistance which other portions of the building offer, I have no doubt it would be amply sufficient for the purpose.

785. You would require a larger staff?—Certainly, and I should say a more efficient staff than I have at present.

786. What number of men are now employed on the ventilation of the part of the building under your charge?—There is an engineer-in-chief and an assistant engineer, three firemen, two labourers, and a boy.

787. *Chairman.*] (To Dr. *Reid.*) What is the number employed under you for the ventilation of the House?—It has never been arranged. My establishment is in the position in which it was when I was deprived of my office, and the gentlemen are with me who attended me in respect to the old Houses of Parliament. At the present moment I may state that there are such numbers of workmen going on with various works, and so much cleaning is necessary from the dust above and below, and from the daily intrusion of the men through doors which are not locked, that we require four labourers to attend to the dusting alone, and to the supply of fuel. I have been asked to give a report to the Commissioners of Works, which I have stated it is impossible to do for a day or two till the labourers, who now enter by doors to which there are no locks, shall be excluded.

788. Mr. *Fitzroy.*] (To Sir *Charles Barry.*) You have stated that eight persons are employed by you for the ventilation of the

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the House of Lords; would the same staff be sufficient for that purpose, supposing the whole of the building were under your control?—I should wish to take a little time to consider my answer to that question, but my impression is that it would be nearly, if not quite, sufficient for the purpose.

789. The whole success of the system of course depends greatly upon the vigilance and attention paid to it by the persons who are entrusted with carrying it out?—To a very considerable degree, no doubt.

790. Do you think that for a building of this magnitude, and where the ventilation is of the first importance, it is desirable to have a system so complicated and so refined as to require such great care on the part of those who have the charge of it?—To ventilate rooms under the conditions of those of the two Houses of Parliament, which are occasionally crowded to excess, and at other times but very thinly occupied, I do consider that it is necessary to make special and somewhat complicated arrangements. The same would also apply to the committee-rooms, which are more or less crowded, or more or less thinly occupied.

791. Can you state the wages of the chief engineer, and the other persons whom you employ?—The establishment paid by my authority, is as under:

		£.	s.	d.
Engineer-in-Chief, at per annum	- -	200	–	–
Sub-Engineer	do. - - -	100	–	–
Two firemen, at 78 *l.*	do. - - -	156	–	–
One labourer	do. - - -	66	6	–
One labourer	do. - - -	62	4	–
One boy	do. - - -	18	4	–
	£.	602	14	–

N.B.—One engineer and one fireman, in addition to the above, are paid as officers of the House of Lords, at the rate of 78 *l.* per annum.

792. You think if the whole of the building were entrusted to your care, it would entail no further expense, as far as the staff is concerned, than the part which is already under your care?—I should not say so, because I think that the person who is left in entire charge and management of the system of warming and ventilation of this building should be a person of no ordinary qualifications as an engineer. The engineer who is at the head of that establishment at the present time answers the purpose, having my

own

own control and that of my own assistants, but if the building were given up entirely to others for the purpose of being warmed and ventilated, I should consider that the salary of the engineer-in-chief should be materially increased beyond the amount which is now given. Sir *C. Barry*, R. A. 30 March 1852.

793. Do you think it would be of importance that the lighting and ventilation should be under one superintendence?—Yes, of the greatest importance.

Jovis, 1° die Aprilis, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Viscount Ebrington.
Mr. Greene.	Mr. Ricardo.
Mr. Locke.	Mr. H. Drummond.
Sir Denham Jephson Norreys.	Mr. Deedes.
Mr. Hope.	

LORD ROBERT GROSVENOR IN THE CHAIR.

William Frederick Pollock, Esq., called in; and Examined.

794. *Chairman.*] YOU are, I believe, the son of the Lord Chief Baron?—I am. *W. F. Pollock*, Esq. 1 April 1852.

795. Do your duties in the Court of Exchequer lead you to pass some time in that court when the court is sitting?—I am one of the Masters of the Court of Exchequer, and part of my duty compels me to sit in court at Westminster.

796. How long have you held the appointment under which this duty has devolved upon you?—I have held that office for the last six years, since 1846.

797. Has the court been all that time under Mr. Gurney's superintendence?—Mr. Gurney, I think, came in, in the vacation of 1850. Up to that time there had been very considerable complaints of the state of ventilation of the court. We all of us suffered a very great deal. The complaints came from the bench, from the officers of the court, from the bar, and from the general public. In consequence of those complaints the Lord Chief Baron wrote to the Office of Works in April 1850, and I believe that the matter was placed in Mr. Gurney's

W. F. Pollock, Esq.
——
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Gurney's hands by the Office of Works. My attention was particularly directed to the new system of warming and ventilation in Hilary Term of 1851, when it was my turn to sit in court continuously. On that occasion I made particular observations every day for three weeks, on the working of the new system, and I always had a thermometer by me. The temperature which we desired was to be 60 degrees, or a little above that. During the latter part of the day, or when the court was unusually full, the temperature would occasionally rise. Whenever that happened we used to send to Mr. Gurney's people below, and I found that the temperature was always brought down again to near 60 degrees in a very few minutes, and without any sensible draught of cold air. On subsequent occasions, and whenever I have been in court, I have found the system to work well. The air which we breathe there is very pleasant; there is no hot or burnt feeling about it at all; and I may say that at present the ventilation there is good and gives general satisfaction. After his plan had been for some time in use, I saw Mr. Gurney, by the desire of the Lord Chief Baron, and knowing what great satisfaction the matter had given, I thought it only right to communicate that to him; and on that or on some subsequent occasion I saw the apparatus, which, as far as I can judge of it, is extremely simple and very beautiful in its scientific bearings, and I imagine not expensive; but of course I am not competent to speak to the question of cost. I imagine that it is neither expensive in its original construction, for there is very little of it, nor expensive in its daily working, and it is completely under control; both the means of creating a current and the amount of temperature are completely under the easiest control. I may perhaps add, that I really used always to have a severe cold after sitting in the Court for a week together, very often so bad that I was obliged to stay at home for two or three days; but that did not happen this last winter or the winter before, since Mr. Gurney has had the management of it.

798. Are you aware under whose superintendence the ventilation was before Mr. Gurney had it?—I believe it was under Dr. Reid's.

799. Viscount *Ebrington.*] You have spoken of the current of air and the temperature being under complete control, both being pleasantly regulated. There is one other element which is necessary to an agreeable state of the atmosphere, namely, the purity of the air; its not being vitiated by gases caused by respiration or combustion, or anything else; can you speak to that

that point?—Yes, I should say that it was always very pure; I never have had a complaint to make of the purity of the air. *W. F. Pollock*, Esq. 1 April 1852.

800. There has been no fustiness (to use a familiar term) in the court?—None whatever. Perhaps I may mention that the apparatus might be seen very easily, merely by walking across Westminster Hall; it would not take ten minutes to look at it.

801. *Chairman.*] (To Dr. *Reid.*) Have you ever had the ventilation of the Court of Exchequer?—I never had it under circumstances under which I could execute it properly. Permit me to say, that at the period when the complaints were made in 1846, 1847, and 1848, the south wall of Westminster Hall was pulled down, and that destroyed the ventilation of the House of Commons. The Board of Works sent an architect to report what had been done, as shown in the report I sent the other day; but the wall being pulled down at the south end of Westminster Hall, the cold blew in very much at that period, as it did lately at the House of Commons. Lord Chief Justice Wilde went, and accompanied me to see this current blowing in. I represented without end to the Board of Works the necessity of controlling those outer doors; I was not supported in that control, and afterwards it was handed to Mr. Gurney. Permit me to add another statement also; I was never empowered to ventilate those courts in the way which I desired. In the same year, 1841, I planned the court at Liverpool and the Court of Exchequer; but I was told, with respect to the Court of Exchequer, that the Treasury desired to expend so much money, and no more, upon those three courts, and I considered myself responsible for the ventilation only under the restrictions imposed upon me. I was also shown a plan of Sir Charles Barry's for cutting those courts in two, or cutting through the building at a future time; and it was said, "Let them pass in any way they can just now; we must ventilate them fully afterwards." That was the general impression under which I acted.

Goldsworthy Gurney, Esq., called in; and Examined.

802. *Chairman.*] YOU were educated for the medical profession?—I was; I practised in London some years in early life as a surgeon in Argyle-street. *G. Gurney*, Esq.

803. When did you discontinue your practice?—In 1822; thirty years ago I gave up the practice of physic, and became engaged in subjects of a mechanical description, more particularly the contriving of apparatus for carrying out experiments connected

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connected with chemistry, of which science I was always very fond.

804. Since that time you have been independent of your profession?—I have independent means; I have not practised since that time.

805. You are at the present moment a magistrate, residing in the West of England?—I am a magistrate of Devon, and also Cornwall; I live in the latter county.

806. You have pursued the investigation of lighting, warming, and ventilation, with other branches of mechanics and pneumatics, and chemistry, very much since that time, from the love of science?—I have been engaged in those branches of science more or less all my life, bearing upon pursuits that I have been engaged in directly and indirectly; since that period the whole of those subjects have been expressly studied by me for certain purposes; the subject of ventilation, warming, and lighting. In 1830, I think, my attention was first practically called to lighting, by the Trinity House, for lighthouses. I was engaged experimentally on light so long ago as 1816, and I then constructed what was afterwards called the "Drummond Light." You will find this reported by the committee upon lighthouses; so that my first experiments upon light were before 1822. Those subjects have been more or less before me since that period.

807. Have you investigated these subjects with a view to professional practice for pecuniary advantage, or merely from the love of science?—More as matter of taste; not as a profession, or pecuniary advantage.

808. You have been several times examined before Committees of both Houses of Parliament, with reference to the lighting and ventilation of the Houses, as well as the ventilation of mines and collieries?—I have.

809. Have recommendations which you made been in some cases adopted?—They have been adopted in many cases. I gave evidence before the Lords in 1846, as to the state of the ventilation of both the Houses of Parliament; there were, I believe, some difficulties existing on the subject, and I was suddenly sent for by Lord Clanricarde, the chairman of the Committee to come up. I came up immediately, and was placed under a long examination; the result of that examination was, that a second and special report was issued from the Committee; the whole of the previous preparations and proceedings for ventilation were stopped. I have the report.

[*The same was delivered in, and read, as follows:*]

"SECOND

"SECOND REPORT.

G. Gurney, Esq.

"By the Lords Committees appointed a Select Committee to inquire into the progress of the building of the Houses of Parliament, and to report to The House, and to whom leave was given to report from time to time to The House:

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"Ordered to report:

"That the Committee have again met; and, having examined Mr. Goldsworthy Gurney as to the best system of ventilation for the new Houses of Parliament, are of opinion, that further inquiries and experiments should be made, under the direction of Her Majesty's Commissioners of Woods and Forests, before the final adoption of any plan hitherto proposed for that purpose.

"And the Committee have directed the evidence of the said Mr. Goldsworthy Gurney, taken before them, to be laid before your Lordships."

Mr. *Goldsworthy Gurney.*—At this time I was examined also before a Committee of this House on the ventilation of the new House of Commons.

810. In those instances in which recommendations which you gave have been adopted, have they since been adhered to, so far as you are aware?—They were only partially adopted; I recommended a steam jet as being the most controllable and manageable motive-power for the extraction of vitiated air; the jet was adopted in the House of Lords. I recommended also that fresh air should be brought in at a high level, and that has also been adopted. I proposed the vitiated air to be withdrawn at a low level; this has not been adopted. I recommended this, because I believe there are evaporations from the skin, and exhalations from the sebacic glands, which are heavier than the atmosphere. Carbonic acid, also, from the lungs, is heavier. These all fall to a low level, and should be withdrawn from thence; they would more easily move away from a low level than a high one; they should be extracted before they can rise by any disturbance to the level of the mouth, and be respired. This system has been adopted in some of the courts at Westminster; also in the courts at Hull, the courts at York, and other places. The system appears to work well, and practically to succeed. In the House of Lords this latter suggestion was not practically carried out; the vitiated air from the House of Lords is drawn out at a high level, instead of being taken away at a low level, as I recommended.

811. In consequence of an order, dated the 12th of March last, you proceeded to investigate the arrangements for warming,

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ing, ventilating, and lighting the new House of Commons?—I did.

812. And you addressed a letter to The Speaker, making a sort of first report as the result of your investigation?—I did; I made that first report at the request of several Members of the House.

813. Dated the 25th of March?—It was.

814. In that report you stated that you had been interrupted in making your investigations in the House as fully and completely as you would have wished; will you state in what those interruptions consisted?—I would rather not state them; but as I am asked, I will do so, though possibly my statement may be considered personal. I have been prevented from making experiments necessary to determine certain points requisite for my report; and in consequence I applied to The Speaker. The Speaker then gave me an order to do what I thought necessary. I did not press it at that time, as I thought it might possibly be offensive to Dr. Reid.

815. Do you consider that those interruptions materially operated to prevent you giving to this Committee and to the House such information as is necessary for their guidance?—Upon some points they certainly have; but upon the great points bearing on the question they have not. I state in my report that I have seen sufficient facts to satisfy my mind upon the causes of the existing evils. The House, I understand, is now in the power of this Committee; the Office of Woods, who first put me in charge, with one of their officers, I am told now hesitate to interfere; and I believe The Speaker does the same. I do not know whether I am rightly informed that the House is now in charge of this Committee, and that therefore I can proceed no further in the House without the consent of this Committee.

816. Sir *D. Norreys.*] Acting upon that information, did you ever apply to the Chairman of this Committee for power?—No, I only heard it yesterday; I do not think it material at this moment to press it, because I think I have got information enough, from what I have already seen, for my present report.

817. *Chairman.*] Will you inform the Committee what your opinion is as to the atmosphere of the House?—The atmosphere of the House, in its mechanical condition, is in a state of considerable disturbance, a state of aërial commotion. I have gone through the chambers below, I have gone through the House, and I have also gone through the chambers above; I find that the air is all in a state of commotion, from the time it enters to the time it escapes. It (the air) is forced

forced in below by a large fan, by which much disturbance is given to the air; it next passes into the first chamber through certain openings prepared for the purpose. In these passages it takes an increasing velocity, and that increased velocity produces a second disturbance; the air is set into a state of retrograde currents, eddies, and cross impulse from one side of the room to the other. The air now goes into a third chamber, in which these disturbances are still increased. In the second chamber the air is warmed; part of it is heated by tubes, or iron cylinders, filled with hot water; this produces a difference in the specific weight of the air, coming in different parts; and here the natural brattice is formed, which is another disturbing force.

818. Will you explain what you mean by a "brattice?"—A brattice is a plate of air at rest between two moving currents, one up and one down; horizontally it seldom exists, but vertically it does. These currents are produced by the difference in weight of two equal columns of air, occasioned by different temperatures, the heavier column descending, and the lighter column ascending. The plate of air between those two columns is called "the natural brattice;" this is a term which was given by me in 1849, when first discovered existing in a coal-pit up-cast, and has been adopted since as a term; persons at all acquainted with colliery ventilation will understand it. In a coal-mine shaft there is often a division of it from top to bottom by a partition of wood; one side forms the up-cast, and the other the down-cast column; this is called a brattice-pit. The cold air goes down the one side, and the warm air goes up the other in this brattice-pit; but when the air forms of itself into two columns, it is called "the natural brattice," namely, the quiescent plate of air between those two currents.

819. Do you mean the Committee to understand that the air is in a constant state of movement, and therefore gives rise to those currents which have been complained of in the evidence before this Committee?—Yes, decidedly. Those currents which I have named, exist from the causes which I have mentioned to the Committee, in the chambers below. When the air comes into the House it meets with another series of disturbances. The House is in a state of *minus* pressure, or partial exhaustion as compared with the atmosphere outside; the pneumatic balance between the external air and the internal air is broken by the air of the House being at a higher temperature.

820. Viscount *Ebrington*.] You mean in winter?—And in

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summer too, at night; the column of air in the House will be warmer than the column of air outside; and consequently lighter; that column has a constant tendency to ascend.

821. *Chairman.*] By that do you mean the column of air in the House as compared with the column of air in the corridors, or as compared with the column of air external entirely to the House?—I am now speaking of the internal air entirely; this has a tendency to drain the House; this force is increased by a large fire in an up-cast shaft connected above, so that these two forces produce considerable pull upon the House; the air is thus extracted with great rapidity. The air, from the nature of the arrangements below, enters to supply the drain with great difficulty; the air cannot enter through the provided channels sufficiently easy, and the consequence is, that the House is left in a partial state of vacuum or exhaustion; so that whenever a door is opened, or any opening is made by a channel to the external air, the air rushes in with great violence to fill the House; gulphing in, when the doors are opened, occasioning waves or currents of air, which produce an increased disturbance of the whole atmosphere of the House.

822. Then you consider the disturbance of the air to be the effect of the pressure of the air, and the great difference between the temperature of the external and of the internal air, and also the great strength of the draught of the up-cast shaft?—Not the strength of the draught of the up-cast shaft so much as want of control; if it was a case of intensity, you might regulate it; you might then compel a given quantity of air to pass through any sized passage you pleased; but at present the feather balance necessary for ventilation cannot be effected by the artificial preparations that I see about the House. It is a very difficult thing to manage a feather balance of the atmosphere by artificial means; if you leave it to nature, she will do it, provided she is not interrupted. You may manage a railway train, a heavy weight; but you cannot manage a train of subtle, light, and practically imponderable air, without much difficulty.

823. Mr. *Locke.*] Is it desirable that you should arrive at a feather balance?—Unless you have it the House must be subject to constant draughts; it is impossible for the House to be quiet a minute unless the air can enter by natural laws to restore and preserve a pneumatic balance between the internal and the external atmosphere; if you disturb it, you are subject to currents in a direct ratio with the amount of that disturbance.

824. Your object in ventilation would be to produce, if possible, a feather balance in the House?—Yes, but not by art;

art; nature must be left to produce the feather balance; the feather balance may be disturbed by artificial preparations for ventilation, but must be restored by pneumatic laws. For instance, if a foot of air is drawn out of the House of Commons, a foot of air must come in to restore the break, but not driven or pulled in by complex machinery; if it is by machinery, the chances are that either you may not succeed, you may have two feet instead of one, or possibly a deficiency. But if the preparations for ventilation are perfect, then an equivalent for that foot of air will come in immediately of itself, in a state of insensible movement. The House should be like the open air in a calm day; there should be plenty of air, but no sensible current crossing in one direction or in another.

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825. *Chairman.*] Will you explain what you mean by "a feather balance?"—It is a term; one used to express a nice pneumatic balance, such as a feather will not disturb.

826. Mr. *Locke.*] A floating air without motion?—Yes.

827. Then, in order to get rid of those cross currents, whenever nature establishes a feather balance in the House, it would be the object of good ventilation in all changes of air to preserve as nearly as possible a feather balance?—Certainly; and if the feather balance be suffered to preserve itself, the ventilation will be perfect; you may then draw from the House as much as you please.

828. Sir *D. Norreys.*] Is it not a corollary from your observation, that whoever has the management of the proper state of the atmosphere in the House must also have under his control all the approaches by which air can push into the House from the external air?—No; you should have the command of the exit, under proper arrangement; leave to nature the rest. If I draw a foot of air from the top of this room, a foot of air will come in if it can; if the foot of air cannot get in, this room will be left minus that quantity; if it can come in easily it will do so of itself, and the balance be instantly restored. Ventilation, according to the principles which I have laid down, is, that you should extract under control a definite quantity of air sufficient for the requirements of the House, and arrangements be so made that that quantity shall be supplied by an insensible movement, under natural laws.

829. Supposing the temperature of the House were from 65 degrees to 70 degrees in different portions of the House, presenting an unequal state of atmosphere, and that the external temperature were at 32 degrees, would it be possible, by any mechanical contrivance in the House, to keep up the

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temperature when there was an unregulated access of the external air at that temperature of 32 degrees?—If the air was unregulated, it certainly would be impossible; but if the air be under control, it would be perfectly possible.

830. It would, therefore, be requisite, in order to preserve an equal temperature in the House, that there should be a power of control over the external air in respect of its influence, and the amount of it which entered the room which you are trying to keep at equal temperature?—That control must not be by complicated machinery, by forcing in at the bottom, and pulling out at the top, but it must be by permitting a definite quantity to pass, taking care at the same time that the supplies shall come freely in to restore the balance under known natural laws.

831. *Chairman.*] Then in order to produce that effect, does it not follow that the person who ventilates that space must have the entire control of the channels which bring the air into the House?—No.

832. Why not?—Because if they are large enough, nature will control; the natural laws of pneumatics will be the self-regulating principle. I will call the attention of the Committee to one fact in illustration. You are all aware of the principle of the Montgolfier balloon, the fire-balloon; it is open at the bottom; the temperature of air in that balloon is very high, yet there is little or no escapage, because it is close at the top; but if an opening was made at the top, and a foot of air was drawn from the top out of the balloon, a foot of air would then go in at the bottom of its own accord; but if a foot of air is not allowed to go out at the top, a foot of air will not go in at the bottom.

833. Supposing you had the control of the ventilation of the House of Commons with such an apparatus as you think necessary for the purpose, and any person connected with the House were to go and open three or four windows, the temperature outside being 32 degrees, and the temperature inside being 65 degrees, would not your ventilation be most seriously disturbed?—If the windows were opened high, the weight of the air would act slightly upon that of the House by interchange; but if the windows were opened at a low level, it would not interfere; it would have no effect whatever. If the external air came in through such a window or such a door, it would come in very slowly, simply by its slight difference in weight, not sufficient to disturb ventilation.

834. Sir *D. Norreys.*] Is not what you call a feather balance simply this, that the air outside is precisely on a balance

balance with the air inside?—Yes ; balanced by weight or by pressure. *G. Gurney, Esq.* 1 April 1852.

835. May not the state of the atmosphere be compared to a simple balance with equal weights in each scale, and that the cold air being allowed to enter the House, acts as an increased weight put into one side of the balance, and draws up the other side?—Your question applies to barometrical pressure ; the barometer will stand at the same height in the House that it does outside, although the temperature in the House may be many degrees higher than it is without, provided the air can have free access.

836. Viscount *Ebrington.*] If there is an opening at the bottom of the floor letting in the cold air, will not that make the room colder?—No ; cold air will not come in. I have already mentioned the Montgolfier balloon, which is open at the bottom ; in a cold atmosphere no air will go in unless air be previously let out.

837. Mr. *Greene.*] But there is no outlet of air above?—Certainly not.

838. But in the ventilation of the House you have an outlet of air above?—Yes ; a definite one ; under regulation and control.

839. Where there are a number of persons assembled, must you not have considerable rapidity of outlet for the air, because you require a considerable quantity to restore a proper state of the atmosphere?—It may be done by rate or volume ; the rapidity will not take place in the House ; it will take place out of the House.

840. But the air must pass through the House?—Yes; but as it passes through a very large sectional area, it does so with an insensible motion ; supposing the House to be full of Members, supposing you allow five or seven feet of air per minute to each Member, you would upon an average require about four to five thousand feet per minute. Now, if you admit four thousand feet of air per minute through the large sectional area of the House, it would make no sensible disturbance ; it would only move at the rate of a foot per minute.

841. If you want to keep the atmosphere at a certain state of temperature, must you not have a control over the access of the external air, so that the air within the space which you are to keep at an equal temperature may not be disturbed by any in-rush of outer air into this chamber?—I conceive practically not ; if a window was opened, there would be so little disturbance that it would be almost insensible.

842. Mr. *Locke.*] In the answers you have given to the

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questions which have been put, I understand you to suppose the state of things to be, that you have the power of drawing off the air by some mechanical means, so as to produce a current through the house to be ventilated. Do you suppose the existence of a shaft, in which you would either have a fire burning or a jet of steam in operation?—Yes; "current" is not a correct term; it is an insensible movement through the House.

843. The principle you assumed was that the air should be admitted into the bottom of the House and taken out at the top?—Yes, under the arrangements now made.

844. Which is the ordinary mode of ventilating a coal-mine?—Yes; the up-cast shaft system.

845. With such a state of feather balance in the House, supposing it to be practicable, would there be a variation of temperature between the air on the floor of the House and the air at the ceiling?—The ceiling would be rather warmer, from the warm air assuming a higher level, but the difference of temperature would be very little.

846. Supposing you make no provision for warming the air before it is admitted into the House, what would be the temperature of the House under those circumstances in the winter time, when the thermometer out of doors is at 32 degrees?—The same temperature as outside, if not warmed.

847. It would be 32 degrees?—Yes.

848. Supposing it were necessary that the air should be warmed for the purpose of making it more comfortable in the House, would that at all affect the principle which you have just explained with reference to ventilation?—The air in the House being made what is technically termed an "up-cast;" for the column of air in the House would be lighter in consequence of being warmed.

849. What difference would be made as to the effect of your ventilation by having the air admitted warm, and prepared for the House, instead of being permitted to enter in the natural way in which you supposed it ought to enter, being supplied by natural means?—If it were admitted at the same or a higher temperature there would be still no disturbance. But if cold air is admitted when the air in the building is warm there will be a disturbance; and if it was prevented from escaping, then the pressure of the outside atmosphere would compress the air within till a balance is established at the opening. The thing will remain in that state undisturbed; there would be no disturbance under those circumstances.

850. You

850. You think that still the same simple system of drawing in the air from the roof of the building, and admitting it at the floor, may be made to afford a perfect ventilation even if the air is prepared and warmed before it is permitted to enter?—Yes.

851. If you were to open a window or a door under those circumstances, would there not necessarily be a great current of air produced?—No; if a door or a window was opened at a high level, cold air would fall faster in; but in so small a quantity that it would not interfere practically with the ventilation of the building.

852. If when the House is being supplied with air of a certain temperature, and a door opens into the outer air, must not the opening of that door produce a current of air by the influx of cold air into a warmed and ventilated room, whether it be at the level of the floor or at any elevation whatever? —No.

853. Do you state that it would not produce a current either at the level of the floor or at any other height?—It would be so small that the disturbance would not be perceptible.

854. Supposing the air inside is at the temperature of 50 or 60 degrees, and the air outside is at 32 degrees?—If there was no escapage, it would not come in at all under those circumstances.

855. I am supposing that your system of ventilation is in operation, and that a constant current of air is going through the House 4,000 feet a minute; if any one opened a door into the external air under those circumstances, would not the opening produce a current?—It would not; by a very delicate instrument you might trace a slight disturbance near the door, but it would not extend to disturb the atmosphere of the House.

856. You know that one great complaint of the present House of Commons is, that at the opening of the doors, a current of cold air comes into the building?—Yes; the cold air does not come in from the law of difference of temperature which we have been discussing, but it comes in in consequence of the state of exhaustion of the House itself; the House being in a state of partial exhaustion, or *minus* pressure. This is a different question altogether. The question hitherto has had reference to weight; now we come to another question: whenever a door or a window is opened, or any opening whatever is made with the external atmosphere, in the present state of the House, the air rushes in with great force to fill the exhaustion.

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857. Sir *D. Norreys.*] But still the practical result is this: that if the internal temperature of the House be at 65 degrees, and the external temperature be at 32 degrees, there would be a rush of air into the House, disturbing the equal temperature?—No, it will not; if the balance be not previously broken, there will be no sensible movement.

858. Supposing the door of the House of Commons, the House itself being at 65 degrees, were to open directly on the external air, that being at 32 degrees, would there be a rush of air?—No, certainly not; I have no hesitation in answering that question in the most emphatic language; there would be no rush of air.

859. The meaning of your answer is this: that you could keep the air within at 65 degrees, at such a degree of force as to resist that air at the temperature of 32 degrees, outside?—Certainly; there is no difficulty whatever about that. I must beg to refer again to the Montgolfier balloon; there is a temperature of two or three hundred degrees in that balloon higher than the external atmosphere, yet there is no rush of air into it; if there was, the balloon would not float.

860. Mr. *Greene.*] But there is an escapage in this case?—The escapage is very slow.

861. Viscount *Ebrington.*] Then are the Committee to understand that the rush of air which you describe as taking place into the House of Commons, at the present moment, is occasioned by some law which causes a rush of air, quite irrespective of temperature, into a partially exhausted receiver?—Certainly; on the same principle as that on which air rushes into the down-cast and through the working of a coal-mine. In the up-cast there is a partial vacuum, made by rarefaction; the air rushes through all the channels prepared for it to fill the exhaustion. If those channels are not sufficiently ample, so as easily to supply the exhaustion, the air will come another way; it is found to come down sometimes on one side of the up-cast shaft itself, and to form the "natural brattice;" but that will never be so if the channels provided for the entrance of the air are perfectly free; if the openings were very large, then nature would establish the balance under a slow movement.

862. Mr. *Greene.*] If I open a door of a room, the outer air of which is colder than that in the room itself, will there not be an immediate rush of air out at the top of the door and in at the bottom?—There will be an interchange, to equalize the temperature.

863. If I were sitting near the door, should I not be immediately

diately sensible of the rush of air from below?—If you were close to the door, you would feel cold air entering at the floor, and might perceive the equivalent warm air going out at the top, but not by a rush.

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864. Viscount *Ebrington.*] Do you believe that the exhaustion of the air, or the vacuum state of the House of Commons, is such as to account of itself for the rush of air from the colder outer passages, irrespective of the difference of the weight caused by the temperature?—Certainly; if you examine the currents that come into the House of Commons, you will find they do not come in only at the lower part of the doorway, and go out at the top, but they come in at every part, at the top of the doorway as much as at the bottom; if it were simply an interchange, by reason of temperature, the cold air would fall in only at the bottom, and the warm air would go out at the top. If you examine the currents of air coming into the House by a delicate anemometer, as I have done, you will find that it comes in as much at the top as it does at the bottom.

865. Mr. *Locke.*] You know that at present it is the fact in the House of Commons, that when a door is open there is a complete rush of air through the House; you think that arises from the exhaustion of the House, and not from the difference of the temperature?—Most assuredly; I have taken the amount of exhaustion very accurately by the differential pressure-gauge. I find that there are seven degrees of disturbance between the pressure of the internal and the external atmosphere; you cannot suppose that the air can be at rest under those circumstances; the atmosphere rushes in at every part, to restore the balance, to fill the partial vacuum.

866. Is that, or is it not, a state of things, which may be easily remedied?—I think it may.

867. Do you apprehend that the accesses of air in the present House of Commons are too small?—Certainly; this is one of the radical evils.

868. You think that the disturbance of the air that is felt in the House of Commons now by the opening and shutting of doors, and the great currents and draughts thus produced, are caused by the want of access of air to supply the deficiency arising from the over-rarefied state of the House?—By the difficulty which the air has to pass through the strangulated channels prepared for it, and the twists and turns given to it before it can get to the House from below. The air being turned aside from one current to another, all add to the obstruction. I hope I have made myself understood in explaining

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ing the difference between the action of the weight of air by temperature, and the state of pressure by exhaustion? If not, I feel my evidence has been of little use. In the case of the opening of a door below, or of the opening of a window above, if the House was in a state of *minus* pressure, the air would come in as rapidly at the top opening as at the bottom; but if under a simple question of weight, arising from the difference of temperature, it would not.

869. Viscount *Ebrington.*] Is there not another movement going on in the air besides the movement of cold and warm air, namely, the diffusion of gases in all rooms which are inhabited by living creatures, because the process of respiration constantly alters the composition of the air?—The laws of diffusion of gases would very soon produce an equal division of any effluvium that may happen to be floating in a room; but in the present condition of mechanical disturbance of the House, there is no disturbance from the laws of diffusion.

870. *Chairman.*] You have stated what the disturbance of the air is in the House of Commons, and what, in your opinion, causes the currents of air which have been so much complained of; will you now state what you consider to be the chemical condition of the air itself?—One of its conditions is partial decomposition from over-heated air: I mean heated above 90 degrees. If air be heated above that temperature, it is partially decomposed; this happens if it be heated, and unheated. Those portions of air which have been over-heated have always that peculiar disagreeable smell, the peculiar effect upon the lungs, which is complained of in the House. A second cause of its unpleasant condition is, that the air, by the partially exhausted state of the House, is contaminated from foreign and unprepared sources. Air coming in from these channels brings with it any offensive matter that may happen to be in its way. A third cause, I think, arises from the wet iron surface over which the air is made to pass having been previously overheated by dry iron surfaces.

871. Do you conceive that the air is vitiated?—Air is so vitiated by over-heating as to have a great effect upon the animal constitution. There was a singular fact observed at the Zoological Gardens, namely, the monkeys there died of consumption said to be from that cause.

872. Viscount *Ebrington.*] Was not that distinctly stated by Dr. Arnott, to be not the result of warming the air by iron surfaces, but of the imperfect supply of oxygen and the imperfect removal of the carbonic acid gas?—It was so stated by Dr. Arnott,

Dr. Arnott, but I think satisfactorily shown by other doctors to arise from over-heated air.

873. *Chairman.*] How do you know that?—I know it only from information; I have not examined it myself.

874. Viscount *Ebrington.*] From whose information?—From several medical men; Dr. Hutchinson more particularly, who has gone extensively into the question; Dr. Hutchinson can give good information upon ventilation also. He was examined by the Lords in 1849 on coal-mine ventilation; he has written some able papers upon the effect of vitiated air on the lungs.

875. Mr. *Locke.*] Will you explain what is the effect upon the air of raising the temperature above 90 degrees; is it a chemical change that is produced?—It is a slight chemical decomposition of foreign bodies in the air; there are certain bodies floating in the atmosphere which are decomposed at that heat. Some organic matter is decomposed, and the peculiar smell arises from the decomposition of it floating in the atmosphere. If you go above 90 degrees, you injure the air. No portion of the air should be heated above 90 or 100 degrees, if you aim at positive perfection. Any portion of the air which is heated above that is partially decomposed.

876. Viscount *Ebrington.*] Is it not the fact that those monkeys in the Zoological Gardens died of a disease analogous to consumption in human beings?—I believe it is.

877. And are you of opinion that consumption is caused by the respiration of air which has been vitiated by contact with heated iron?—It seemed so. Since the temperature has been kept low, I understand the monkeys have done very well, but when the temperature was raised by artificial heating they died.

878. *Chairman.*] Was that artificial heating over iron?—I believe so; I know from experience, if air be heated above 100 degrees, it decomposes some portions of animal matter in the atmosphere.

879. Whatever it may be heated by?—No matter by what.

880. Therefore you recommend that it should never be heated up to a high degree, in order to be pulled down again?—No; it is found in Germany and in Russia, where they warm by heated stoves, that if they get any portion above that temperature, it becomes disagreeable; and now they are using large surfaces of porcelain or earthenware.

881. You consider that the complaint which has arisen in the House of Commons, on account of the badness of the air,

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as having a very peculiar dry taste (so to speak), is caused by the improper heating of it?—Partly.

882. You wish the Committee also to understand that in consequence of the deranged and undirected state of the currents of air in the House, and the exhaustion and suction by vacuum, air is brought in not only from the authorized channels, but from almost every portion of the appendages of the House?—It is. I may state, in further answer to that question, that when the two doors going into the House of Commons are opened, there is more air passing through the doors, if kept up, than would be sufficient to ventilate five such houses. I can give the actual quantity in cubic feet, and its rate, if the Committee wish it.

883. Will you state whether the smells that have been complained of by the members who have so complained of them, have in your opinion been caused by this improper suction of air from the urinals and other places?—The air comes in through any channels that happen accidentally to be open; and in that way the air comes through from the urinals, and is drawn into the House, instead of passing off, as it should do. All this vitiation arises from the same radical evil.

884. You speak with reference to the quantity of air that comes in at the doors, from having actually measured it?—I have; I have measured it at almost every door. The numbers were also taken by two very able men, Professor Hann, of King's College, and another gentleman; I had those gentlemen to take them after me, because I would not trust entirely to my own observations.

885. You consider that it is objectionable to heat the prepared air to the temperature at which it is now heated in coming into the House of Commons; do you also object to the use of the fan?—I object to the use of the fan. I consider it an unnecessary appendage, doing mischief; the fan involves additional machinery in the management, and it is almost a physical impossibility to keep the aerial balances true; the balance will be constantly broken on one side or the other side by atmospheric changes.

886. Are the Committee to understand that you object to what may be termed forced ventilation, as contradistinguished from what may be termed natural ventilation?—Certainly; the ventilation should be as simple as possible; let nature do what she can, she will work better than we can by machinery. Put things right; draw off the vitiated air; nature will do the rest if you give her fair play.

887. You have explained your objections to the system that

that you found in operation in the House of Commons for the purpose of ventilating it; will you have the goodness to inform the Committee whether you have had under your control, for the purposes of ventilation, the Court of Common Pleas and the Court of Exchequer?—Yes.

888. Will you have the goodness to give as popular a statement as you can of your method of ventilating the courts of law, of which we heard some evidence just now, which probably will illustrate to the Committee the method you would adopt, in case, as you propose in your Report, the ventilation of the House of Commons should be committed to your care?—The ventilation of the courts is in accordance with the evidence which I gave to the House of Lords in 1846, and to the House of Commons. The mode of ventilating the Court of Exchequer is downwards. The vitiated air is drawn away by a steam jet placed in a chimney opening into and very near the floor of the Court. The air comes into a chamber below the floor, and it is drawn out by a steam jet, and sent into the open atmosphere. This steam jet is under the management and control of the man in the charge, who opens or shuts the stop-cock more or less as he requires power; he has the power of producing any amount of draught he pleases. The air comes in from above unrestricted and unthrottled, so that the pneumatic balance between the court and the external atmosphere is preserved. Baron Parke sometimes likes the windows open, and we find no inconvenience from this opening; the cold air does not come in through those windows, as might be supposed, in sufficient quantity to make an unpleasant draught. During frost his Lordship will sometimes have the windows open, when the temperature inside is not above 60 degrees.

889. At what height above the head of the persons in the court are those windows?—They are about two-thirds of the distance between the floor and the roof.

890. What is the height of the whole building?—Thirty feet, I think; I am not quite certain.

891. Are the Committee to understand that the air which is brought in through the top is drawn immediately from the external air, or that it is tempered in its passage?—It is drawn immediately from the external air, and the chilliness is taken from it in cold weather as it passes.

892. By what means?—By drawing it through a warming apparatus; an apparatus founded on the laws of conduction contrived for the purpose.

893. What do you mean by warming by conduction?—The

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The usual mode of warming by steam or hot water is to pass water or steam through iron tubes, and the heat passes directly through the metal, and immediately from the surface to the surrounding air. In the apparatus at the courts, the steam or warm water is passed into a small vessel, to which there are metallic leaves connected; those leaves are warmed by conduction. The heat in the box is always constant; so that as fast as the heat is conducted away by those leaves, it is supplied again by the steam pipe which enters the box; by this means the leaves are always of the same temperature. They present a very extensive heating surface in a small compass; there are 100 feet of warming surface presented in a cubic foot of space.

894. Are they metallic leaves?—Yes, they are made of zinc. This plan reduces the warming apparatus to a very simple and small form. The apparatus designed for warming this House is like that previously in use at the courts; it is very large and heavy; with such a mass we could not get the temperature either up or down as we wanted it; when warmed it could not be cooled, and when cold it could not be warmed without inconvenience and loss of time; by the apparatus we use we can do it in a few minutes one way or other.

895. Mr. *Locke*.] Where is the apparatus placed?—The apparatus is placed above the roof for tempering the in-coming air; before the court is opened it is generally warmed from a part of the apparatus below, but when the court is sitting it is warmed at the upper level.

896. *Chairman*.] Is it warmed by radiation from below?—No; before the court sits, it is warmed by interchange; the warm air ascends, and the cold air descends.

897. You state that the court is warmed from below before the sittings commence in the morning. Have you any mechanical apparatus under the floor by which the floor is warmed?—No.

898. How, then, is the floor warmed?—The air warms the floor as it passes from below up and down through those "batteries," as we call them. The air warms of itself. An interchange takes place by change of atmosphere until the mean is obtained.

899. You have two sets of apparatus, one above and one below?—Yes.

900. Before the court is opened, you make use of the apparatus below to warm the atmosphere of the court?—Before the ventilation is set on we warm the atmosphere of the court from below.

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901. Will you describe to the Committee how you warm the atmosphere of the court before the court sits?—Before the court sits the steam or hot water is passed through those boxes or "batteries." The atmosphere of the court is warmed in consequence of warm air passing up; its place is supplied by cooler air which moves down from above; it goes gradually round and round till the whole atmosphere of the court becomes of a uniform temperature; when it arrives to about 60 degrees, the man turns off the stop-cock.

902. As respects this apparatus which is underneath the court, are there any channels which communicate with the external air in order to feed it?—No, not at this time.

903. It merely heats the atmosphere of the court?—Yes; he draws out the whole of the atmosphere of the court before he begins to warm, and then the fresh air is brought up to about 60 degrees before the court sits in the morning.

904. Are there channels of ingress from this heating apparatus below the court which lead from the apparatus to the court itself?—Between the floor below where the apparatus stands and the court there are communications; there are openings in the floor.

905. When the court begins its sittings, are those channels closed?—No; these channels are still open; the vitiated air is drawn down through them; when the jet is turned on fresh air comes in from above, and the vitiated air is drawn away below.

906. Is the channel by which the vitiated air is carried down from below, the same that the court is warmed by?—No.

907. Is there a steam jet underneath the court?—At the side of the court.

908. How does the air from underneath the court get to this steam jet?—There are passages prepared for the purpose.

909. It first is carried underneath the court?—Yes, and then it is drawn up and escapes through the chimney.

910. So that this operation is in action all the time the prepared air is descending from the top?—Yes; at the time fresh air is coming in, the vitiated air is drawn out by the jet. More or less power from the jet is turned on and off according to the requirements of the court; and fixed in accordance to the pressure gauge connected with the anemometer provided for the purpose.

911. Does the vitiated air only escape by the bottom of the court?—Principally.

912. What

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912. What other escape is there?—There is a little escape provided through the lanthorn by a small self-acting Venetian valve; this small escapage is to take off a certain gas which I find formed from respiration, and which I find is much lighter than the atmosphere.

913. Sir *D. Norreys.*] The difference in principle between your system and that adopted by Dr. Reid, and also partly by Sir Charles Barry, seems to be that instead of a furnace drawing off the air, either downwards or upwards, you adopt a steam jet as your tractive power, and instead of using tubes filled either with hot water or steam, as adopted by Dr. Reid and Sir Charles Barry, you adopt parallelograms which you call "leaves"?—An apparatus which we call "warming batteries;" they are called so on account of being in form like the galvanic battery.

914. Admitting that Sir Charles Barry and Dr. Reid may not employ that principle so mechanically well as you do, and may not produce so good a result, in what does your system differ, as regards its principle, from the system adopted by them, namely, that there shall be some power driving upwards or downwards air of one description, and that the air to be supplied in its place shall be brought to a certain temperature before it is so supplied?—The difference between Sir Charles Barry's principle and the one adopted in the courts of law, is that we have one power only, which is an extracting power. Sir Charles Barry has a fanner for injection, so that he may keep up, by the force of injection; and at the same time by a simultaneous action which is going on above, an exact balance in the House of Lords is preserved; the balance is adjusted by these powers. The air in Sir Charles Barry's system at the House of Lords comes in at a high level, and goes out at a high level. In the system I have adopted it comes in at a high level, but goes out at a low level. We have the means of sending it out also at a high level, but if that is done, the court is not so comfortable; we like the other better.

915. So far as the Committee can judge from your last answer, the difference between you is simply that you, in your system, do not consider the fan requisite?—I do not; I think it unnecessary.

916. When you reject the fan, must you not apply a great force of traction?—No; when you reject the fan you must increase the areas for the ingress of air, so that the atmosphere shall pass freely, without friction, and without any obstruction; so that the break of balance, which would be otherwise produced, shall never happen. It is self-evident, if air can

of

of itself go in freely, it will do so, and much better than can be done by artificial forcing; give it room enough and it will restore the balance of itself, as it is required.

917. Have you examimed the principle upon which the House of Lords is ventilated?—Not lately. I examined it 12 months ago, at the request of Lord Lansdowne; two years ago I also examined it at his Lordship's request.

918. You are not prepared to give any opinion upon it?—Not from observation lately in the House of Lords. I am prepared to give an opinion upon the system of ventilation of the committee-rooms of this House.

919. With respect to the vacuum which is formed in the House of Commons, which you say is too rapidly supplied, may not the present mode of lighting the House be to a great extent the cause of that excessive vacuum, which you believe to create currents?—I do not think so.

920. Is not that amount of gas light continually burning at the ceiling equivalent to an increased furnace for drawing upwards the lower stratum of air?—It assists ventilation; but it slightly disturbs the atmosphere of the House at the upper stratum, by producing what is called "the pneumatic flower-pot." The air goes up in a column from the chandelier, by being warmed, and strikes the panels, and *ricochets*, or falls down again a short distance only into the atmosphere of the House. This interchange takes place in the House.

921. Would not that depend upon the fact, whether or not there were openings in the ceiling to allow the air to escape, so that it should not descend again into the House in the mode in which you describe?—Certainly.

922. *Chairman.*] Would there not also be a great obstruction to your downward current, supposing the House were supplied from the top, in the way in which you supply the Court of Exchequer; would not that body of heated air, radiating all along the roof, form a great inconvenience to you in your operation?—Yes, it would warm the air, and that when the air was too hot before, would be an evil; in the summer time it would be insufferable. The lights must be insulated, as they were in the old House.

923. Mr. *Locke.*] Would the lighting materially interfere with your process of drawing down the air from the ceiling?—Not if the lights were insulated, as they were in the old House. I could point out a simple means to insulate them from heat; the products of combustion are now carried away separately, but the heat from the metal is not, or it is surrounded by a non-conducting body.

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924. Are the products of combustion from those lamps now taken away?—They are, but the heat is not; the gaseous products of combustion are taken away, and as they pass through the tubes their heat is communicated to a large mass of metal; the whole of that metal becomes hot, and radiates heat offensively. In the old House of Commons the products of combustion and heat went away directly through a pipe which was entirely insulated, so that none of the products of combustion or heat came from the lights into the House.

925. Sir *D. Norreys.*] You have objected to the use of a fan as creating currents; is not it the fact that both in the system of Sir Charles Barry and that of Dr. Reid, any current which is produced by those fans is so diffused through a large space, and intended to pass through so diffused an area in the floor of the House, and under the seats, that anything like a forcible action of that current is lost before it can enter the House?—I do not think it is.

926. Mr. *Locke.*] The Committee understand you to think that it is not necessary to have two powers in action, namely, the fan at one end and the jet at the other?—It is not necessary, but objectionable, certainly.

927. Do you think it would be possible, having both the power of forcing and the power of drawing, so to regulate them as to produce a perfect equilibrium, or nearly so, throughout the House; it would always be an approximation?—It is possible but very difficult; it would always be liable to disturbance.

928. Do you think it would be more easy to get a perfect system of ventilation by the use of the jet alone, or by having a double power, the one drawing and the other forcing?—By the single power.

929. You think it would be better to have the jet only?—The jet, or some other motive equivalent; if you prefer the forcing principle, the air jet is the best.

930. You are of opinion that, in any circumstances, whether you draw the air down from the roof or take it from the floor, and allow its exit at the roof, one power gives you more facility for the control of the ventilation than having both in operation?—Certainly.

931. *Chairman.*] In this system of tempering the air by conduction, do you consider that the air contracts any impurities by the change which occurs, after it is taken from the outside of the building to the time it enters the Court?—No, I do not; the temperature is never raised above 100 degrees.

932. Is it ever raised to 90 degrees?—It may sometimes reach 100 degrees, but very rarely.

933. When

933. When it does so, then the air suffers?—It would suffer in that case, I believe; at least such seems to be the result of experiments which I have made. *G. Gurney, Esq.* 1 April 1852.

934. How often do you think it is raised to that temperature?—Very seldom; for a few minutes possibly, in case they want in very cold weather to get the temperature up rapidly, and use high-pressure steam.

935. Are the leaves in your apparatus hollow or solid?—They are solid; they have a metallic contact with the chamber. The temperature of the chamber is always at a constant elevation; the heat steals away through those leaves, and becomes diffused throughout by conduction; the air is warmed by passing between the series of leaves.

936. Are those leaves heated by a box filled with water, or by a fire underneath them?—By a box filled either with water or steam.

937. Practically, which do you use?—We use low-pressure steam.

938. That warms, both above and below, those leaves through which the air passes?—The leaves are in metallic contact with the sides, so that the box itself is not the warming surface. The air passes between the leaves; they are about half an inch apart, and the air passing between them becomes tempered and warmed.

939. Mr. *Locke.*] You take care that it shall not be heated above 100 degrees?—It is hardly possible that it can be.

940. Mr. *Greene.*] A certain portion of that box is exposed to the air, is not it?—A very few inches, not one-fiftieth of the whole; the box presents a very small surface to the atmosphere, and, if desirable, might be covered so as to exclude the air from it.

941. You say that there is a certain degree of injury to the air by passing over a considerable degree of metallic surface?—Yes, if the surface is too hot, and the air above 100 degrees.

942. If it is below 90 degrees, you do not think there is any injury done to the air by passing over that surface?—No; if you have the temperature of the pipes, when and where used, no higher than will warm the air under 100 degrees, you must have for practical purposes a very large mass of surface; too large to be admitted.

943. Mr. *Locke.*] Would you run the risk of increasing the temperature of the air beyond 80 degrees, by your great desire to combine compactness with the other features of your apparatus?—No.

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944. Do you practically in the courts of law now work to above 90 degrees?—We do not.

945. Mr. *Hope.*] Would the application of your plan to the House of Commons be attended with much difficulty or expense?—No; I think the brattices might be made for less than 100*l.*

946. Viscount *Ebrington.*] Drawing hot air down from above is reversing the natural order of things, is it not?—You require an equivalent power.

947. *Chairman.*] You have stated in your report, that if the entire control of the ventilation of the House of Commons were placed in your hands for a short time, say a week, you would pledge yourself to remove all the material evils which at present exist, at a very trifling expense. With the mechanical means which you find in existence, could you put into operation your plan of ventilating the House of Commons, in the same manner as you have described with respect to the Court of Exchequer?—Not precisely in the same way in which we supply the Court of Exchequer. My report states that I pledge myself to remove "the material evils;" by those I mean the draughts and the desiccated state of the atmosphere.

948. How would you propose to operate?—By doing away with the fan below, and enlarging the openings so that the air may come in freely without interruption; so that it may restore of itself the break of balance between the external and the internal atmosphere, through the channels I should provide for it, at a less rate of current than 11 feet per minute.

949. Mr. *Locke.*] Would you preserve the present warming apparatus?—I should do so, because I find it there, as a matter of saving of expense and time.

950. Would you enlarge the openings into the present House?—Certainly; I should enlarge the sum of them in the House itself, and make other arrangements above and below.

951. Would you alter any of the material arrangements for the exit?—No; I should not.

952. Supposing you took away the fan, and relied entirely upon your power of drawing or sucking the air out of the building, would any of the other apertures or any of the other air channels be dispensed with, or would you keep them all in their present state?—I should enlarge them generally, and remove the *vena contracta.* The air at present is throttled; to get to the House it is obstructed by mechanical interferences below the hair carpet, which I should remove the first thing.

953. Do

953. Do you believe that the permanent accesses for the air are large enough at present?—I do not.

954. How would you propose to enlarge them?—By taking away the obstructions, so as to allow the air to pass with facility.

955. Have you any recollection of what the air accesses are which you think are not large enough?—Yes.

956. Would you continue to allow the air to be brought in from the tower which is now used?—I should prefer the Clock Tower, but I should not care about its coming through the courts for the present; I think the air from the courts is sufficiently pure for the present purpose; it is not that source which I would take it from as a permanency, but it is a source I would take it from now to show that those material evils to which I have adverted could be removed. The air is taken from that source now, and therefore you would not have a worse condition of air than you have at present.

957. How long have you ventilated the Court of Exchequer?—I think the apparatus was fitted up in the vacation of 1850.

958. About a year and a half since?—Yes; it was fitted up by the Office of Woods under my direction.

959. Where does the air come from which you supply?—It is taken from above the courts.

960. Have you ever got bad air in?—No; there was bad air which they used to complain of before I ventilated it, but now the air is pure.

961. *Chairman.*] Do you consider it absolutely necessary, for the comfort of the House of Commons, that there should be a vast variety of sources; for instance, the Victoria Tower on the one side, and the Clock Tower on the other, and various places about the courts from which to take fresh air for the purpose of ventilation?—I do not; I think that you might find one source sufficiently pure under all conditions of the atmosphere.

962. Mr. *Drummond.*] Is there any sensible difference on analysis between the air at the top of the Clock Tower and the air in the courts?—Nothing that chemistry can detect.

963. Mr. *Locke.*] Do you think that the vaults through which the air from the Clock Tower or the Victoria Tower is drawn at all prejudice the air?—I think they need not; the vaults are rather damp, but not more so than you generally find.

964. It is not a part of your plan to reject those vaults as a means of obtaining air?—No.

965. *Chairman.*] Have you mentioned the present area for the access of air to the House of Commons?—I have.

966. Do you think it sufficient?—I do not; the air now enters

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enters the House through a portion only of the hair-cloth carpet; in which there are a great number of interstices, but the sum of the whole is not much; there is also a power of obstruction which we have not yet gone into, which is technically called the *vena contracta*. There is an opposition arising from the air having to pass through those small interstices which entails upon the shaft great force to overcome, and occasions the air to enter with great rapidity; if it strike the legs it produces a feeling of cold water.

967. What is the extent of the area of access?—The exact sum of those openings would be very difficult to ascertain; the facility with which the air passes cannot be accurately measured by the anemometers; but we can approach it by calculation by measuring the difference between the pressure below and above by the differential gauge.

968. Mr. *Locke*.] Do you think that the passage of the air through the carpet very much hinders its ingress into the House?—Certainly. The air in the present House comes in only through the centre of the floor, behind the Speaker's chair, and under the Peers' benches; it is cut off below from the other parts of the House. I think that more air would come through an open area of ten feet, than through the whole of the present interstices; it is not sufficient for the requirements of the House, and consequently it comes in at the doors whenever it can.

969. Do you suppose that the principle on which the air is obstructed in passing through the carpet is similar in some measure to that which in a safety lamp prevents the flame from passing through?—Yes; and consequently it requires a larger amount of pressure or exhaustion to get a proper quantity through. The sum of the area was larger in the old House.

970. Do you think that the passage of the air through a carpet of that sort must have the effect of carrying with it particles of dust lying in the carpet?—Certainly; because the air which does come through, must pass at a greatly accelerated speed; and raises dust from the disturbance, which I have described, in my diagram of the effects of a stream entering a pond, to the Committe.

971. Would not that be facilitated by persons walking over the carpet when the air was passing through?—Yes.

972. You have probably heard of the complaints of the disposition to cough, which is produced in some Members by the state of the air in the House?—Yes; some experiments have been made on the subject.

973. May not that have arisen, in your judgment, from the dust

dust which is carried up from the carpet?—Partly; and partly from portions of the air, forming the atmosphere of the House, having been previously over-heated.

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974. Mr. *Drummond.*] Supposing one aperture to be of the dimensions of 10 feet, and supposing the sum of the small apertures through the carpet to be equal to 10 feet, still would there not come a larger quantity of air through the single aperture, than through all the rest put together?—Certainly; the laws of the *vena contracta* will stop it in the small opening.

975. *Chairman.*] In your report you have spoken of having met with interruptions; Dr. Reid does not like to have it supposed that he has put interruptions in your way; will you explain what you mean?—I have not yet said that they arose from Dr. Reid. Several gentlemen in whom I had confidence, came at some inconvenience and expense from a distance to assist me in my inquiry. An appointment was made with Dr. Reid by the officer of the Board of Works, for us to examine the amount of inlet and outlet of the air; we attended the appointment, accompanied by the officer from the Board, and measured accurately the outlet of the air; we now were going to examine the inlet to determine the amount of leakages from foreign sources, when Dr. Reid objected to our going down; of course, the whole of our time and the expense of these gentlemen was thrown away. They left with disgust, were very much displeased, and the experiment went for nothing; for unless they had ascertained the quantity of air going in, and at the same time going out, we could get at nothing satisfactory, nor make any after experiment that would be of use to enable me to report to the House. On another occasion Dr. Reid first objected to some other scientific friends passing without giving their names. The names were given by the officer from the Board of Works; they were never sought to be withheld. Dr. Reid personally knew those gentlemen. The names, however, were, as I have stated, given, so that difficulty was removed; still we were not permitted to make any examination; he said he would not have the House put under the conditions which we required, because the application was not in writing. I now desired the clerk of the works, who was the channel of communication appointed by the Office of Works, to communicate with Dr. Reid by letter; he expressed a wish from me to have the House put in "its working condition" at any convenient time, so that we might examine it. The answer to that was, that "his letter was so vague that he could not understand it." It was useless asking for other appointments, and I sent the correspondence to the Office of Works.

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976. The principal interruption on the part of Dr. Reid was this, that he objected to your examining the inlet below?—Yes, the first time.

977. (To Dr. *Reid.*) You have heard what Mr. Gurney has stated; will you have the goodness to state whether you have anything to advance in reply to it?—When Mr. Gurney's name was placed on the votes of the House of Commons, and I saw he was instructed to make a report, I know of nothing that I have done, except to give him every facility which a gentleman and a man of science could require. When Mr. Gurney came, I asked him into the cabinet-room, in which I happened to be sitting at the time. I offered to give him the explanations which would enable him to make an examination, and to submit to him every drawing of the structure. As he was going away to examine it, I put him in communication with Mr. Pattison and Mr. Blake, that they might attend him, and that he might not be troubled with my presence if he did not wish it. To my surprise, however, I found outside a whole host of people, seven or eight in number, among them there being several mining engineers whom I had known at Newcastle. I found a professor from University College, and several other professional gentlemen. I then thought that if a commission were to examine the House, at least I should have the names; and I said, "Give me the names." Mr. Gurney did not give me the names, and they were not introduced. Then I gave Mr. Pattison instructions that the whole world might enter with Mr. Gurney if he chose, upon the names being given; but that if they would not give their names, no such gentlemen were to enter. I afterwards consulted with The Speaker, with Lord John Manners, and with other Members; and they thought it was quite fair that Mr. Gurney should give me the names of the professional gentlemen who came to examine an unfinished work; secondly, on a certain day your Lordship brought several gentlemen to meet me at five o'clock in the afternoon. Mr. Gurney arranged that he would come the next day at eleven; but I dare say your Lordship may recollect, that to suit the convenience of some of those gentlemen, I made, under your Lordship's directions, but without any reference to Mr. Gurney, or any desire to interrupt him, and without knowing what he was to do, an appointment for the next day; so that I had two gentlemen to meet at 10 o'clock; another gentleman was coming at 12, and Mr. Gurney was coming at 11, the intermediate hour. I had therefore to attend to the other duties of the House, and to provide for attending upon three parties from the House

and

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and from the Committee. Mr. Gurney proceeded to take observations on the roof, the channels of supply being shut while he saw the exit. I objected to that; I said, "You cannot observe the exit properly, unless you see the ingress." His words to me were, "We do not want any talking; we will take our observations, and speak afterwards." Then I said, I should object to the experiments. That was the spirit in which I was met. At 12 o'clock he came down to the House; and I said, as he had a special appointment, and wished to take evidence as to the ingress of the channels, I should at once speak to the other gentlemen who are now here, and request them to stop till he went down below, and took observations with the gentlemen in attendance; he said, "No, he would not do it; he would rather attend at another time;" these facts took place before a number of witnesses. I declare to the Committee that I have done everything to assist Mr. Gurney; but he experiments in the dark, without a knowledge of the structure. That is my answer to his evidence. —(Mr. *Gurney.*) Seeing the excited state in which Dr. Reid was when he called the officer of the Board, Professor Haum, and myself into the cabinet room, I declined to communicate personally with him, because the officer of the Board of Works was appointed to be the channel of communication. I now submit that that officer had better be called, who can state exactly what the circumstances were. I think it right to say I did not take a single step without him. I told him what I wished, and he communicated with Dr. Reid. I thought it best to have no personal communication with Dr. Reid, as my conversation might be mistaken.

978. Viscount *Ebrington.*] With regard to the apparatus, of which you have produced a specimen, for heating the courts of justice, is it not the fact that that battery consists of plates of zinc which are heated by contact with a chamber containing steam?—Yes, or warm water.

979. What is the temperature of the steam in the chamber?—Two hundred and twelve degrees.

980. Is the surface of that chamber brought by the steam to about the same temperature?—The surface of the chamber is brought to 212 degrees.

981. The plates, I conclude, are at 212 degrees where they are in contact with the chamber, and they become rather less hot as you approach their extremities?—Yes.

982. Can you tell the Committee what is the temperature of the extremities of those plates?—The temperature of the extremities

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extremities is somewhere about 110 or 112 degrees, depending of course to some extent upon the atmosphere outside.

983. The air, as I understand, has access to the heated surface, not only of the outer extremities of those leaves which you have stated to be at a temperature of about 112 degree, but to the surface of those leaves from the outer portion to the point where they join the steam chamber, and to the surface of the chamber itself?—Yes, the chamber presenting a very small surface in comparison with that of the leaves.

984. The air is heated by contact with those surfaces?—By passing between those surfaces.

985. Is it not your opinion that if contact with surfaces at a temperature above 90 degrees is injurious to the chemical character of the air, that effect must be produced upon air passing through such a machine as that?—No; my observation applied to air heated above 90 degrees. If the heat of the air be at 30 degrees, it may pass over a surface which is hotter than that, and not rise higher than 90 degrees. You may pass it over a surface at 212 degrees, and still the air may not rise above 90 degrees. If you kept it in contact with it without moving, for a time, the air would arrive at last at the same temperature as the box; but being in motion, and disturbed by the change in its temperature as it rises, it never gets beyond this temperature.

986. You believe it can pass between two plates varying in temperature, in their different parts, from 112 degrees at their extremities, to 212 degrees at the point of contact with the steam chamber, for a length of two feet or two feet and a half, without at any moment being itself brought to a higher temperature than 90 degrees?—Yes.

987. Have you ever placed a thermometer in the current of air ascending from between two of those plates, at the top?—When you put a thermometer close to those plates, you have the direct radiation from the box, which affects it a little. But placing it a few inches above the box, in the warmed air, you will find the temperature never exceeds 100 degrees.

988. It is only your own opinion that the air is never raised to that heat. You have not any means of showing it, have you?—Yes; we can show it when in action, by putting a thermometer into the current as it rises.

989. Does not the air on each side give off heat?—The air on each side is drawn in.

990. *Chairman.*] What quantity of air do you give to each person in the Courts of Exchequer and Common Pleas?—About

About seven feet; we draw about 7,000 feet per minute through the three courts.

991. Is that air drawn from the outside of the court, or is it the air of the court?—For every foot of air that we draw out, a foot of fresh air comes in from above, so that the escape is an exact measure of the inlet.

992. When you speak of there being a vacuum movement in the House of Commons, do you mean to say, that you have never noticed the plenum movement in operation in the House of Commons?—Never; I have never observed that the static balance in the House of Commons has ever approached to an equality; certainly never to such an extent as to induce air to go outwards; if so, there would be no current of air inwards through the passages.

993. Have you never noticed the windows open at the closets and urinals?—I have. The air is drawn in there, particularly that near the Reporters and Ladies' Gallery.

994. Ought those windows to be shut, or is the air that is felt rushing in from them in consequence of the want of plenum ventilation?—The air which rushes in there, does so from the same cause as it rushes through every other opening. If there were a balance between the external and internal air, the air would not be disposed to come in; a very small force would carry the whole out from those particular places, the ordinary existing force.

995. Have you turned your attention to the ventilation of the Committee-rooms?—I have been through many of the Committee-rooms, and through most of the chambers of this part of the building twice, but it is such an immense place that it will occupy me very considerably more time to obtain an accurate notion about it. I have examined experimentally the ventilation of some of the Committee-rooms, but it has not been so perfectly done as I could wish.

996. With regard to the warming of the House, how do you disconnect the warming from the ventilation?—The warming of the House at present is by hot-water apparatus, which is confined to one particular chamber; the air is warmed in the chamber too high; at least, part is warmed too high to bring up the rest. The warming air is thus made too hot; part of it finds its way into the House, before it is unheated by mixture with cooler air.

997. By what means is the House warmed?—The House is warmed by a coil, or series of zigzag iron pipes, through which hot water passes.

998. Where are they placed?—They are placed in a small chamber

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chamber in the second chamber below the House. There are three floors below the House, namely, a basement or ground-floor, a first floor, a second floor; the House being above the second floor. The warming is in the middle chamber; there is a warm-water apparatus in the centre of that chamber of very considerable dimensions.

999. Is not that what Dr. Reid calls the tempering chamber?—The mixing chamber, the one above; the great apparatus for warming is in a room in the centre of the second flat, and is either cut off or made to communicate with the other part of the chamber by the opening or shutting of doors.

1000. Do you mean that when the House requires more warming certain doors are open, and when it requires less they are shut?—Yes; when it requires more warmth those doors are opened which communicate with the coil-chamber; when it requires less warmth those doors are shut. There are also steam-pipes going to various parts of the floor of the House, some under the front row of the Opposition seats, some to the first row of Ministerial seats near the table; some, I believe, go to The Speaker and corridors. There is such a number and complexity that I can scarcely tell where they go at present; I believe the whole of those parts of the building are heated in the same manner, by those pipes carrying hot water or steam.

1001. That hot-water apparatus is connected with the House by certain channels, is not it?—From the heated chamber the air which is warmed comes out into the second floor, and mixes with cold air as it comes up from below from the fanner.

1002. That is a portion of the ventilation of the House, is not it?—No, the ventilation of the House is from above; the motive power is above; the extracting or up-cast shaft is in the roof.

1003. Does not the hot air which arises from this apparatus of pipes, mix with all the air which is introduced through the bottom of the House of Commons?—It does not mix with the whole; it mixes only to some extent with it; it gives a greater buoyancy to some parts of the atmosphere of the House than others.

1004. Is not that intended to form part of the air which is introduced into the House, by the Speaker's chair, under the table and through the carpet?—Yes.

1005. What is your objection to that?—I presume the question is as to the apparatus. My objection is, that it is too great a mass of matter, heating portions of the air too high. A tube lying horizontally forms an eddy above on which the air

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air remains too long in contact so as to get overheated. The upper part of the tube is always in consequence found to be at a much higher temperature than the lower part.

1006. In your opinion does the air get desiccated by that operation?—Yes; small portions.

1007. Do you imagine that to be the cause of the disagreeable sensation of which the Members complain?—Partly so, but not entirely; the desiccated ferruginous state of the air which I have reported is added to from impurities drawn in from channels which were never intended.

1008. The desiccated air which has been very much complained of is, you conceive, produced by that overheating of the coils?—Yes, a good deal; supposing it to be occasioned by dryness. I have taken the hygrometric state of the House in different parts; I find that in the table of the House there is about 10 degrees break of the hygrometer, 11 degrees in the lobby, in the galiery nine degrees. In the ante-room, that is, the room adjoining the corridor, the break is only four degrees. At the Peers' seats it stood at 10 degrees. This examination was on the 21st of March, at 10 o'clock at night.

1009. What is the number of degrees which you consider necessary that the air may be wholesome?—I think the most healthy is from about four degrees to five degrees.

1010. Viscount *Ebrington.*] Do the smaller numbers represent greater dryness in the air?—No, greater humidity.

1011. Mr. *Drummond.*] Suppose you had a column of air at a temperature of 200 degrees, and supposing you had an equal column at 50 degrees, in how long a time would they equalize so as to arrive at the mean?—Presuming those columns to be in a room, free to move, they would do so in a very little while. The ascending pillar of warm air would go up, disperse itself over the ceiling, mix in its passage, and so fall back towards the floor.

1012. So that there would be two columns in motion at the same time?—Yes; the descending volume of air would fall in unequal temperature at the sides till equalization was established. This action is one cause of the oppressive feeling in the House.

1013. *Chairman.*] Do you consider the apparatus which you have described to the Committee as being underneath the floor at the Court of Exchequer to be a warming apparatus?—Yes.

1014. You would always have that, as well as a ventilating apparatus above, for the purpose of warming any large building?—That, or some other, for warming. The ventilating

apparatus

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apparatus is another thing; in the Exchequer it is a steam jet, connected to the lower part of the building.

1015. You must have a warming apparatus as well as a tempering apparatus?—In cold weather, when it is necessary to keep the temperature of the building to a certain point above the outer air, the atmosphere ought to be raised in cold weather to 60 degrees, or nearly so, before it is brought in.

1016. It will not do to bring it in through the ceiling downwards without having previously warmed it from beneath?—It does not require to be of the same temperature exactly, because it partly warms as it comes down.

1017. Mr. *Locke.*] It is not necessary that the building should be first warmed from below, and afterwards ventilated from above?—No; it is matter of convenience.

1018. You might, if necessary, warm it from the top just as effectually as from the bottom?—Yes, it is a matter of convenience.

1019. *Chairman.*] Are the Committee to understand that you do not consider that the warming apparatus at the House of Commons would be at all necessary if your own system were in execution?—You must warm the air by some apparatus or other; I might prefer another; but if I were to make the experiment now proposed, I should not disturb that apparatus, but alter its condition; what I propose to do, and have pledged myself to do, is to remove the material evils.

1020. Mr. *Locke.*] You would use for that purpose the warming apparatus as it exists; you would enlarge the channels of communication with the House, and you would adopt a power for producing such a current as should not be objectionable in the House?—Certainly so.

1021. *Chairman.*] Have you seen among Dr. Reid's machinery an apparatus in the roof for warming the air supplied to the House?—There are coils of small pipes which may be intended for it; there was no warmth in them when I saw them.

1022. Did you inquire whether Dr. Reid's apparatus when completed would present a ferruginous surface?—If the system of ventilation is reversed, the system of warming the air will be reversed; it will take place in the in-coming shaft, and if so, the same ferruginous effect upon the atmosphere will be produced.

1023. Mr. *Locke.*] Is the warming apparatus of the House of Commons totally distinct from what may be called the apparatus for heating air for the purposes of ventilation?—Yes, one is at the bottom, and the other is at the top of the House.

1024. *Chairman.*]

1024. *Chairman.*] Does not the cold which comes from the various sources of supply pass into this chamber, where the warming apparatus is?—Not all.

1025. Does not it pass from thence into the House of Commons?—Yes; and adds to the buoyancy of the air in the House, but it is no element of the ventilation. The motive powers for ventilation are the shaft above and the fan below.

1026. Does not the fan operate in any way upon that heating apparatus?—Yes; the fan brings the air into the first chamber, then it passes into the second, where it is partially heated. Part of it passes into the next cold, and part of it passes hot; it all goes into the third chamber, where it is mixed.

1027. What is the Committee to understand you to mean, when you speak of it as having nothing to do with the motive power of ventilation?—Cold air or warm air of course will produce the changes we have spoken of in an atmosphere at rest, but it forms no part of the cause by which the motive power is produced.

1028. Mr. *Locke.*] It is a part of the machinery which warms the air which ventilates and supplies the House of Commons?—Yes.

1029. Mr. *Drummond.*] Whether you have machinery, or whether you have not, hot air will go out at the top, and cold air will come in at the bottom?—Certainly, if openings are made for it.

1030. Viscount *Ebrington.*] Is the apparatus which you employ in the courts of law covered with silk, or any other material?—It is, where it is in sight. In the Judges' passage there is a battery which is covered with silk by the sides; it is open at the bottom and also at the top.

1031. Would not that silk tend to prevent the air from escaping between the leaves, and so tend to convert the leaves into pipes containing air, which goes in at the bottom and goes out at the top?—Yes.

1032. So that the air will be detained longer in contact with a surface heated above 112 degrees?—Yes.

1033. That covering of silk will prevent the free communication between the air outside and the air inside?—Yes.

1034. Mr. *Locke.*] Do you produce that apparatus which you have described for any other object than to show that it is an apparatus for warming, which is very portable?—To show that it exposes a very large surface for warming in a small compass, which surface is at a comparatively low temperature, and never heats air above its proper temperature.

1035. There

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1035. There is no other advantage than that?—No.

1036. *Chairman.*] You have stated your plan of warming and ventilating the Court of Exchequer in winter; how do you proceed in summer, in order to cool the air?—The air is cooled by what is called "the spray jet." It is an invention of Mr. Cayley's, the barrister, the son of the member for the North Riding, which we had recourse to within the last twelve months. Water is driven by a compressed jet of air, or high-pressure steam, one tube acting within another, like the oxy-hydrogen blowpipe, into spray, which cools air very rapidly. When we find by the hygrometer that the air is taking up too much water, so that the hygrometer shows a break below 5 degrees, air is then passed through the same battery or apparatus, which battery becomes reversed in its action by being filled with cold water instead of hot; instead of being filled with steam, it is then filled with water at a lower temperature than the atmosphere. If you employ ice water, the cooling power is very rapid; or freezing mixtures so rapid that you may bring the air down below 40 degrees, and it falls out at the bottom between the leaves of the apparatus.

1037. Where is the spray jet placed in the Court of Exchequer?—It is at the inlet of the air.

1038. In point of fact, the air is cooled by means of a little shower of water?—It is cooled by the spray jet and by the batteries; if by the battery, it is supplied with cold water from our deep wells, the temperature of which in summer is about 50 degrees; it may be further cooled by the spray jet as it passes into the boxes of the batteries.

1039. Have you ever used any chemical means of purifying air in habitable buildings?—No.

1040. Sir *D. Norreys.*] As a chemist, what is your opinion of the power of relieving air of impurities, either in smell or quality, when that air is required in large quantities?—The process which has been adopted in a large manufactory on the other side of the water, where the escape of smell was so great as to be an annoyance to the whole neighbourhood, was, by driving the impurities, by means of a steam jet, through a fire at a white heat.

1041. Did not that destroy the air?—It burnt the air and the offensive particles which were floating about in it.

1042. Is it your opinion that where air is required in large quantities, it can by any chemical process be cured of its impurities?—I know practically of no such process: chloride of lime is used to correct smells; the chlorine partly acts on the hydrosulphurets, but it seems to act on the principle of one smell

smell overpowering another. I do not think that any chemical change is effected by it of the atmosphere. There is an effect produced by electricity or galvanism, and on oxygen of the air, called ozone. It is said there was none of it in the atmosphere when the cholera was here. I know of no means of profitable interference with the air; we had better take it as we find it.

1043. You have the power of giving moisture to air which is too dry, have not you?—Yes.

1044. You have stated in your report that we have the misfortune in the House of Commons of living in a ferruginous atmosphere. Is it possible to cure that evil after the air has passed through the processes which give it that ferruginous quality?—Very difficult, if not impossible.

1045. Mr. *Drummond.*] With respect to the chemicals to be employed, must not they depend upon whether the noxious matter to be got rid of is organic or not?—Yes, upon its character. If nitrogen is in excess, you would give it oxygen; if oxygen were in excess, you would give it nitrogen. If carbonic acid were in excess, you would withdraw it by lime water or some other process. Those processes, however, are applicable enough on a small scale in a chemical laboratory, but they will not do in the question before the Committee.

1046. *Chairman.*] When the air is cooled by the spray jet does that affect the moisture of the air?—Yes. When we find the air has enough moistness by the spray, the compressed air is stopped, and the air for ventilation is then passed through those batteries and cooled by simple contact. A portion is passed through one or through the other, so as to keep the hygrometer at a break of about four or five degrees.

1047. Do you keep up any heat among the leaves of your apparatus in summer?—No; the leaves are brought down as low as possible.

1048. Do you know who invented the spray jet?—Mr. Cayley, the barrister; he went with me to a great experiment in the north, in which it was important we should cool very rapidly, and on a very large scale, volumes of the atmosphere; he suggested the possibility of dividing the water mechanically, so that it might be held in suspension, and the air fully cooled and saturated; cooled by evaporation, by taking up water and holding it mechanically suspended. His suggestion was carried out in practice, and produced the effect; it produced when in full action a spray, which floated a very considerable distance in the open air.

1049. Mr. *Greene.*] About what time was that invention of Mr. Cayley's made?—About twelve months ago or more.

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1050. Has not something of the same description been adopted in the House of Lords for some years?—No; the shower or water jet, not the spray jet; the latter is like mist, a finely divided state of water, more like mist than rain; the water will float and remain suspended in the air; the difference in the two is the same as between a shower of heavy rain and a mist.

1051. *Chairman.*] It is the same principle, but carried out in an improved manner, is not it?—The water is much more finely divided, by which greater cold is produced by solution.

1052. In your examination of the warming and ventilating arrangements of this House, did you require any drawings?—No; I trusted to my own observation; I saw all I wanted; I required no drawings. Dr. Reid was kind enough to say that the drawings of his apparatus were at my disposal if I wished them, and so did Sir Charles Barry; I said I would apply for them if I wished for them; I have not done so.

1053. Supposing the House were to be placed in your hands for the experiment which you say you can make, should you require drawings in order to carry it out?—No; I should require no drawings of any kind, when I had the thing itself before me. When I speak of the House in my report, I mean the actual House for debating, and the lobby.

1054. Did Sir Charles Barry give you the sight of any drawings?—No.

Veneris, 2° die Aprilis, 1852.

MEMBERS PRESENT :

Lord Robert Grosvenor.	Viscount Palmerston.
Mr. Thomas Greene.	Mr. Bankes.
Viscount Ebrington.	Mr. Henry Drummond.
Sir Denham Norreys.	Mr. Stephenson.
Mr. Cochrane.	Mr. Locke.
Mr. Henry Hope.	

THE RIGHT HONOURABLE LORD ROBERT GROSVENOR IN THE CHAIR.

Neil Arnott, Esq., M. D., Examined.

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1055. *Chairman.*] YOU have, I believe, for many years given your attention to the subject which this Committee is required

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required to discuss, namely, the ventilation and warming of buildings?—The occurrences of my early professional life drew my attention strongly to that subject, and convinced me of what is now the belief not only of the members of my own profession, but of many enlightened men of other classes, that the epidemic diseases which have ravaged countries, and much of the broken health, and of the permanently imperfect health which we meet with everywhere, are consequent upon impurities allowed to accumulate in the parts of the atmosphere in which men are living.

1056. I believe that, under your superintendence, some large buildings have been ventilated?—I have been consulted with respect to the ventilating and warming of several large buildings, and as the different parts of the subject are brought before the Committee, I shall be able to say in what particulars my counsel has differed from the ordinary practice.

1057. Have you examined the system of ventilation pursued in the two Houses of Parliament?—Yes; I have walked over the House of Commons on the one hand, and the House of Lords on the other, and the adjoining rooms and passages, to judge of what was doing there.

1058. Are you able to give the Committee your opinion in reference to the systems pursued there?—I think it will give order to what may follow if I am allowed previously to remark, that there cannot be a perfect system of warming and ventilating in a building having separate rooms, if there is a deficiency in respect to any one of the following six particulars:

First, Means of moving through the building steadily the definite quantity of pure air known to be required;

Secondly, Means of duly distributing this air to the different rooms and compartments;

Thirdly, Means of properly diffusing the air in each room;

Fourthly, Fit means of discharging the vitiated air from the room;

Fifthly, Means of giving to the air the fit temperature;

And lastly, Means of giving the fit moisture.

And I would remark, that the more the apparatus is rendered self-regulating, or independent of the constant watching and interference of attendants, the better it is likely to be, both as to performance and economy.

1059. What, in your opinion, is the best means of moving through a building uniformly, the measured quantity of air that is required?—Before entering on details, perhaps your Lordship will allow me further to observe, that it is but lately

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that even the learned have understood that the air we breathe is as much a material substance as the water we drink or the food we eat, and may be mingled with poisons as these may be. A hundred years ago nobody on earth knew that there was such a substance in nature as oxygen, now called also vital air, which is one of the elements of our atmosphere, but which constitutes also four-fifths by weight of the whole substance of the ocean, and nearly one-third by weight of the solids forming the crust of the earth. In respiration the oxygen which enters the lungs takes from the blood there some carbon, and returns as carbonic acid gas, which cannot safely be breathed again, and therefore has to be removed by ventilation. The natural ventilation of persons is produced by the warmth of their breath and the wind. The poisonous hot breath being lighter than the surrounding air, is buoyed up, and the wind carries it away. Walls and roofs of houses, however, by preventing these natural movements, soon made men aware of the necessity of ventilation; therefore, even of old, when crowds had to meet, they did so in the open air. Smaller numbers found that they could meet under cover, and yet breathe comfortably for a while if they had open doors and windows. Then appeared more spacious houses, and particularly with large space above, as in cathedrals; then openings for air were formed in buildings below and above. The history of the attempts to ventilate the English Houses of Parliament during the last 100 years, is curiously instructive, both as proving that the art of ventilation is a very new art, and as showing the steps by which the art has advanced. For a long while the only means of ventilation in the House of Commons were four openings made, by order of Sir Christopher Wren, in the ceiling of the House, of a foot square each; short tubes were placed by him over these openings, to make them draw more strongly; then fires were lighted in connexion with the tubes, still further to increase the effect. Another adviser by-and-by introduced a fan-wheel over the ceiling of the House, which, although answering better than anything which had preceded, was still very unsatisfactory. Then, about 30 years ago, Sir Humphrey Davy being consulted, caused two iron tubes, of one foot diameter, to be made as channels for vitiated air, leading from the ceiling through the roof, and in their course passing through fires to heat the air in them. But this scheme also signally failed, owing to the smallness of the tubes and the weakness of the fire. Not long after happened the destruction of the houses by conflagration. In the temporary House of Commons which succeeded, Dr. Reid had the merit of exhibiting for the first

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first time an air-moving mechanism equal to the demand. It was his great heated chimney, 100 feet high, and with internal area of nearly 100 square feet. Its performance gave great satisfaction. In the present new Houses, similar gigantic chimnies again appear; and, in addition, there are gigantic fan-wheels, moved by steam engines and powerful steam jets, familiar now to the public eye in the chimneys of engines on railways.

1060. Did you say that the fan-wheel was used in the old House of Commons?—Yes, for more than 50 years, placed over the ceiling; it was put up by Dr. Desaguliers originally, and was continued down to the time of Sir Humphrey Davy.

1061. Mr. *Greene.*] Was that fan-wheel for the purpose of forcing air into the House, or of extracting the foul air?—It was for extracting the foul air from over the roof. I have now to remark, that the various means of moving air above enumerated, can be used to produce the one or the other of two effects, which have been distinguished by the names of the plenum and the vacuum movements; the first blowing pure air into the House, so as to force an equal quantity of foul air out; the second, extracting foul air from the House, and so drawing in (to use a popular phrase) an equal quantity of fresh air. The plenum is the more simple of the two, and has considerable advantages. A plenum, produced in another way, it already familiar to the public, as seen working in great perfection at all the common gas-works, distributing over a great town one kind of air from a central station, with uniform force, and with certainty, to all the houses, from garrets to cellars, of the town.

1062. Mr. *Stephenson.*] You mean the use of the gasometer?—Yes; the gasometer is a simple mechanical means of moving air without fail, upon the plenum principle. Considering that it can be made to act with any desired steady force, that it is cheap, and easily managed, and is always by its visible movement declaring accurately the amount of work done by it, we may wonder that it has so lately been introduced as a ventilating agent. Some of the advantages of a plenum used in ventilation are, that it makes impossible the entrance into the place so supplied with air, of smells from drains, or of smoke, and lessens or prevents altogether the leakage of gas from pipes.

1063. That will depend, of course, upon the pressure of the air in the room, as compared with the pressure of the gas in the pipe?—Yes; a plenum always lessens the chance of leakage, and, if strong, might prevent it altogether. With

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a plenum in a room, all crevices are made outlets, instead of inlets; cold air cannot come in; if any door is open, the air flows out. The vacuum, again, has the disadvantage of favouring the entrance of all these impurities into the house; every crevice, with it, becomes an inlet ready to admit smoke or gas, or smells from the kitchen, or any other source of impurity.

1064. *Chairman.*] Those, then, are the means of moving through a building uniformly, the measured quantity of pure air required?—Yes.

1065. Do you conceive that it can be moved uniformly by both the plenum and the vacuum, or by the plenum only?—It can be moved uniformly by either, provided the means of producing the plenum or the vacuum are strong enough, and of steady action; but I would remark that the chimney, or hot shaft, the fan-wheel, and the steam jet, are all liable to vary in their rate of working from slight causes, and without giving clear notice of the changes; they therefore demand constant watching of attendants.

1066. Do you consider the Houses of Commons and Lords as pure instances of the exhibition of the plenum and vacuum, the plenum being in the House of Lords and the vacuum in the House of Commons; or that the House of Lords exhibits the plenum only, whilst the House of Commons exhibits a mixture of the systems, both of plenum and vacuum?—They are both mixtures of the two systems. In the House of Lords, where I understand the plenum of the fan-wheel has been introduced very recently, there exists also the hot shaft or chimney, with coils of steam pipe at the bottom to increase the temperature, and with the steam jets at the top to add a new force. In the other House, there is the chimney with the great fire to make the vacuum, and there are strong fan-wheels to make either vacuum or plenum.

1067. Will you have the kindness to state how far those principles, which you consider necessary to satisfactory ventilation, are exhibited in the ventilation of the Houses of Lords and Commons, or how far they are departed from, and in what points you consider that they are incorrectly or correctly applied in those two instances?—I would say, that mechanical power enough exists in both of these Houses to move the ir through with the required force, but owing to the complexity of the arrangements increased attention and intelligence will be required in the attendants, and the chance of irregularities will be greater.

1068. Mr. *Locke.*] If you find that there are sufficient means

means for moving steadily the quantity of air required, do you find that the present means employed are effective, and, as such, ought to be satisfactory?—I would say, that the difficulty of using this complex instrument is considerable, so that ordinary attendants are more likely to fall into error.

1069. Supposing the means to be there, are you in favour of adopting the means as they are, or with any modification?—While I believe that one means or agent sufficiently strong, as being more simple, would give performance more satisfactory, still I think that the apparatus already completed here, or in progress towards completion, may be made to work very well.

1070. Admitting the perfect system which you have illustrated, by alluding to the plenum movement of gas through pipes, do you think that the ventilation of large rooms would be fairly illustrated by the mere exemplification of a power used for forcing gas through pipes, where there are no disturbing causes?—The gas forced through pipes has to encounter the very same disturbing causes which can affect ventilation currents, as the action of fires in the rooms, the action of the wind blowing in at windows, the opening and shutting of doors, &c., and still the force of the gas jet produced by a pressure of one inch of water at the gas-work, is sufficient to overcome all these. The pressure of one inch of water is about a fiftieth only of the pressure exerted by some furnace-blowing engines; yet it distributes gas over a large town, and therefore pressure still less would distribute even a heavier air over one house.

1071. Then, your opinion is, that, although the aperture is very small for permitting gas to escape from a pipe, as compared with the size of the room, the application of the plenum system for the ventilation of a large room would be similar in principle?—It would be similar in principle.

1072. And because you do not find a disturbing cause to the free egress of gas from a pipe with a small aperture, that therefore you would find no difficulty from the disturbing causes with greater apertures for the admission of air into a large building?—I think it follows as a matter of course, that if the urging pressure be the same in the two cases, air must issue with greater speed from a large aperture than from a small one, because there is less friction.

1073. Then am I right in apprehending you to be in favour rather of the single system of the plenum movement, than of drawing the air out by another power?—Yes, a strong reason being that it is simple, and not so likely to be mismanaged

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as the other. I think that some of the complaints of discomfort made here lately have been owing to the different parts of the apparatus not acting harmoniously.

1074. Can you tell whether any defect ever arises from the difficulty of managing the one system or the other?—I cannot refer to particular occurrences, but the probability is as I state. If, again, the plenum system, with measuring, is acted upon completely, it becomes unerring. I would still remark, however, that there may be cases where there would be an advantage in joining the two systems, as where the water required to work a strong plenum pump is with difficulty procurable.

1075. Sir *D. Norreys.*] Can you conceive any possible arrangement of apparatus which should make the forcing movement of fresh air or tempered air into the House, as equal as in the illustration to which you have referred, namely, the pressure of the gasometer?—It can be had easily, and a meter may be put into every pipe, which shall determine the quantity of air allowed to pass along the pipe.

1076. You can conceive, then, of enormous air-meters being established, into which you should force, by some mechanical process, the required quantity of air, and which should be then distributed in a similar mode to that in which gas is distributed?—A bulky meter is not required; a simple addition made to a pipe which carries air along, will regulate the quantity of air transmitted.

1077. Is not the tractive powers of the furnace more equivalent in its action to the pressure of the gasometer than any other actual force which could be applied to the supply of air?—A furnace may with care be caused to exert a uniform force, but the management is not so easy as of the gasometer.

1078. The uniformity in the gasometer arises from its being made a reservoir of a given quantity of gas, on which is applied a certain pressure, which forces it out with the greatest possible regularity; in what way would you practically collect the quantity of air which would be required to supply the House of Commons during a sitting, and deliver it out with the same accuracy and steadiness with which gas is delivered out through the pipes?—A simple arrangement has already been made, by which a gasometer, such as is used at the gas-works, only of much smaller size, is converted into a reciprocating pump, which descends with any pressure that is desired, and ascends with the same, and which, whether it move up or down, gives its fixed number of cubic feet of air per

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per stroke, and its fixed number of strokes per minute, and this for any length of time.

1079. Then, in point of fact, instead of the meter, you would employ some instrument which would be equivalent to the forcing power of the pump, so that your forcing power would resemble the pump in its general action, instead of the forcing power of the fan adopted by Sir Charles Barry and Dr. Reid?—Yes.

1080. In what respect could the forcing power of the pump be brought into such steadiness of action as to supply the forcing power of a fan, under proper regulation, and with proper distribution, so as to spread the force, and not to allow it to come in currents?—As a common smith's bellows gives a continuous blast, although worked by intermittent efforts of the arm, so by a kindred mechanism, but more perfectly, does the ventilating pump give its uniform stream from reciprocating strokes. I may here farther observe that a form of dry pump, having the same useful qualities as the water or gasometer pump, can be made as easily as that, and that both forms are as much vacuum or sucking pumps as plenum or forcing pumps.

1081. The pump of which you speak, would be a pump of considerably less area in its cylinder, than the area by which the air is now supplied in the case of the fan?—The pump may be of any area that is desired; a small pump with quick action moving the same quantity of air as a larger pump with slow motion.

1082. Then, in point of fact, the whole difference between the two principles is, that you consider that the forcing power of an engine, such as you have last described, is preferable, in its equality of movement, to the power obtained by the fan?—It works with uniformity, and has the other advantages of visibly measuring, &c.

1083. Then, in point of fact, the only difference in principle between yourself and Dr. Reid and Sir Charles Barry is, that you conceive that this forcing machine which you have just described, would be more regular in its action than the forcing machines which have been adopted by Dr. Reid and Sir Charles Barry?—I deem it the simplest and cheapest, and for many purposes the best air-forcing machine.

1084. Still, in principle, it is merely the mechanical preference which you give to one machine over the other?—The mechanical effect is of the same nature in all, that of moving air.

1085. *Chairman.*] As I understand you, having examined the

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the systems in operation at the two Houses of Parliament, you consider them to be too complex, and that although they might, with a great deal of close attention, be made to work satisfactorily, yet you would yourself much prefer a more simple method, such as you have just detailed to the Committee?—I would; but I have to add that with such skilful attendants as there will be in this House, I believe the desired ends will be well attained from the arrangements already made, or now being made here. The very satisfactory action of the single force of the great chimney in the late House of Commons was sufficient evidence of this.

1086. Still your opinion is, that the better plan is that which you have just described?—I would prefer the pump as the moving agent.

1087. Do you believe it to be efficacious?—I do.

1088. Have you ever applied it?—I have had no opportunity but as giving counsel, when requested, in charitable or public works; but I have to state that, on my recommendation, such a pump has been adopted in the New Hospital at York, and has now been measuring 2,000 cubic feet of air per minute into the hospital, night and day, for the last year.

1089. Have you applied it anywhere else?—Not the gasometer or water pump; but the dry form of pump of similar action is used in other places, and has been successfully adapted to ships.

1090. Viscount *Ebrington.*] You mentioned that you saw there were some advantages in combining the two movements, the tractive for taking off the bad air, and the plenum for forcing in the good air; am I to understand that you think the two are preferable, in their conjoint action, to the simplicity and greater command which is obtained by the one alone?—No; I deem the one sufficient plenum agency the best; but as in all cases there must be a chimney, or a shaft, by which vitiated air is to pass away, there will be in that a certain amount of tractive force, co-operating with the other.

1091. Do you think that it would be possible, or at any rate easy to keep up a tractive power by means of a furnace or fire so equable in its measure, as not to be liable to disturb the action simultaneously going on, of a plenum movement for forcing the air in?—I do; and particularly if the plenum were effected by the pump above described, which, by its construction, resists disturbance.

1092. But is it not the case that the effect upon the atmosphere of the chamber would not be identical if unequal quantities of air were drawn off though a continuous and equal stream

stream of air were poured in?—The little difference of barometric pressure, which could only momentarily be produced by the attempt to draw out either more or less air than was passing in, would be utterly insignificant. In the elevated city of Mexico, where one fifth part of the whole weight of the atmosphere is wanting, no hurtful effect on the health of the people takes place.

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1093. I was not speaking so much of the different barometrical states of the atmosphere in the House, as of the tendency to leakage inwards, which would be occasioned by any great excess of the tractive over the plenum movement, supposing that plenum movement to be regulated as you have described it?—There would, in any case, be less chance of leakage, if a plenum were joined with a vacuum action, than if the vacuum worked alone.

1094. When I spoke of leakage, I meant rather the tendency to indraught from any openings of gas-pipes, or doors or windows which there might be in the apartment?—That tendency would alway be proportioned to the degree of vacuum produced anywhere, whether by a vacuum action alone, or by an excess of vacuum over plenum action.

1095. Then I understand, that if you kept both movements in action simultaneously, you would always, as a matter of precaution, give a greater power to the plenum than to the vacuum movement, in order to guard against any accidental effect that might be produced in the way of facilitating indraughts of air or leakages of gas?—I should prefer always to have the plenum predominant, for the reasons referred to.

1096. *Chairman.*] Your great object, I understand, is to obtain as much simplicity as possible?—As much simplicity as possible, with certainty of the desired results.

1097. Mr. *Stephenson.*] Do you think that you attain that simplicity by combining the plenum movement with the chimney; if I understood you in the first instance, you preferred the plenum alone?—I do prefer the plenum, but it can rarely be had quite alone, on account of the existence of the shaft or chimney by which the hot air escapes from the House, and which will exert some degree of tractive force. Cases may occur in which the simplicity of the vacuum alone would be convenient, and the gasometer pump can work to effect a vacuum just as readily as to effect a plenum; it has the same power to draw out as to force in.

1098. Which of the two systems do you prefer; I understood that you brought forward the gas-works in large towns, as

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as an example of what your mind considers almost perfect? —I did; I think the plenum system is the most perfect.

1099. You have proposed the use of a large chimney, by which the plenum would be to some extent interfered with, would it not?—I did not mean a large chimney, but the ordinary chimney unavoidably present, and acting in a certain degree as a drawing agent, to use a common phrase.

1100. Then, in point of fact it comes to this, that there is a plenum in the chimney as well as a plenum in the House? —The chimney action, of whatever force, will be a vacuum action, facilitating the passage of the air from the plenum region, but not increasing the quantity of air which comes from the pump.

1101. Would not it depend entirely upon the temperature of the chimney?—It would.

1102. If the temperature of the air in the House or surrounding the House, and of that in the chimney were the same, the chimney would not draw, to use the ordinary word, and the plenum would operate, in fact, up to the end of the chimney?—It would.

1103. Would it not be modified by the velocity, because, even supposing the temperature of the chimney to be greater than the temperature of the air of the House, a certain amount of velocity is due to that difference of temperature?—It would, and whatever action the chimney exerts, it leaves a little less for the pump to do.

1104. If it leaves a little less for the pump to do, does not it amount to really establishing a plenum up to the very top of the chimney?—Its tendency is to diminish a plenum.

1105. Mr. *Locke*.] I understood you to say, that whatever were the resistances on the drawing part of the system, you intended to overcome those resistances by a little extra pressure on the plenum side of the system?—The pump makes a certain number of strokes, regardless of any help or resistance met with in the building.

1106. Will you discharge from your mind the fan; let us take a plenum movement with some sort of pressure?—The action of the pump gives a fixed quantity of air; that is a chief peculiarity of this pump; it measures a certain quantity.

1107. You do not mean to say that you cannot have the plenum movement without the pump?—No.

1108. Then, as I understand you, there are the means now of steadily giving the requisite quantity of air to the Houses of Parliament: you propose the plenum movement,

as

as I understand you?—I believe that the means now here are perfectly sufficient, when acting with all their force, to move the air along.

1109. I understand you to say, that you prefer the plenum system of effecting the ventilation, and that whether you have a chimney or not, whether you have any facility or not, you prefer the simple system of only a plenum movement, without any aid from the drawing of the air by means of a chimney?—I do; and the simple chimney existing everywhere will facilitate but will not disturb the ventilation.

1110. Am I to understand you, that you do not mean to apply any mechanical contrivance in the chimney, either of a furnace or a jet?—I do not.

1111. Whatever advantage you may derive from a chimney is merely the advantage which nature provides for you, and you do not intend to complex your system by the application of any other matters?—I do not. I may here observe, that there may be the advantage of simplicity also in a mere vacuum movement, as in the single chimney movement of the old House of Commons.

1112. That was vacuum movement?—It was.

1113. Which do you prefer, the plenum movement or the movement which is to draw the air through?—I have no hesitation in saying the plenum movement, for all ordinary cases

1114. We also have your opinion, distinctly, that you do not advise the double system?—I would not; but finding it established here, and with the intelligence which is likely to superintend it, I do not recommend that it be altered.

1115. Have you any doubt that there are means in the present arrangement of the Houses of Parliament to enable you to use the plenum system without the application of any mechanical contrivance for drawing off the air?—I cannot answer that question positively; but I think that a good fan-wheel, moved as in the House of Lords apparatus, by two 10-horse power steam engines, should be able to force the required quantity of air through the House without needing help.

1116. Have you any means of knowing that the exit areas for the air are sufficient?—I have no doubt they are.

1117. Viscount *Ebrington.*] As I understand you, you would use your chimney mainly as an air-drain, and not as a means of tractive power?—Not as a means of tractive power.

1118. Mr. *Stephenson.*] It would, in effect, be that?—It would favour the desired motion of the air.

1119. Mr.

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1119. Mr. *Locke.*] Will not the warm air of the House always form a very powerful up-cast?—It must always aid in proportion to its warmth and the height of the shaft.

1120. Would that interfere with the regularity of your plenum movement?—No.

1121. Not at all?—No.

1122. Mr. *Stephenson.*] Would not the temperature which might be due to a chimney ventilating these Houses, be always very insignificant, that is to say, its levity, as compared with the plenum that you propose to use?—The plenum does not require to be very strong to inject air over one House, however large, for we know that the pressure of one inch of water, at a central gas station, will inject air strongly into every house over a large town.

1123. Have you ever ascertained what vacuum, or what drawing force you can obtain from a chimney of very large dimensions, and very great height?—I have not; but it is a matter of simple calculation.

1124. I may state to you at once, that taking the draught of a large chimney, 150 feet high, and six or eight feet in diameter, and in contact with coke-ovens, where the temperature has been probably 100 or 120, I have never found that that chimney could exceed a quarter of an inch of water; three-eighths is a very unusual thing; if the water happens to oscillate, it may oscillate to three-eighths, but I have never had it steadily moving at that. The object of my former question was, that if you propose to use a plenum, say to the extent of one inch of water, which I consider to be very feasible, then no temperature which you ever can get in the chimney, will prevent a plenum existing in that chimney to the very end of it. Therefore I think that any draught which you can assume to be derived from a chimney, would be altogether inappreciable, as compared with the plenum, and if that be so, then the plenum would exist from one end of the House to the other. What is your opinion of that view?—There would be no disadvantage from the plenum existing to the very end of the air channels, but the injecting force needed would be so moderate, and so much of it would commonly be expended in wire-drawing or forcing the pure air through the narrow diffusing apertures in the rooms, that I think the neutral point between the plenum of the pump and the vacuum of even a feeble chimney, might be far within the chimney top.

1125. Mr. *Locke.*] Is it not usual that the smallest aperture is at the top of the chimney?—Yes.

1126. Supposing you had no mechanical contrivances, upon your

your system of ventilation, by a plenum movement, must not the plenum continue to the top of the chimney?—It might, if the top of the chimney were much contracted, but a shaft or chimney merely for ventilation would generally be very open above.

1127. *Chairman.*] Supposing the air that you forced into the House were admitted through small apertures, would it increase the velocity?—The velocity would be increased in the apertures themselves, and therefore in jets proceeding from them, for fluid moving in a channel of varying area has greater velocity always in proportion as the area is less.

1128. Having stated the general mean by which you think that air ought to be moved through a building, in order to ventilate it successfully, and your objections to the complex system here, together with a description of a more simple system of your own, will you state what the means are which you think ought to be employed for duly distributing the air to the different rooms where the building consists of a variety of apartments?—At present the distribution is made by having channels to every room, and every channel, with its simple valve or door, which has to be more or less opened and shut, as found necessary, by attendants always watching. Now, instead of the simple doors or sluices mentioned, which if left in any fixed position allow very different quantities of air to pass, as the moving force or the resistances vary, I would advise self-acting, regulating valves, of a kind which when adjusted to any known degree, maintain, notwithstanding any accidental change of forces, a uniform current or supply until a new adjustment be made.

1129. Do you consider that we have at present the means of distributing this air; in the former part of your examination you stated that you thought we had sufficient means for the purposes of the admission of air, and transmission through the building; have we sufficient means of distribution, do you think?—I think you have, but only with hand regulation instead of possible self-regulation.

1130. Would those means be sufficient, supposing the vacuum plan were abandoned entirely, and simply the plenum put in action?—I think their sufficiency would be equal in both cases.

1131. The present channels would be sufficient?—I believe so.

1132. Mr. *Stephenson.*] You referred to the York apparatus as being self-acting; by what means is that attained?—I have not yet had time to publish the detailed description of the apparatus,

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apparatus, but a good many engineers and scientific men, among whom were members of the Board of Health, went to see the pump before it was carried to York. The water which enters for the general purposes of the hospital, in falling from a high cistern to lower ones, furnishes the power for moving this machine; it acts on a small water-engine, which keeps up the motion of the air-pump night and day without cessation; the number of strokes is determined by a cock in the descending pipe.

1133. Is there only as much water flowing through the pipe as the hospital requires?—Nearly so; and less would suffice if the height of fall had been as great as is obtainable elsewhere. I think by this apparatus one pint and a quarter of water, descending from a height of 60 feet, injects 250 cubic feet of air at every double stroke of the pump, and eight strokes in the minute give the required quantity of 2,000 cubic feet of air in a minute. The engineers to the Board of Health made an estimate that it would cost about 1 *s.* a day for the whole expense of the apparatus, the working power (even if the water flowed to waste) and the superintendence.

1134. *Chairman.*] We have spoken of the distributing power; will you now state what the diffusing power is, and will you also say what you consider to be the difference between distribution and diffusion?—The distribution is made to the separate apartments of the House; the diffusion is the sending of the air equably over any single apartment. If there were a crowd assembled on a field, in the wind, the people on the windward side would have pure air, those to leeward would inhale a portion of the breath of others near them. As the smoke of London accumulates to leeward on a windy day, and the air is pure to windward, so it is with the breath of a crowd. If there were no means of ventilating a room but by open doors and windows, some of the company would have too much and others too little. The idea of perfect ventilation for a crowd is suggested by seeing birds on a tree, where the air enters below and passes up between them, and no one is taking air from another. The pierced floor of the House of Commons exhibits a like result; the air is diffused by entering an apartment under the floor of the House, and then rises through narrow apertures equally to every person. The difficulty connected with this matter is, when the quantity of air passing is considerable, to convert the sharp jets which traverse the apertures under the impulse of the ventilation movement, into a diffused slow-moving mass of air like what may rise among the branches of a tree in a calm; a sensible draught or current of

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air in a room is unpleasant, and, unless the air be properly warmed, is dangerous. Various means of slackening and diffusing air currents are known, such as the great multiplication of the openings, diffusing covers placed over these, the hair carpet; and such are adopted in both houses; but I doubt, from the complaints made, whether with the completeness required.

1135. Then do you consider that we have in the two Houses of Parliament sufficient means for the purpose of diffusion?—I think there are; but in the House of Commons the means are used as yet only partially, because of some paint of a disagreeable odour still on the wood of the openings of the floor where the air should pass. If there is any want of uniformity in the entering of the air, or in the temperature of the air which enters, the sitters will be sensible of it, and will complain of hot or cold blasts coming in.

1136. Practically, do you know at all how the air that does enter the House of Commons is felt by the Members, whether it is agreeable or disagreeable?—One gentleman who accompanied me last night when I went in, placed me where he said I should soon have my toes cold if I remained, he having had that experience recently.

1137. Did you remain there long enough to feel that sensation?—No; knowing the remedy to be easy, and that the arrangements were not yet complete, I did not deem it of importance to remain.

1138. I rather understood you to say that you believed that that part of the floor was not used because of a certain want in the arrangements which were not complete?—I understood that many of the openings, being in an unfit state, were not as yet used.

1139. How do you account, then, for the current of air which was felt at the feet of the Members?—It must have occurred from some openings that were at the time free. I did not inquire particularly into that.

1140. Supposing you had to arrange the ventilation of the House of Commons with its present means, or any means, would you bring the air in from the ceiling or from the floor?—From the floor; although the downward current from the ceiling would more directly prevent the rising of dust from the carpet, and any sensible draughts among the feet. The bringing of air in at the ceiling is a less natural mode, as in all temperate climates the air which we breathe ascends to pass away; and if an artificial ventilating current descend only as fast as the hot breath tends to rise through it, that breath will ac-

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cumulate round the mouths of persons there, and may be breathed again. Then, because cooler heavy air above cannot repose quietly or evenly on warm lighter air beneath, more than water can rest on oil, the pure air will descend irregularly in some parts, and the hot breath will rise irregularly in others, and the desired uniform downward movement will be prevented. Still, notwithstanding the objection stated, if the speed of the descending air be rendered considerable, and if the expense of sending the much larger quantity of air required through the House be not regarded, it is possible to ventilate very fairly by a downward current.

1141. Do you know whether, in the operation of your system at the Hospital at York, the air practically ascends from the floor, or does it come in at the ceiling?—The system is very different there, as there is no crowd in the wards. The air enters the wards by chinks round the skirting board, in sheets as thin as the blade of a knife, and so mingles at once completely with the air of the room.

1142. Does it ascend by the roof?—It passes away by the openings near the roof, and as, when diluted, it is not so hot as the breath of the parties in the room, the breath rises and escapes first.

1143. Viscount *Ebrington*.] I apprehend that the number of persons there are very few?—Very few; and thus there is little resemblance between the ward of an hospital and the House of Commons.

1144. In the case of the House of Commons, or any large room similarly situated, do you think, that in allowing the ventilation to take place from beneath to above, there is any risk of its carrying up dust, or anything disagreeable?—There is, and the following are among precautions used in regard to this: daily cleaning of the carpets; having the parts of the floor most trodden upon, left solid or unpierced, so that no air can pass through; or if pierced, having separate air channels underneath them, by which a downward movement of the air can be there established, while the upward movement goes on elsewhere; and lastly, on the principle of road-watering, it has been proposed to keep the gangways or portions of the carpet on which persons chiefly tread, moistened a little by threads absorbing water from below, as for the wet bulb of the common hygrometer.

1145. *Chairman*.] Did I rightly understand you, that you did not think that the downward current from above would go so low as to join the draught of the channel which carries the dust away from the feet of the Members?—The different currents

rents spoken of can be forced to proceed quite independently of each other.

1146. Have you examined the system which is pursued in the House of Lords?—It was explained to me.

1147. In the House of Lords are you aware that there is both an ingress of ventilation from the ceiling, and also an egress of air from the gangways under the feet of the Peers, forming, in fact, a double action?—I have so understood, and an egress of air near the sides of the roof.

1148. Is that among the complexities as to which you think it better, if they can be avoided?—It is.

1149. What is the velocity at which air must move to create the sensation of a draught?—I cannot state the number of feet per minute; it would depend much upon the difference of temperature; air of the temperature of the face blowing against it, is scarcely felt as a current, unless coming with great force.

1150. It depends upon the temperature whether you feel it disagreeably or otherwise, but you do not mean to say that it depends upon that whether you feel it all?—If the difference of temperature be small, a weak current is scarcely felt.

1151. What is the velocity necessary to reverse the natural upward movement of the air?—It would vary much with the circumstances.

1152. Viscount *Ebrington*.] That would depend upon the temperature of the room in which the person was breathing, would it not?—Very much; in winter the breath rises quickly, and the air, to reverse the motion, must descend still more quickly; if the downward motion of the air be only of the same speed as the upward motion of the breath, there would scarcely be ventilation at all, and the breath would accumulate about the mouth.

1153. Mr. *Locke*.] Do you know whether the apertures in the floor of the present House of Commons would be sufficient for your system of ventilation beyond that which is now applicable to the carpet?—I think they would.

1154. I was asking the question in reference to that portion, exclusive of the part covered with the carpet, under the benches and at the back of the steps?—My opinion is, that the air should be let in over the whole floor, except where the principal gangways are, and also from some perpendicular surfaces about the steps of the floor and benches.

1155. You suggested the propriety of moistening the carpet of the floor to prevent the dust rising, supposing that suggestion should be considered objectionable, are there other means, in your judgment, of introducing your system of ventilation

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tilation without using the carpet of the floor?—I think an upward ventilation would be imperfect if no part of the carpet were used, but at the gangways there might be a down-draught through the carpet.

1156. Viscount *Ebrington.*] A local down-draught?—A local down-draught, obtained now, I believe, both in the House of Lords and in the House of Commons.

1157. Mr. *Greene.*] If you moistened the carpet, would it not interfere very materially with the quantity of air which could pass either up or down through that carpet?—The moistening would be only over the unpierced parts of the floor; if there were down-draughts at the gangways, it would not be needed.

1158. Mr. *Locke.*] Supposing it should be determined that that portion of the floor of the House was not to be made open for the purpose of the admission of air, do you believe that the other parts of the floor, namely, the parts not used by the Members walking, would be sufficient in order to apply your system of ventilation?—I think tney would, if some perpendicular surfaces near the floor were used for the admission of air.

1159. Mr. *Hope.*] I think you mentioned that your apprehension of dust arose merely from the floor of the House; if the air passes through a number of vaults and passages, is it not likely to collect a great deal of dust from them, independently of the floor of the House?—Not if care be taken to keep them clean. I deem it of great consequence that all the air which enters here should be sifted on entering, as is done in some other places in London, through fine wire gauze. I have seen a large mass of smoke-blacks and dust intercepted by such a screen during a single day, in the centre of London. Then the passages should be always clean and dry. The arrangements in these respects are not completed for the House of Commons, for I saw workmen there, amidst their rubbish and wet pavements.

1160. Do you think it is possible, in London, to keep a large surface of passages perfectly free from dust, and in that clean state which would make it agreeable and wholesome to drive a quantity of air through?—I do, although in London the whole atmosphere at low levels is loaded with dust and smoke and ground granite from macadamized roads. The object of having pure air for the Houses of Parliament will be greatly favoured by taking the air, as proposed, from a great elevation.

1161. But if the air is taken from a great elevation, and brought

brought to a very low level, and carried through passages where it may be fairly supposed that dust will accumulate, does not that deprive the Members of the advantage of the elevation?—I think not, if the passages are kept clean, by being watered and swept, as is usual.

1162. Have you ever tried to keep a very large house clean in London?—In a house looking out on the drive in Hyde Park, I have heard a lady say that she could write her name upon her pianoforte twice in the day.

1163. Is it not the case, that with a closet or a box all but hermetically sealed, there must be a vast accumulation of dust in the inside?—I have observed how well the covers of the common chimney-piece clocks perform their office.

1164. Mr. *Locke*.] Do you think that vaults, such as those constructed here for the air passages, would be less liable to the accumulation of dust than the ordinary rooms of a large building?—I should say much less, because of the quality of the air entering.

1165. Do you see any reason to doubt that, when the workmen are once removed, and the passages cleansed, in order to begin and act upon a system of ventilation, the air may be kept perfectly pure without any serious admixture of dust in its passage?—I see no reason to doubt it.

1166. Viscount *Ebrington*.] The presence of the workmen, and the dust consequent upon it, you think, would alone account for a great deal of the inconvenience?—Yes, for a good deal of what has lately been felt.

1167. Sir *D. Norreys*.] A difficulty has been suggested by a previous witness, with respect to the passage of air through the meshes of the carpet below the House; have you examined that carpet?—I observed it, but I did not examine it particularly.

1168. Should you think from the examination which you have given to it, that there would be any material difficulty in carrying into effect your plan of creating a plenum in the House, by having to force the air through that carpet?—None at all.

1169. The outlets for the air are, I understand, calculated to be 250 square feet in the panels, by the panels not being perfectly close to the ribs?—Yes, I have been told so.

1170. If the outlet channel appears to act according as it is desired, would not it seem evident that the passage of the pure air through the carpet is not so materially interfered with as the previous witness has supposed it would be?—If the outlet channel discharge the quantity of air which is deemed the

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proper quantity to pass through the House for the purposes of ventilation, that quantity must pass through the carpet, or through other openings in the House.

1171. Still, if the quantity passing from the ceiling could be measured, it would completely put an end to any theory in respect of the interference of the carpet by friction with the transmission of the air?—Yes, if it were known also how much passed by any other openings.

1172. It is a matter of easy calculation?—It is.

1173. Mr. *Stephenson.*] Referring to your explanation of the movement of the air when it descended from the roof, you stated that you thought it objectionable, to some extent, in consequence of the vitiated air being pressed and kept down at the bottom of the House?—I said I thought it objectionable, because the pure air above is a heavier air entering over the breath-warmed lighter air below, and, like water poured over oil, will sink down irregularly, causing the lighter fluid to rise irregularly in a like manner, and thus will derange the desired uniformity and purity of the ventilating current.

1174. Would not that very fact assist the diffusion of the air throughout the House very greatly; would it not have a tendency to prevent local currents?—The desired diffusion is, I think, best obtained by the fit placing and management of the ventilating apertures; if the whole of the air enters above, persons below can scarcely feel local current; and particularly currents about the feet; but it would not be the less true, that the pure air entering, being a little colder than that mixed with the breath, would tend to come down irregularly, as I have described.

1175. According to your own proposition, is not there to be so much air forced in, as rather to overcome the ascending current, and to keep it upon the whole descending, so that there would be a total movement of the whole mass of air downwards, and yet there would be a tendency of the warm air to commingle itself with the cold air coming in?—If it were possible to maintain a level surface of meeting between the cold and warm air, no hurtful disturbance would occur; but this is not possible.

1176. Would that natural mode of diffusion not tend to lessen what is now found to be so objectionable, namely, local currents, which are now forced in first from one point and then the other; do not you think that the natural movement of the airs amongst themselves is rather better than mechanically forcing them?—The easy avoidance of local currents is one of the chief recommendations of the downward movement; but

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but with the upward movement also, if the air entering be rendered, as it should be, all of the same temperature, the mixing of currents of different temperatures in the House is guarded against most completely, and the hottest air, containing the breath, will rise to the top, just as should happen. Still an abundant downward movement of air may effect very satisfactory ventilation.

1177. Viscount *Palmerston.*] I wish to follow out your process a little systematically; if I understand you, you are now recommending the introduction of the cold air from the top, and the egress of the vitiated air through the floor; do I understand you rightly?—I do not recommend that; I prefer the opposite mode; but I say that with the descending stream, good ventilation may be produced. It has the advantage of blowing down the dust; but there is the disadvantage of the unequal descent of the pure air.

1178. Let us see whether there would not be other inconveniences attending that system. The air which is breathed by persons sitting in the House of Commons who sit near the floor, is heavier by its specific gravity but lighter in consequence of the increase of temperature which it receives when it quits the human body; this bad air is constantly rising by its temporary rarefaction. At the same moment, you have a stratum of air, naturally lighter, but heavier by its temperature, descending. These two currents meet in some portion of the building, and that bad air which has been breathed must, sooner or later, be brought back again to the mouths of the persons who have already breathed it, before it can pass through the apertures of the floor, whereas, if the egress of the air were at the ceiling, that air, having once quitted the mouths of the persons who had exhaled it, never would return to them, but would be carried off, and they would receive a constant supply of purer air from the apertures in the lower part of the building. Would not that be so?—Your Lordship has expressed, only in better words, one of the reasons which I gave for preferring the ascent of the air from below to the other mode. Yet the difficulty referred to may be in great part overcome by increasing the amount and speed of the pure downward current.

1179. Mr. *Locke.*] Supposing that mode of yours to be the simple mode of ventilating by means of the roof, instead of the floor, do you know whether there are any difficulties in the lighting of the House of Commons?—Yes.

1180. Will those difficulties, namely, the over-heating of the upper portion of the House, be better overcome by the

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ascending system of ventilation, or by the descending system of ventilation?—I think by the ascending.

1181. Sir *D. Norreys.*] Were you present when a witness was giving evidence yesterday?—I was, for a little time.

1182. Do you coincide with him, that it is possible, so far to fill the House with what he called a plenum, that its general temperature should not be affected by contact with air of a different temperature, to illustrate which he referred to the Montgolfier balloon, which is filled with air of a certain temperature, and surrounded by air of another temperature, and yet unaffected by it?—I did not happen to be present when that subject was spoken of; will you have the kindness to state it again.

1183. So far as I recollect, the evidence of the witness was to this effect: we see that by the Montgolfier balloon a certain quantity of air may be enclosed in its cone, and yet be open directly to the action of air of a different temperature, yet the air enclosed in the balloon, being at a certain density, is able to resist the greater density of the air surrounding it, and continually ascends?—So long as the air in the balloon is warmer than the surrounding air, so long is it specifically lighter, and the mass in the balloon, therefore, like cork immersed in water, but not in the same degree, is lighter, and is pressed up by the buoyancy of the surrounding atmosphere; as soon as the temperature falls, so that the specific gravity of the whole mass is less than that of the surrounding air, then the balloon descends.

1184. Then you would not consider that a fair illustration of filling a room with air of a certain density and a certain temperature, and allowing that to be acted upon by air of a lower temperature?—I do not see the relation of the two cases which can illustrate ventilation.

1185. In the case of the Montgolfier balloon, if a hole were made in the silk of the balloon, would not the whole action of the air cease?—Then the air would rush out at that little opening made at the top of the balloon, and very soon the specific gravity of the balloon would be diminished, and the balloon would fall.

1186. If the House were filled with air of the required density, so as at one moment to resist the pressure of air of a different density, would not the opening of every door and window which might take place act in the same way as making holes in the silk of the Montgolfier balloon?—If there were openings below and above in the room, then the warm air, being

being specifically lighter, would issue by the openings above, and the denser air would enter by the openings below.

1187. So that in that respect there would be an analogy between the House of Commons and a balloon; there must be similar action in the two cases?—There would.

1188. Mr. *Stephenson.*] Do you think that if the House of Commons were without a roof, and had 600 Members in it, and the weather were fine, they would find any inconvenience from bad ventilation?—Not from want of air.

1189. Would the fresh air in that case not have to mix with the vitiated air ascending from the lower parts of the building?—It would not mix at all uniformly, but being in excess, little inconvenience would be felt.

1190. Mr. *Greene.*] When you spoke of the diffusion of cold air entering at the roof, you said that it would descend by its own specific gravity, but in cold weather, when you wished to introduce warm air, would there not be a greater degree of difficulty in that warm air diffusing itself over the House, than the cold air which you have before described?—There would not; the air would descend by the force impelling it, whatever that were; the specific gravity of the entering air would of course always be greater than that of the same air arrived below, and mixed with hot breath.

1191. In the House of Lords, at the present moment, there is an admission of air from the roof, and there is an exit for the foul air by the sides, also in the roof; would there not be, in case that upper air was warmed, a great liability for it not to arrive at the Peers below, but to make its escape at once from the side exits?—There would be great liability, if the temperature were not properly maintained, of the two opposite currents, in the lofty room, interfering with each other. The new air must enter under the impulse of the moving force, whatever happen to it afterwards; if it be considerably cooler, and therefore heavier than the air in the House, it will descend to where the Peers are sitting; if it were lighter, or nearly as light, it would, as you have mentioned, turn round and pass out by the side.

1192. Therefore, in case you introduced warm air from the roof, there is a very considerable degree of doubt whether the Members would ever derive any benefit from it, on that system of ventilation?—The failure would occur if the entering air were either very hot, or of a temperature too nearly that of the air below.

1193. Mr. *Locke.*] Do you know the system of ventilation of the House of Lords?—I do.

1194. Do

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1194. Do you approve of it?—There is the difficulty just spoken of, in the delicate balance of specific gravities.

1195. Would you yourself adopt such a system of ventilation as is now in practice in the House of Lords, namely, introducing the warm air by a plenum pump from the centre, and drawing off the vitiated air from the two sides of the roof?—I would fear the interference of the opposite currents.

1196. Would you, as a gentleman understanding these matters, adopt that as a system?—Seeing that difficulty, I would not.

1197. You think, in fact, the simple mode which you have suggested to the Committee, to be a better system than that?—I must say that I do.

1198. Mr. *Greene.*] Will you describe to the Committee, the mode which you would propose for discharging the vitiated air, where it tends to accumulate?—The simplest mode is to have it discharged at the roof, through the vitiated air channels, towards the up-cast shafts, moving chiefly under the influence of a plenum impulse from below, aided by the action of the simple chimney or shaft through which it escapes to the atmosphere.

1199. Will you confine yourself at the present moment to the House of Commons, to the mode of ventilation which you have seen adopted there, and the discharge of foul air?—In the House of Commons, the air having been used in the body of the House, passes through openings in the ceiling to the up-cast shaft, under the influence of the much-heated chimney, and impelled also by the fanner which is moved behind, and a small downward current is established through the carpet on the gangways to a separate channel.

1200. Will you give the Committee your opinion of the system as pursued, whether you think it a good or a bad one, and whether you think it could be improved?—Managed by the skilful persons employed here, I have no doubt that it will answer well. It gives the power of moving the air very completely, but the two forces, at the beginning and at the end, are not so simple as a single force at the beginning.

1201. Viscount *Ebrington.*] And that you prefer?—That I prefer.

1202. Mr. *Locke.*] Will you point out the difference between the system at present existing in the House of Commons and the system which you yourself would prefer?—I would prefer the plenum action made so powerful as to be independent of the action of the chimney.

1203. Is it not the fact, that there are no artificial means there?—

there?—The chimney is made very powerful by a fire, which increases the action, just as the steam-jet increases it for the House of Lords' chimney. *Neil Arnott, Esq., M.D.* 2 April 1852.

1204. Then in point of fact, the system adopted in the House of Commons now, is the same in principle as that adopted in the House of Lords, only that the one is drawn through by means of a fire in the chimney, and the other is drawn through by means of a jet of steam?—Yes, nearly the same in respect to traction, and for both there is a strong fan-wheel to impel.

1205. Therefore, in both cases, it involves the complex system of which you disapprove?—Yes.

1206. You would prefer the plenum movement simply, without the addition of either the chimney or the steam-jet?—In all common cases, I have no hesitation in saying that I would; but in the House of Commons I think the united agencies now established here will perform very satisfactorily.

1207. But in order to ensure what I call an uniform action in the practical application of the means, do you think it is likely to be better effected by means of the single action or the double?—I think here, with the attendants provided, the action will be quite such as is desired.

1208. Supposing, in practice, it is not found to work satisfactorily, do you think that multiplying the number of chances of accident, is an advantage or a disadvantage?—Decidedly a disadvantage.

1209. Therefore, would you not say that if you could get any force you require by the plenum movement, on the one side, or by the force of the jet or furnace on the other, it would be better to adhere to one of those modes?—I would.

1210. Do you see any difficulty in adopting the system of the plenum movement only in the ventilation of the House of Commons, so as to make a perfect ventilation of the House of Commons?—I do not.

1211. Do you believe that the other system, namely, by the application of a jet or fan, or pump at the other end, to draw the air out, would be effectual as applied to the ventilation of the House of Commons?—I have no doubt of it, but with the hazards of drawing in the smells and the gas, and the cold air when the doors are open.

1212. Mr. *Greene.*] In hot weather, is there not a very great degree of advantage in having some mode by which you may draw the vitiated air rapidly from the House; and do you not

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not therefore think that the action of a fire, or the steam-jet, would be very desirable under such circumstances?—With good management, there never can be need for any rapid change; but if need of change arise, the hot air can be removed just as certainly by forcing fresh air in as by drawing the hot air out.

1213. Cannot you reduce the temperature very materially by rapidly drawing off the hot air from the House?—In precisely the same time, if the apertures of ingress and egress are fitly placed, as by forcing the cooler air in. And I would repeat that if the works are in a proper state, there can never be need for any sudden change; a sudden admission of cold air upon persons too warm would be dangerous to their health.

1214. I am not proposing it as a sudden change, but I am supposing the temperature of the atmosphere to be exceedingly hot during summer time, and that it is found desirable to keep the House as cool as possible; could you not keep it infinitely cooler by means of some mechanical mode of drawing the air through the House?—There would be no difference in the ventilating efficiency whether change were made by injecting or extracting air.

1215. Mr. *Locke*.] You are acquainted with the discharging apertures for the vitiated air in the House of Commons?—Yes.

1216. You are satisfied that they are sufficient for the adoption of your system, or the adoption of either system?—I think they are.

1217. And that no further expense will be incurred, whether the system which you propose is adopted, or the drawing system?—None; and it may be observed, that with a strong plenum system smaller channels and openings throughout the House would answer the same purpose.

1218. And it would be very easy to diminish the openings, if thought desirable?—Yes.

1219. Viscount *Palmerston*.] What would be the greater density of the atmosphere within the House by your plenum system; in what degree would the atmosphere be denser within the House than the ordinary atmosphere without?—It would be less than a man would experience in passing from the top to the bottom of a hill 500 feet high.

1220. It would not, therefore, sensibly affect the respiration?—Not in the slightest degree.

1221. Sir *D. Norreys*.] Have you considered what portion of the House of Commons buildings it would be requisite

quisite to place under the sole control of the individual who had charge of the ventilation of the House itself?—One system will answer for various adjoining rooms, or for the whole; but I have not looked at the details in regard to that matter.

1222. Viscount *Ebrington.*] Do you think that it would be necessary that he should have control beyond the actual walls of the chamber, considering what are the numerous communications into that chamber from without?—Yes; the difficulty of ventilating the House of Commons or the House of Lords, is much greater than in ordinary cases, from the great number of rooms to be kept at a certain temperature, and where strong ventilation is wanted at one part of the day and not at another. To ventilate any single room, as a court of justice, is a comparatively easy task.

1223. That is not my question; it is whether you do not consider it necessary that the person who has charge of the ventilation of the House of Commons should have control over the ventilation and temperature of some of the apartments more immediately opening into it, considering how constantly the communications are in use and action?—It is essential.

1224. Are you able to give any opinion as to certain apartments which you would consider it indispensable to place under the control of the person who has charge of the warming and ventilation of the House?—I would say that wherever there is open passage or frequent communication by doors, there should be one management.

1225. Mr. *Locke.*] In point of fact, you mean, that the person who is charged with the ventilation of the Houses of Parliament should have complete control of the means necessary for accomplishing it?—Yes.

1226. Mr. *Greene.*] We will come to the head of giving to the House the fit degree of temperature; what is the mode which you propose to effect that?—I will state it.

1227. Mr. *Locke.*] Have you seen the present mode?—I have.

1228. Have you any objection to the means, either in the House of Lords or in the House of Commons, now employed for that purpose?—I would speak of the difference between steam and water employed to communicate heat.

1229. Do you therefore entertain an objection?—At least I have to explain.

1230. To what is it, in the present system of raising the temperature of the air, that you object?—As the gently warmed

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warmed air injected for ventilation consists generally of one portion which has been much warmed, and of another portion of the natural cold air diluting the first, it is desirable that the first named portion should be warmed but moderately, for a little air which had been raised to a very high temperature, and then mingled with other air, gives to the whole a disagreeable odour, unfitting it for breathing, probably because intense heat burns or alters the minute impurities which generally float in the air; the pipes of Mr. Perkins being commonly raised to 300° of temperature, or more, thus damage air.

1231. Are there any of Mr. Perkins' pipes in the House of Commons; is there any temperature in practice in the House of Commons now equal to that temperature?—No; I mention them merely in illustration; but there are steam pipes in the apparatus of the House of Lords heated to above boiling heat. I believe that the temperature of 212°, which is the temperature of boiling water, cannot harm air that is to be breathed; but where the temperature has been carried beyond that, many persons complain of the effect. Water, of course, the temperature of which in ordinary boilers can be raised only to 212°, cannot, as a communicator of heat to air, be objectionable; but steam, which under pressure may be raised to 240° or more, must be used with caution.

1232. Sir *D. Norreys.*] May not steam be raised so as to be red hot, under pressure, and set fire to anything?—It might be, but in this building the pressure is adjusted, so as to limit the heat to a few degrees above boiling point.

1233. Mr. *Locke.*] Do you know the pressure of steam at which the boilers are fixed for warming the present Houses of Parliament?—I think at not more than 5 lbs. or 6 lbs. above atmospheric pressure.

1234. And how many degrees is the temperature above 212°?—Fifteen to 20.

1235. Do you consider those 5 lbs. of pressure, and 15 degrees of additional heat, prejudicial?—I do not, although some persons object to so much.

1236. Then I understand you to say, that you may warm with steam without imparting any prejudicial change to the atmosphere, by working with a pressure of 5 lbs., and a temperature of something like 220° or 225°?—Yes.

1237. Viscount *Ebrington.*] To 212° you feel confident there is no objection?—Certainly.

1238. Then do you believe that the air is injured by even having been heated above 90° or 100°?—Not at all; it cannot be.

be. In tropical climates, where a dark-coloured stone exposed to the sun in the middle of the day is heated to 130°, and the air on it acquires that temperature, the air is not in the slightest degree injured, for it afterwards spreads north and south to be the healthful breeze of temperate climates.

1239. Mr. *Locke.*] Then although you are not favourable to heating air to a very high temperature by steam, still you are not against the application of steam in heating air as employed in the present Houses of Parliament?—No; if it be employed with care, although I would prefer the milder heat of water, which cannot exceed 212°.

1240. Viscount *Ebrington.*] An instance has been given us of the injurious effects arising from the contact of the air supplied for the respiration of living creatures with metallic surface, so as to bring it above 90° or 100°, and the instance selected was that of the monkey-house in the Zoological Gardens; are you able to say, whether the consumptive disease in the monkeys there was produced by the deterioration of the air from contact with hot metallic substance, or by repeated respiration?—That was a case of want of ventilation; it had nothing to do with the heating of the air; there were two open fires in the room.

1241. Mr. *Locke.*] You have already told us that you see no objection to the means adopted here, with reference to the use of steam for heating the air; I wish to know whether you have any objection to the distribution of the apparatus for heating?—Assuming that the steam be carefully managed, I think the distribution is suitable.

1242. The object of my question is simply to ascertain, whether you would propose any change in the machinery or apparatus now in the possession of the parties having the management, for any system which you yourself would propose?—I think what is now fully established here should be used, and I think it may be used with satisfactory result.

1243. Supposing then that the ventilation of the Houses of Parliament were placed in your hands, could you, with the apparatus which is there, properly ventilate the House of Commons upon your own idea, and upon your own system?—It would not be according to the system which I deem the simplest and best, as already explained; but, skilfully worked, I think the apparatus now here will perform satisfactorily.

1244. Giving you the control of the steam, so as not to work it at so high a pressure as to vitiate the air, could you, with that apparatus, carry out your own system with satisfaction to yourself?—I repeat that I think it may be worked so

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as to give general satisfaction. Some other reflections on it will occur as we proceed.

1245. I am speaking now simply of the warming apparatus? —To equalize and in all ways regulate temperatures as desired, by the existing system of hot tubes, will require more care and delicate management than would be needed with some simpler arrangement of heating surfaces, and particularly in regard to the mixing of the hot and cold airs here required.

1246. Will you have the goodness to explain to the Committee any changes or simplification of the system, if you know of any, what you would wish to introduce?—The existing apparatus could not be simplified without much change, and the ends may be attained by intelligent and careful use of it as it is. The errors most likely to happen are from imperfect mixture of airs of different temperatures, so as to produce in the rooms cold draughts and the hot draughts. I think a good deal of the complaint made in the House has been from the fact of the air entering being sometimes beyond the temperature desired in the room, and sometimes below it.

1247. Is that a defect arising from the imperfection of the system, or the want of application in the manipulation of the system?—A more simple system would be more obedient, and would act with more certain result.

1248. Do you think that, in order to give you the facilities which you would require for mixing the air, the means already exist, and could be placed at your disposal for doing it, or would you require additional chambers?—I would not propose additional chambers, but very careful management.

1249. In point of fact, it would be the manipulation of the system?—Very much the manipulation of the system.

1250. Sir *D. Norreys.*] Will you be kind enough to explain a previous answer of yours, that the steam-pipes might arrive at a temperature of 220° or 212° plus 7 or 8; I find a statement by an author who has written on the subject of ventilation, Mr. Price, in the following words: "If the external air, at a temperature of 32°, be drawn into contact with the heating surface at 160° (which supposes the included water to be at 190°)", is that according to your experience?—That is a common fact, but the difference between the external and internal temperature of pipes depends much on the rate of motion of the air and the arrangement of the surfaces.

1251. Then if so, at what temperature must be the steam which you conceive would heat the temperature of the pipe to 220°?—It would depend much upon the duration of the contact of the air with the pipe. If the air be made to pass very rapidly,

rapidly, it will lower the external temperature many degrees; if the warm air remain long about the pipe, the external and the internal temperature of the pipe, and the temperature of the passing air become all very nearly the same. In the heating of the House of Lords, many of the pipes are perpendicular; all those, indeed, that warm the air which first enters. In this there is the disadvantage that the air which has been warmed at the bottom of the pipe continues to ascend, clothing the pipe to the very top with warm air, and that air may become heated up to nearly the temperature of the steam within. The external surface of the pipe near the top will be considerably warmer than it is at the bottom; and the air heated in that manner, will be altogether heated more unpleasantly and will approach more nearly to the high temperature of the steam, than if the pipe were horizontal, and the air, therefore, passed more rapidly, keeping the surface cool, and receiving itself only the temperature of that surface.

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1252. Then your observation, that it is possible for the steam in the present apparatus to reach an external temperature on the pipes of 220°, presumes that there should be no current whatever of air passing along the pipes?—That the current should be much lessened, in the way I have described.

1253. If there be any current at all, that current must be of a temperature equal to the pipe?—The air could not quite attain the temperature even of the outside of the pipe, unless it became stagnant altogether.

1254. The question still returns to this: if you have the temperature of the pipe at 220°, there being a current of air passing along it, at what temperature must the steam within that pipe be?—To answer the question it would be necessary to know the temperature of the air before touching, its speed of transit, and the thickness of pipe substance.

1255. Mr. *Locke.*] Supposing the steam in a pipe for the ordinary purposes of ventilation to be as you have supposed, 5 lbs. pressure on the inch, which would perhaps be 220 or 230 degrees of temperature, and supposing, under the ordinary operation of ventilation, a current of air to pass, what would be the temperature at which the air would arrive in its passage along the pipe?—Under ordinary circumstances, I think there would be about 20 degrees or 30 degrees difference between the external and the internal temperature of the pipe; and the temperature required by the air in passing would depend on its quantity, as proportioned to the extent of heating surface touched by it.

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1256. In your former answers, as I understood you to give them, in stating that you would not heat air up to more than 212°, you meant the temperature of the steam, making a little deduction probably for the thickness of the pipe, and the want of sufficient time to remain in contact?—Yes.

1257. Mr. *Greene.*] Have you noticed, or do you know, whether the hot water apparatus in the House of Commons is ever used at a temperature above what you object to?—As the temperature of water in ordinary boilers cannot rise above 212°, the temperature can never be objectionable.

1258. Did you ever see during your inspection any actual case where the mixing or the use of warm air below the House was in any way objectionable during the sitting of the House?—I did not; but judging from the complaints made, and because I did not see certain means of avoiding error, I fear that error of this kind has occurred.

1259. Mr. *Locke.*] Do those observations apply to the House of Commons itself, or to all the rooms?—To all.

1260. To these rooms in particular?—To the Houses of Commons and Lords; to the whole building.

1261. With reference to the ventilation of these rooms, do you know whether there is a separate apparatus for the air for each of these rooms?—I believe there is.

1262. Are the means there for mixing the air sufficient, do you think, to produce a proper ventilation in these rooms, if properly attended to?—I think they are, but not by simple adjustments. This remark leads me to speak of the temperature of a room as indicated by the thermometer; very many persons misconceive this matter; if they see the thermometer in a room standing at 60°, they believe that the air is at 60°, and that the walls are at 60°; there cannot be a greater mistake than this in many cases. In a room with an open fire, the radiation of heat from the fire to the walls, and therefore to the thermometer hanging on any wall, may keep the thermometer standing at 60°, while the room is filled with air below 40°; and many persons, with morbid conditions of lungs, who have been in the habit of breathing air at 60° and 65°, on going into such a room will begin coughing violently; they are really breathing air at 40°, though the thermometer is standing at 60° in the room.

1263. Mr. *Greene.*] Will you explain that?—It is known that air cannot be warmed by heat merely radiating through it; thus the air at the top of Mont Blanc, although nearer to the sun, and transmitting his powerful rays which warm the summer vallies below, remains itself always under the freezing temperature.

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temperature. Air can be heated only by contact with other bodies which are heated; and cold air entering a room where there is a fire, receives its heat not directly from the fire, but slowly by touching the solid walls and furniture, which can be warmed by radiation. Thus the temperature of the air in a winter room, with the thermometer at 60°, may be below 40°, and may so remain while there is free ingress of fresh air, with the strong draught of an open chimney, and therefore a rapid ventilation.

1264. Viscount *Palmerston.*] That is, supposing the thermometer not to be protected from the radiation of the fire?—Yes; supposing it to be hanging exposed as usual, on one of the walls. The feeling which a person has on going into any room, depends so much upon the heat radiating to the body from the fire and walls, and on that abstracted by the radiation from the body to the cold window, that many persons neglect to think of the temperature of the air itself.

1265. Mr. *Cochrane.*] The thermometer is no criterion, in point of fact?—It is a criterion only of the united effect of two things acting together, which may unite in very different proportions.

1266. If I want to know of what temperature a room is, whether 60° or 65°, in point of fact the thermometer is no criterion?—It tells the sum of the effects of two forces; but a room with hot walls and cold air, and a room with cold walls and hot air, may both have the same thermometric indication. The same person with sensitive lungs entering one of these, might begin to cough violently on account of the cold air, and on entering the other might feel stifled by the hot air.

1267. Sir *D. Norreys.*] Does not that show that the thermometer is acted upon by something more powerful than itself at the moment, namely, the wall around it, and that it is no fault of the thermometer?—The thermometer always tells truth, but it indicates the combined effect of two influences, which may combine in very different proportions to effect the same result.

1268. Not more so than if there were a vessel of hot water and a vessel of ice in the same room, and you put the thermometer in one or the other, it would indicate the position into which it happened to be placed?—Yes.

1269. Mr. *Greene.*] I understood you to say, that your remarks respecting the want of a proper mixing of the air in the House of Commons arose, not from what you had perceived actually within the walls of the House, but from your own observation as to the mode in which the mixing was

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carried on?—Hearing of complaints made respecting hot and cold currents in the House, and not having seen means that certainly avoided errors in mixing, I thought it likely that some such errors had been fallen into.

1270. Mr. *Locke.*] Then I understand the object of your last answers to be this: that although you may see a uniform temperature registered by the thermometer on the wall, persons may be apt to be mistaken as to the uniform temperature of the air which has been carried into the room?—Yes.

1271. And you think that has reference, not only to the House of Commons but to these committee-rooms?—Yes.

1272. My question was simply to ascertain from you your opinion upon this point; do you see any means by the present mode of apparatus of so applying your views, supposing your mind were to be applied to it, as to obtain, in these committee-rooms, a perfect, or proper or uniform system of temperature?—Much would be done simply by maintaining the desired temperature during the nights as well as days, and then during the use of the rooms, by admitting only the greater or less quantities, as needed, of air, carefully rendered of the one proper medium temperature.

1273. As I understand you, this misconception of the actual state of the air, arising from not understanding the difference between the thermometer and the air, is one of those little differences which ought rather to be attributed to bad manipulation than to the actual system itself?—Yes.

1274. Mr. *Greene.*] As far as our sensations go, does not it make a very great difference whether the air is passing rapidly by us or whether it is stationary?—It does.

1275. In point of fact, with the thermometer at 65° or 70°, we should feel it almost cold in consequence of the rapidity of the current passing by us?—Yes. The temperature of the body being 98°, when a person sits in a tranquil atmosphere, the air in contact with the skin acquires nearly the temperature of the skin, consequently if this be brushed away by fresh air of a lower temperature, say from 60° even to 80°, there is felt the application of a colder air to the surface; in a very warm room a lady with a fan brushes away the hot air of 98°, and is cooled and relieved, although the air which she throws upon her face is the hot air of the room.

1276. Have you any further remarks to make with respect to the best mode of effecting an equal temperature?—Something more has to be said under the head of lighting.

1277. Will you inform the Committee what is the best mode

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mode of supplying sufficient moisture to the air of the House?—The importance of the moisture in air I need not speak of; persons know that a north-east wind in spring is very dry and cold, and that coming upon the body it absorbs the moisture from both external and internal surfaces, and occasions great discomfort. A south-west wind is the opposite in those particulars, being warm and moist. Hence, in cold and dry winds, it has been deemed important for persons in weak health, and even for persons in strong health, as precaution, that a due proportion of moisture should be added to the air: common means have been to hang up wet cloths in the place, or to let a jet of steam pass in. The simplest mode for large buildings I believe to be that of jetting steam from a pipe with branches placed in the channel by which the air enters. The steam should be uniformly diffused. It is easy to let more or less enter as may be desired, by turning the steam cock; the hygrometer would show always what quantity of moisture were in the air. All air which is warmed from a low to a high temperature, is thereby made drier or capable of dissolving a larger quantity of moisture to make it like the ordinary atmospheric air.

1278. What do you conceive the healthiest state of the atmosphere in respect of moisture?—To be with a difference of about eight degrees of temperature between the wet bulb and the dry of the hygrometer.

1279. At what amount does it become absolutely unwholesome?—Great differences may safely exist; very healthy persons live at sea, where the atmosphere is usually charged with moisture; or again, in high regions where there is very little.

1280. Is a state of 10° or 12° absolutely unwholesome?—No.

1281. You state that you would apply steam for the purpose of moistening the air?—Yes.

1282. Would you do it in summer as well as in winter?—Steam is for winter; in summer evaporating surfaces or the cold-water jet; artificial rain has been made to fall into a channel by which the pure air was entering a building; these cool the air, and if the air be dry, moisten it.

1283. In case of the air being impure, would you use any chemical preparations for the purpose of improving the air? Not if I had the pure atmosphere near me.

1284. Are there any means of applying such preparations?—Some such experiments have been made.

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1285. But for the ordinary purposes of ventilation, having access to the pure air, you would not have recourse to any chemical agents?—I would not.

1286. Mr. *Locke*.] Are there any means employed now for giving moisture to the air in the House of Commons?—I saw a steam pipe in one place, but it did not appear to be ready for complete operation; it was not in operation when I saw it.

1287. I suppose it would be sometimes not required?—Sometimes it would not be required.

1288. And it is not an expensive application?—Not at all.

1289. Therefore any machinery necessary for the purpose of giving moisture to the air, might at any time be applied at very inconsiderable expense?—At very inconsiderable expense.

1290. Mr. *Greene*.] Have you seen the lighting of the House of Commons?—I have.

1291. Will you give us your opinion upon that mode of lighting?—I passed into the gallery yesterday when the lamps were burning, and I found the heat from them very oppressive there. These lamps when lighted up in the House, already warm enough, become like a blazing fire lighted in a summer apartment. In this committee-room, lately, an Honourable Member reported some experiments which he had made on the difference of temperature at different distances from the lamps in the upper part of the House, according perfectly with what I observed last night. Light from above is the most natural light to us; for the sun sheds his light from above; but where light is united with much heat, as in the sunbeam or in the illumination of the mass of gas-lamps in the House of Commons, a screen becomes necessary. In nature, the hair of the head even of the naked savage defends him from the sun; among civilised people we see the turban answering this purpose; the hat, the umbrella, the parasol, and so forth; frequently, persons exposed to the hot sun with the head uncovered are affected with head-ache, *coup de soleil*, palsy, &c.; the lower animals seek the shade of trees. Now, the intense heat upon the heads of Members sitting in the gallery of the House of Commons, is oppressive and not without danger; it seems essential, therefore, if the House is to be lighted chiefly from the top, which probably is the best mode, that there should be some screen to give protection. It happens conveniently that the substance of glass, although allowing the heat of the sun to pass with the light, (as proved by the action of a burning glass,)

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glass,) arrests the radient heat of ordinary combustion; this is familiar to us in the instance of a glass screen standing before a drawing-room fire; a person sits on the distant side of the screen and feels nothing of the radiant heat of the fire; the glass itself becomes heated just as a sheet of iron would be, and then, as a new centre, diffuses the heat which falls upon it in all directions, instead of letting it pass on to the person screened. Lamp-glasses themselves being near the flame may become almost red hot, but a sheet of glass at a greater distance remains comparatively cool. If the lamps in the House of Commons were raised so near the ceiling as that a floor of glass could be placed beneath them, separating them in fact from the House altogether, and causing them to be supplied with air from above, nearly the whole light of the lamps would enter the House, with very little of the heat. It had been proposed for the late House of Commons, by Dr. Reid, to place the lamps outside altogether, above the ceiling and on the outside of the windows.

1292. Sir *D. Norreys.*] I understand you to recommend a sheet of glass in the place of the present ceiling, and that the lights should be suspended above it?—I say, that if the lamps were placed above the ceiling, or above a floor of glass near the ceiling, over which floor a current of cool air could pass, carrying away much of the heat, the light would be made to descend with scarcely any of the heat. I may here observe, that pure hydrogen gas in burning gives intense heat with very little light, while coal gas, and still more oil gas, consisting of hydrogen with carbon dissolved in it, gives, with little more heat, increased light in proportion to the quantity of carbon present. Gas with little carbon is more cheaply produced than richer gas; much of the gas used over London is of inferior quality, and I believe that the gas now used in this House is of the ordinary kind.

1293. You would not recommend a Committee of this kind to trouble themselves with the question of the quality of the gas; any recommendations which you would make would have reference to the possibility of the very worst gas being employed?—They would. These lamps now in the House of Commons, of Mr. Faraday, are, like everything which comes from him, ingenious and beautiful, but if the lights are to be placed above the ceiling, a simpler form of lamp, or gas jets without chimneys, would probably be found more convenient.

1294. The lamps in the House are on Mr. Faraday's principle, are they not?—They are.

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1295. You are aware, that a certain portion of the roof is now the space by which the vitiated air is carried off through the panels?—Yes.

1296. If it were as you recommend, desirable to take out the existing panels, and insert plates of glass in their room, and to place the light above them, would it not be requisite to open some new mode of ventilation at the side?—Probably only to enlarge or to multiply openings already there, towards the sides of the roof.

1297. If you adopted that system, do you think it would also be requisite to have recourse to reflectors, so as to throw the light into the House?—Either so, or to have still more lamps, to compensate for their increased distance from where the Members sit.

1298. Mr. *Greene.*] Might you not also apply lamps without the existing windows?—That also might be done.

1299. Sir *D. Norreys.*] In case of the application of the lights above the ceiling as you have stated, would you recommend the adoption of ground glass beneath them, so as to soften and modify the intensity of the light?—That might be done or not; I should not think it very essential, because my impression is that, from the lights being placed so high, persons would no more need to look at them than at the meridian sun; so that whether the light were passing through ground glass, which is a considerable impediment, or descending through clear glass, they would little heed the difference.

1300. Mr. *Locke.*] But if the intensity were found to be considerable, it might be diminished by the introduction of ground glass?—Yes.

1301. Sir *D. Norreys.*] The system which you propose is a system of direct action, the light being assisted by reflectors, and not a system of light only by reflectors?—Yes; I would not waste any of the direct light without a necessity.

1302. You would combine radiation and reflection?—Yes; but I am not prepared to say whether sufficient light might not be got by reflection alone, from the ceiling and walls strongly illuminated. It is believed that concentrated light coming from above does not show the expression of features to such advantage as when there is also considerable reflection from surrounding walls.

1303. Viscount *Palmerston.*] Does not ground glass refract the rays of light rather unequally and disagreeably?—Some persons dislike to look upon any extended very luminous surface, such as the ground glass globe of a lamp, or a white

row of houses in the sun, or white sands; but the refractive and other effects are uniform over the whole surface of ground glass.

1304. Sir *D. Norreys.*] In respect of the side lights, when you stated that lights could be placed where the painted windows are now, would you adopt a direct light, or would you adopt a reflected light, or a direct light assisted by reflection?—I think the last named, passing through ground glass, or reflection alone from intensely white surfaces.

1305. Mr. *Locke.*] Have you at all considered the question of lighting the House by means of wax?—Yes; a smaller quantity of light might be made to answer the purpose, by placing the wax candles near to the persons; but the whole heat and impure air of the combustion would spread in the atmosphere of the House.

1306. What would be the difference in the quantity?—I think the light might be less by a half.

1307. Then, if the lighting by wax could be introduced with the same simplicity, in your judgment it would be a better light than gas?—It would answer well if the heat and carbonic acid could be at once removed.

1308. It would be cooler?—It would be cooler than equal lighting by common gas, of which the heat were allowed to remain; but if the candles were placed high up, and were therefore more in number, there would be no advantage. I was at the Hotel de Ville, in Paris, last year, when it was brilliantly lighted up by many thousands of wax candles placed high; but the excessive heat caused much dropping of the wax on the company.

1309. Do you think it would be possible to introduce any system of wax lighting which should get rid of the annoyance arising from the excessive heat of the gas, and with any degree of efficiency?—I should think it inferior, for several reasons, to the gas-lighting, well managed.

1310. And you think that the gas-lighting might be so well managed as to render having recourse to wax unnecessary?—Yes, I do.

1311. Then you think the system of gas-lighting for the House, with a false glass roof, and the lights above it, would be sufficient for lighting the House of Commons?—Yes.

1312. If it were not sufficient, you think, at all events, it might be made positively sufficient by the introduction of lights at the side, where the present coloured windows are?—I have no doubt of it.

1313. With the introduction of such means, would your system

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system of ventilation, upon which you have been giving evidence, be at all inapplicable?—The two would readily harmonize.

1314. And the introduction of an artificial glass roof would not interfere with any mode of ventilation which might be adopted?—Not in any degree.

1315. Viscount *Palmerston*.] Would not wax-lighting, at the same height as the gas-lighting which you propose, be liable to this disadvantage; that the wax-light would not radiate the light downwards in the same way as the gas-light would in the shape of lamps?—Yes; the body of a candle intercepts more of the downward light produced than the solid part of a good gas-burner does.

1316. Is not the surface of the frame of the gas-burner of larger diameter compared with the solid frame of the candle, taking the diameter of the candle itself?—I think the simpler forms of gas-burner throw less shade downward than candles; but in the lamps now in the House I think the proportion of the solid frame below is greater than that of the solid candle.

1317. Mr. *Locke*.] Supposing that objection to hold good, as the noble Lord has put it, I understand you to admit that one of the advantages of using wax would be, to permit you to use the chandeliers at a lower elevation than you could use gas, on account of there not being so much heat given out?—Wax may be used at lower elevation or nearer the persons assembled, because of the greater subdivision of the sources of light and heat; but the whole heat produced in giving the same amount of light would be exactly the same for wax candles and for good gas.

1318. Sir *D. Norreys*.] Suppose that, in the present House of Commons, by direct light, you required 40 gas-burners to give a certain amount of illumination, how many similar burners do you suppose you would require, if they were placed above the ceiling, with ground glass of the most approved dimensions for the purpose, interposed between the House and the lights?—I am not prepared to speak with precision upon that point; I have not made the experiment.

1319. Could you, from your experience, state whether twice or three times the amount of light would be required, or more?—It certainly would not exceed twice.

1320. Mr. *Drummond*.] For the inflammable illuminating matter, what you would prefer would be, a gas containing more carbon?—Yes; and I may mention that it is possible to convert the common gas into good gas, by letting a portion of

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naptha vapour mingle with it, in a suitable vessel connected with the gas pipe. *Neil Arnott*, Esq., M.D. 2 April 1852.

1321. Mr. *Greene.*] If you had the finest description of gas in the present gas-lamps of the House of Commons, would there be any great inconvenience felt?—The heat would still be excessive: I believe there can be no comfort to persons sitting in the galleries, while that blazing fire, as it may be called, unscreened, occupies nearly the whole of the ceiling.

1322. Not even using the very best description of gas which you could procure?—No.

1323. Did you mean to state that the present House of Commons and the present House of Peers are so alike with respect to the ventilating arrangements, particularly to the floors, that you see no practical difference between them?—I did not examine particularly the condition of the floors, knowing that in the House of Commons the arrangements were not yet completed.

1324. Have you ever ventilated a room where numbers of people congregate, such as a law court, or the House of Commons, or has your system been applied hitherto only to hospitals and offices with a less number of occupants?—I have never, as the responsible undertaker, ventilated any building; I have merely, when applied to, given gratuitous counsel to parties engaged in charitable or public works, but I have seen enough to feel confidence in the opinions I hold. I have here to add, that until the late House of Commons existed, as ventilated by Dr. Reid, there never was in the world a room in which 500 or more persons could sit for 10 hours in the day, and day after day, for long periods, not only with perfect security to health, but with singular comfort. I think an important novelty was therein achieved.

1325. What system do you adopt for the ventilation of the Hospital for Consumption?—What I recommended there was the dry form of pump fitted to throw a known quantity of air into the house for distribution by fit channels. A small steam-engine was the moving power provided. I desired to have had there a water-engine such as now exists in the York Hospital, but at the time the neighbouring water company could not supply the high-service water needed. The steam-engine was made with a view to the general principle of having the whole apparatus as much self-regulating as possible; it did not require a regular stoker or attendant, for coal had to be supplied only twice a day, and the gardener managed it well for many months. His successor was less fit, and proved clearly that the water-engine, which requires no skilled attention, is

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preferable for all such cases. The experience obtained in these early trials will make it easy in future to guard against every possible cause of disappointment. In York a water-engine was introduced, as already stated, and it works with the regularity of a clock, the air-pump making its eight or nine strokes per minute, as desired, night and day, without other watching than to ensure that the daily supply of water comes into the hospital, and the force expended being about the twentieth part of one horse power for 24 hours. I do not enter upon details respecting the other essentials of good ventilation and warming, which for the wards of a hospital have their special modifications.

1326. Are there ever the same number of persons, for instance, in a room of that sort, which there must be in the House of Commons?—No; and although the general objects in the two cases are similar, the exact means of attaining them yet differ considerably.

William Clark, Esq., called in; and Examined.

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1327. Mr. *Greene*.] WHAT is your profession?—I am a Civil Engineer.

1328. You have studied pneumaties, with considerable care, at King's College?—I passed through the course of study prescribed for students in the engineering department of King's College, of which institution I am an Associate.

1329. Have you been practically engaged in ventilating and warming several buildings?—I have.

1330. Have you lately ventilated the court at Hull?—I have.

1331. Have you been engaged also in others?—I was consulted as to the ventilation, and have been engaged to ventilate the Assize Courts at York Castle; through my success at Hull, I have been consulted on very many occasions in that part of the country.

1332. Do you know Mr. Gurney's system of ventilating?—I am familiar with the system recommended by him for the ventilation of the Houses of Parliament several years ago.

1333. Have you applied it in your ventilation of the court at Hull?—I have; the court at Hull was put under my care for twelve months, which have just expired. I found that the upward system of ventilation had been adopted; air was admitted from the exterior, which came in contact with hot-water-pipes; the stench in the Court was very great indeed, owing principally to the peculiarity of the persons who attend

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the Court, of whom a great number are very dirty unwashed people; I established the opposite system, that of the downward ventilation, by erecting an air-shaft, which is connected with the building by channels passing under the floors; a series of steam-jets are placed in the shaft, which, when in action, exhaust the air from the building; air is admitted at a high level; the result has been found perfectly successful; in fact, I have numerous testimonials with reference to it, if the Committee would like to peruse them.

1334. Your system is the down-draught; where is your exit for the foul air?—The exit for the foul air is up an air-shaft, built for the purpose, in which the steam-jets are placed, and the inlet of the air is through the windows. I had but limited means placed at my disposal for effecting the object, and I was compelled to do it in the most ready manner I could; therefore I adopted the windows as the cheapest means of ingress for the air; they are set open for the purpose.

1335. How do you prevent the current of air coming upon the people unpleasantly?—When the openings of the windows are properly regulated, as they are, the velocity with which the air comes in, is not found to be at all objectionable; the apertures being sufficiently wide, air has no tendency to come in at an objectionable velocity at all.

1336. Is that mere external air?—That is mere external air.

1337. For the purposes of warming the Court, how do you apply the hot air?—The air within the building is warmed; the air is not warmed as it comes in; the means of warming is by steam-pipes.

1338. Where are your steam-pipes applied, and how is the circulation of warm air effected throughout the Court?—The warm air from the pipes ascends, and mingles with the other air, and preserves the Court at a very uniform temperature.

1339. What is the position of these warm pipes?—I found that the pipes were for water when I took them in hand; but I have now made them steam-pipes, for the purpose of having a better command over the temperature. They are placed round the interior, in various parts of the Court, upon the floor.

1340. Mr. *Locke*.] Are they under the floor?—No, they are above the floor.

1341. In the wall, or by the side of the wall?—They are by the front of the seats, and round the gangways of the Court.

1342. Did I rightly understand you to say, that there are

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no means of admitting the air through the roof at all?—None; but it is admitted at a very high level of the windows.

1343. And you use your drawing force entirely from the floor?—Entirely from the floor. A limited amount of the ventilation is allowed to escape upwards, though I have powerful means by the steam-jet, and extract a very large quantity of air, 4,000 cubic feet per minute; I believe still a small portion of the air escapes upwards, and so I desire it to do.

1344. What control have you over its escape upwards?—The size of the aperture.

1345. Which aperture?—The aperture provided in the ceiling.

1346. I understood you to say that you had no aperture in the ceiling?—I said that I allowed a limited aperture in the ceiling for the escape, but none for the admission.

1347. Viscount *Palmerston.*] Do not those open windows produce a draught unpleasant to the heads of some of the persons in the Court?—It has never been complained of; today it is in use.

1348. Not even in cold weather?—Not even in cold weather; I have no other means of admitting the air.

1349. Are the windows very near the ceiling?—They are near the ceiling; the air becomes tempered as it falls. As I have said before, the velocity with which it enters is but very small, not sufficient to be found objectionable. If the apertures were too limited, of course the air would come in at a greater velocity, the quantity abstracted remaining the same.

1350. Mr. *Greene.*] What is the space which is given for the admission of air?—It is regulated by the requirements of the building. If there are many persons assembled, I admit a larger quantity; the pull of the jets is stronger.

1351. But upon all occasions you have the windows open, however cold the weather may be?—Yes; that is the only means of admitting the air, save the action of opening the door.

1352. And you find that that air circulates round those pipes and becomes sufficiently warm for the comfort of the Court?—For the most part; the Court is generally so crowded, that no artificial means of warming are required; when it is necessary, by adopting steam, I have the power of warming the Court very quickly; and I have also the power of suddenly reducing the temperature, by stopping off the heat and increasing the ventilation.

1353. Do you mean that, in case the Court is very crowded, you have no application of warm air at all?—When the Court is very crowded, there is no application of warm air at all.

1354. Even

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1354. Even in winter?—Even in winter; the Court is capable of containing about 800 persons, and then it is sufficiently warm without any artificial means.

1355. In point of fact, your artificial means are rarely used?—The artificial means of warming are used only when there are few persons there, but occasionally the numbers vary; perhaps 300 or 400 persons will suddenly leave the building; then the warming is applied.

1356. Can you apply that warming suddenly to the building?—As rapidly as the steam will enter the pipes.

1357. Is the apparatus always ready for the pipes?—The boiler which is kept in operation for the purpose of the steam-jets, is also applicable to the warming, it is always ready for that purpose.

1358. It would take some little time to fill your pipes and warm those pipes sufficiently to give the necessary degree of warmth to the atmosphere around?—Not more than 10 minutes or a quarter of an hour; 10 minutes.

1359. Mr. *Locke.*] Do you draw your air from the level of the floor, above the floor, or below it?—I have perforations in the risers of the seats for the most part. I prefer the downward ventilation for several reasons; the temperature of the building is more uniform. I believe that the purity of the atmosphere is greater, and that the persons within the Court are less liable to be inconvenienced by the mechanical disturbances of the air.

1360. Mr. *Greene.*] But must not there always be the escape of foul air from those open apertures, as well as the admission of fresh air?—No; that would be the case if the windows were open too far; but if they are open to the proper extent there is no escape of air from the windows; that I avoid.

1361. Do you imagine that the whole escape of the foul air is through the apertures in the roof?—Not the entire; the greater quantity of the air is drawn through the floor, a small portion only escaping by the roof.

1362. And you do not imagine that persons breathing, retain a certain portion of the foul air around them for a length of time?—I think certainly not; I think the extent to which the exhaled gases ascend is very much less than is generally supposed. When it is considered that one of the most abundant impurities, carbonic acid, is as heavy at 250° as pure air is at 60°, that the specific gravity of the combined gases is as great at the temperature of 68° or 70° as the pure atmosphere is at 60°, and when a person breathing upon a thermometer, in an atmosphere

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sphere of 60°, and at a distance of 12 inches from the mouth, cannot raise the thermometer so high, then I think it becomes apparent, that these gases do not ascend so far as is generally supposed; at all events, they can only ascend while they retain their temperature; but inasmuch as the temperature becomes diluted by mixing with other atmosphere, I think they have a tendency to obey the law of gravity, some being heavier, others lighter, particularly in a crowded assembly, who being perfectly still, cause but a very slight mechanical disturbance of the air.

1363. Mr *Drummond*.] They start at 98°, do not they?—They would start at about 94°; 98° is the temperature of the body; but I have frequently placed a thermometer in my own mouth for the purpose of experiment. As I have stated, if you breathe upon a thermometer, in an atmosphere of 60°, at the distance of a foot, if you place it in the direction of your escaping breath, you cannot raise it to a temperature of 70° by breathing.

1364. Mr. *Greene*.] Have you any further remarks to submit to the Committee upon the subject of ventilating the Court at Hull?—I may mention that I have been engaged to ventilate the Assize Courts at York upon the same principle, where I have introduced a heating battery as the means of raising the temperature.

1365. Mr. *Locke*.] That is only another mode of heating?—That is only another mode of heating.

1366. Does the principle of ventilation at all vary from that which you have adopted at Hull?—Not at all; I shall have more means at my disposal for effecting the desired improvement, and therefore shall bring in fresh air from above.

1367. It is a continuation of the same principle?—It is so. It is about also to be applied to another court in the neighbourhood, namely, at Beverley.

1368. Mr. *Drummond*.] At what cost is it done?—The cost at Hull was very small indeed; the cost for effecting the improvement, which has been admitted on all hands to be very great, was only 120*l*. The Recorder, who is a Member of this House, Mr. Granger, tells me, speaking of the improvement, that I have lengthened his life five years.

1369. Mr. *Locke*.] Have you examined the system adopted in the Houses of Parliament?—I am familiar with the system; I have not seen it in operation in the Houses of Parliament; I believe I am familiar with most of the systems which are in use.

1370. Have you heard of many complaints having been made

made by Members who occupy the committee-rooms and the Houses, as to the bad state of ventilation?—I have been made aware that there have been such complaints; I have seen it mentioned in the public papers.

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1371. As you know the apparatus and system adopted here, can you give the Committee any notion as to what the causes are which give rise to those complaints?—I think many of the causes are inherent to the principle.

1372. Sir *D. Norreys.*] What do you call the principle?—That of upward ventilation, I think that the persons sitting within the immediate influence of the incoming air, will be sure to feel some degree of inconvenience. The Haymarket Theatre is one of the best ventilated theatres in London, as to quantity; at least there is a large quantity of air through it; I took a thermometer with me there, and found my feet in an atmosphere of 10° less temperature than my head; still, so far as the question of quantity is concerned, that is perhaps one of the best theatres in London. I was consulted by Mr. Lumley, with reference to the ventilation of Her Majesty's Theatre; I found it in an entirely different condition; there were no means of admitting the air at all.

1373. What is the system of ventilation adopted at the Haymarket Theatre, which you say is so good?—I do not approve of it; I say it is one of the best ventilated theatres, simply as to quantity of air.

1374. What is the system?—That of admitting air I believe warmed in a slight degree at the floor, and it is extracted at the ceiling over the chandelier.

1375. If that is one of the best ventilated theatres in London, would you suggest any system which would improve that theatre?—Yes, as in my report to Mr. Lumley on the ventilation of Her Majesty's Theatre, I would recommend that the general directions of the moving air in the theatre be reversed.

1376. When you say "the best ventilated theatre," you do not mean the most agreeable, but having the greatest quantity of air?—Having the greatest quantity of air.

Sir *Charles Barry*, R. A., further Examined.

1377. Mr. *Greene.*] HAVE you prepared a statement pursuant to the wishes of the Committee?—I have.

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[*The Witness delivered in the same, which is as follows:*]

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DESCRIPTION of the mode of warming and ventilating the House of Lords, and other Portions of the New Palace at Westminster, amounting to about four-fifths of the entire Building, under the control of the Architect.

STEAM and hot water constitute the heating power employed, and the motive power for the supply and discharge of air independent of gravity, caused by differences of temperature, consists of a powerful fan, worked by a steam-engine, local rarefactions, and steam-jets; the steam-boilers and engine employed are placed in a court to the south of and contiguous to St. Stephen's Crypt.

The supply of atmospheric air is taken solely from the turrets of the Victoria Tower, at the base of which the air is purified by water, and then passes through a main channel in the basement of the building, aided where necessary by the tractive power of the fan, which forces it into a chamber under the Central Hall; it is there tempered to any degree of temperature which may be considered desirable, according to the season of the year and the state of the external air. From this central chamber the air passes, or is forced, as may be necessary, by other main-air channels of distribution, to the several portions of the building, namely, southwards, to the House of Peers, Royal Gallery, &c.; eastwards, to the Libraries, Committee-rooms and Refreshment-rooms, &c. belonging to each House; in the River-front westwards, to St. Stephen's Hall, St. Stephen's Porch, the Cloisters, and Westminster Hall, &c.; and vertically, to the Central Hall. By means of valves in these main flues of distribution, the whole supply may be thrown at pleasure upon any one portion of the building, as the exigency of circumstances may require. Each of the above-named portions of the building, and the several chambers within each portion, have respectively a separate warming apparatus in the basement for special use, when a high temperature is required; and each of the windows of the principal rooms towards the river has a similar warming apparatus beneath it within the room, to counteract the cooling effect of the glass in severe weather. The House of Peers, the Prince's Chamber, Royal Gallery, House Lobby, and the Libraries, Committee-rooms and Refreshment-rooms, &c. of each House, are supplied with air in a tempered state, by means of vertical flues in the walls connected with the main air-channels of distribution in the basement, which air enters through a portion of the ceiling of each room, as well as partially through the skirtings and wall framing, and is delivered in such abundance as to create a plenum within the room, by which all ingress of air, and consequent draughts by the opening of doors, may be avoided. The supply to every chamber is separately controlled by valves; the vitiated air from each chamber is discharged through a portion of the ceiling separated from that which is used for supply; and in respect of the House of Peers, partially through the floor, into the main foul-air flues in the roofs of the building, from whence it is conveyed into exit shafts in the Royal Court and Speaker's Court, the Central Tower, or tower used for the smoke flue of the boilers west of the Central Tower, a tower west of the Public Lobby of the House of Peers, and a tower at the north end of the House of Commons, wherein rarefying apparatus and steam jets are employed

to

to ensure a constant current of sufficient force and velocity for the purpose required. The smoke from the whole of the fires is also carried into main smoke-flues in the roofs of the building, which terminate in the same exit shafts. The total area of supply is, or will be, about 100 superficial feet, and that of discharge about 230 superficial feet. The cubic space warmed and ventilated amounts to about 3,644,000 feet.

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Lunæ, 5° die Aprilis, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Bankes.
Lord John Manners.	Mr. Henry Drummond.
Mr. Thomas Greene.	Mr. Stephenson.
Sir Denham Norreys.	Mr. Locke.
Viscount Palmerston.	

The Right Hon. Lord ROBERT GROSVENOR in the Chair.

Sir *Charles Barry*, R. A., called in; and further Examined.

1378. *Chairman.*] AT the request of the Committee you put in a Paper on the last day of its sitting, giving an account of the method in which the Ventilation under your orders is carried out?—I did.

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1379. That Paper, I believe, is the Paper which has since been printed, and which we have now before us?—It is.

1380. You state in the first paragraph of that paper, that besides other motive powers to which you refer, there are certain local rarefactions; will you have the kindness to describe to the Committee what you mean by local rarefactions?—A series of pipes placed in particular situations filled with steam, for the purpose of creating those rarefactions, such as in the smoke flues, &c.; each Committee-room is furnished with a complete coil of pipes, filled with steam, to give heat upon occasions when required.

1381. Those rarefactions then cause certain currents?—They do.

1382. Will you describe what you mean by the air passing through the channel from the Victoria Tower before it reaches

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the fan, becoming purified by water?—The preparations for purification of the air by water are not quite completed; it is intended that the air should be subject to a spray of water, either from a steam jet or otherwise, and pass through screens, but hitherto we have not had occasion to make use of that means of purifying the air.

1383. That is before it reaches the fan?—Yes, at the base of the Victoria Tower.

1384. And, therefore, naturally before it reaches the tempering chamber?—Yes.

1385. Or before it comes into contact with any rarefying or heating process?—Yes.

1386. What advantage do you imagine results from that process?—It is to free the air from any impurities that it may acquire from the state of the atmosphere, as well as to add to its hygrometric quality.

1387. And you do not apprehend that its passage through the tempering chamber, and its contact with metal afterwards, will deprive it of that hygrometric quality?—I think it will not do so altogether; but other means are provided in the tempering chamber for the purpose of moistening it again, if necessary.

1388. Mr. *Stephenson.*] When you say impurities, you mean mechanical impurities?—I do.

1389. *Chairman.*] In a subsequent part of the Report, you inform us that each of the apartments has a separate warming apparatus in the basement for its special use?—Yes.

1390. Is that by means of a coil heated by steam?—It is.

1391. You also state that each of the windows of the principal rooms towards the river has a similar warming apparatus, namely, by a coil of iron pipe, heated by steam beneath the window, within the room, to counteract the cooling effect of the glass in severe weather?—That is the case.

1392. Have you made use of that apparatus?—I have.

1393. What do you conceive to be its effect?—Its effect is to do away with the cooling power of a very large proportion of glass, when considered in comparison with the cubic contents of the room; it is employed for the purpose of counteracting those effects before the rooms are occupied, and is either kept in action or not, according to circumstances.

1394. Has it in effect been successful?—Perfectly.

1395. In what way then do you account for the complaints which have arisen?—From the cause which I have before stated; the aspect of the river front, which is due east, the contiguity of the river, and the draughts that are consequent thereon;

thereon; and the large proportion of glass in the windows, as compared with the cubic feet of area in the rooms.

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1396. Did you not state the other day that you rather apprehended that the present means, not only had not been successful, but would not be successful, and that if you found it was so, you must resort to double glazing the windows in the east front?—I did so; and I imagine that great advantage will follow from the introduction of the double glazing, not only in giving a more perfect control over the ventilation of the rooms, but also improving the acoustic properties of them.

1397. There is a complete similarity in operation by your system of ventilation throughout the entire building, as I understand you?—There is.

1398. Namely, that in every room and in almost every considerable space under your control, there is both a downward and an upward admission of tempered air?—Yes; a downward admission of tempered air, and an upward discharge of vitiated air; but the supply of tempered air is not only from the ceiling, but from other portions of the room, such as the skirtings and the wall framing, as occasion may require.

1399. The principal supply, I presume, is from the ceiling?—Principally so.

1400. Mr. *Greene.*] Is that observation confined to the chamber of the House of Lords, or does it extend to all the Committee-rooms and other parts?—It applies equally to the House of Lords and the Committee-rooms.

1401. *Chairman.*] You have stated that the apparatus is the same throughout the whole part of the building under your control; is there not this difference between the House of Lords and the rest of the building, namely, that the foul air in the House of Lords not only escapes by the ceiling, but also by the floor?—Yes; I should make that exception to a certain extent. It will be found in the report which I have delivered to the Committee.

1402. Will you have the goodness to state what your knowledge is of the direction and force of the attempered air which descends through the ceiling, reversing the ordinary current of the air?—The air which is supplied from the ceiling is so supplied by the impulsive force of the fan, and that is proved by various experiments which have been made, such as creating a large volume of smoke in each from the combustion of gunpowder, and watching the currents that act upon that smoke. They are seen to descend from the ceiling in that part of the ceiling appropriated to the purpose,

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and are also seen to arise in those portions of the ceiling that are used for discharge; one of the Committee-rooms, when filled with smoke, may be cleared in seven or eight minutes.

1403. Do you find that there is a connexion between the descending current of air and the foul air which makes its exit at the feet of the Members?—I am not able to discover any such connexion. I have seen the descent most perfectly within about three feet of the floor, and the ascent as perfectly to the discharge flues.

1404. Then I understand from you that the downward current descends within three feet of the floor, but no lower?—It does; it turns upwards generally at that distance from the floor.

1405. You are aware that we made an experiment the other day, when walking through the House of Lords. There are three lines of orifices which extend over the whole ceiling of the House of Lords; the right and left orifices are designed for the ascension of foul air; the central orifice is designed for the descent of pure air; the central compartment bringing fresh air to descend from the ceiling to the floor of the House, and the side ones being for the expulsion of vitiated air, under the influence of the steam jet with which they communicate. They are supposed all to act at the same time. The experiment tried was to prove whether they did or not act simultaneously. The double line of side orifices, which were the orifices of ascension, were closed; the effect of that was to stop the downward current immediately; there was then nothing more done than to reopen the double line of ascending orifices, and the downward current commenced directly. The inference drawn was, that the downward current did not descend at all, but merely skimmed that small amount of surface which ran between the orifices. That experiment having been tried with that object, can you account for the effect which has been stated to have been produced?—Yes; I think I can perfectly account for the effect produced. I do not at all consider that it was any proof that the air which was thrown in at the ceiling did not descend to the floor; but I conceive the effect to have arisen from this circumstance, that when the foul air discharge was closed the house became a plenum, and would take no more air than it had; consequenty the supply to the House was stopped for a time, until the air within the House could get vent, which it had not at that moment.

1406. Viscount *Palmerston.*] The force of the fan was not sufficient to overcome the resistance of the plenum?—It was not,

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not, at the force usually given by the fan. As the house would take no more air at that pressure than was sufficient to fill it, the remainder of the air found its way into other channels, out of the house, wherever it could escape, in fact, and therefore for a time, the supply to the house itself was stopped.

1407. Sir *D. Norreys.*] Do you conceive that the air in the house could possibly, in that short space of time, have been brought to that degree of density or plenum, so as to resist the action of the fan, and prevent the in-draft?—I conceive so.

1408. Viscount *Palmerston.*] Would not that resistance have stopped the fan, or would the air get away behind the fan?—No; it would not have that effect while there were other channels for the escape of the air forced by the fan.

1409. Sir *D. Norreys.*] To obtain that point of resistance must not the resistance of the air in the House have been equivalent to the force of the fan; is it possible?—Yes, I conceive it is quite possible that that should be so.

1410. Then if that be the case, would not the action of the fan cease if it was a resistance equivalent to its force?—No; it would not cease while there were other channels of discharge for the supply created by the fan.

1411. Still the air came up through the orifice through which it should come in fact?—But it came up with much less velocity, as I understand. I was not present at the experiment, but my belief is that it must have come up with much less velocity.

1412. *Chairman.*] It went in very rapidly at one end and came immediately out at the other?—Then there was both a forward and a backward current. I may perhaps take this opportunity of stating that some years ago a series of experiments were made in the House of Lords, with the assistance of Professor Faraday, to determine really whether these currents were in full operation. The means employed on that occasion, when we had not the advantage of the fan as we have now, was to burn pastiles in the chamber below, and by occupying certain positions in the House to discover how far the odour of the pastile affected the air of the House in certain places, and at certain times; it was invariably found that the first place where the odour of the pastile was experienced was upon the floor, when it was not felt in the gallery; that after a very short time it was felt in the gallery, and eventually in the discharge shafts of the roof itself, when the supply was entirely free from all odour.

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1413. Can you at all ascertain what the velocity of the downward current is?—It is quite possible to ascertain that by the amount of air thrown into the House per minute. I have not the records of the experiments which have been made before me, and therefore I could not state what the actual velocity is without referring to them, but it is very gradual.

1414. Mr. *Stephenson.*] May the circumstances which the Committee observed the other day in the House of Lords not be explained in this way, that so long as the orifices were kept open the ascending and descending currents from the ceiling to the floor were in operation?—Certainly.

1415. But when the discharge orifices were closed, instantly a plenum took place, and although the fan was still forcing air into the House of Lords, it made its exit by the nearest road possible to the discharge orifices along the roof?—Yes; that is my belief.

1416. But the moment you bring the two columns of air into action, the one being specifically heavier than the other, you would force the fresh air down nearly to the floor of the House, merely for the purpose of supplying the vacuum which would be created by the ascending current near the walls?—That is exactly my view of the case.

1417. Sir *D. Norreys.*] Is the fair inference from that, that the fan alone would not be operative, unless assisted by some power, either of a furnace or a steam jet, in creating the current which you require?—I would not undertake to say that, but I believe that the circulation would not at all times be efficient unless there were such means of discharge at command.

1418. Mr. *Stephenson.*] The fair mode of checking the accuracy of that position would be, to remove the steam blast, or whatever may be in operation upon the discharge orifices, and merely to allow the orifices to remain open?—Yes; that would be a fair test.

1419. To take away the suction power, and then to let the plenum power act alone; that would be the fair mode of trying it?—Yes.

1420. I apprehend the orifices being left open would be quite sufficient, because the channels between the orifices and the ultimate exit would be of a temperature corresponding with that of the House of Lords itself, and therefore warmer than the air coming in; consequently, you would have an ascending column of warm air, and a descending column of cold air, which would, in point of fact, be a chimneyoperating by

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by a natural draught instead of an artificial one?—Yes; that would be the operation. I was not present on the occasion of the experiment; I am not aware, therefore, whether the steam jet was then in operation.

1421. It was?—I imagine that the effect of the currents within the House would be just the same, whether with or without the steam jet, only that without the jet the circulation would not be so rapid.

1422. Sir *D. Norreys.*] Are we correct in supposing that the principle which you adopt is this, that the fresh air descends in a certain extent of current downwards towards the seats, and after having passed under the seats, ascends in the same chamber to the discharge shafts?—Yes; that is the theory of the ventilation of the House of Lords; but I should state, that dependence is not alone placed upon the discharge from the ceiling; other means of discharge are provided for use on emergencies on the floor of the House; but the circulation would equally work without such means.

1423. Mr. *Drummond.*] You have stated that the purification of the air is produced by passing it through water before it is passed to the tempering chamber; and that there, if it becomes impure, means are again taken to water it afterwards; why is that double process necessary?—The first process is necessary for the purpose of freeing the air from the grosser and mechanical impurities of the atmosphere; the second is for the purpose of giving it specially that degree of moistness which is required for purposes of ventilation.

1424. You consider, of course, the art of which you are so distinguished a professor, namely, architecture, as one of the fine arts?—I do so; although it is fair to say it has been made a vexed question.

1425. Its being applied to domestic purposes is comparatively recent, since the time of the Tudors; I exclude, of course, in this question cathedrals and religious houses; I do not mean that people did not live somehow or another in something, but that domestic architecture is really a new art, so to speak?—May I ask whether it is meant that the application of the Tudor style of architecture to domestic purposes is to be considered as a new art?

1426. No; what I mean is, that before that time the object of domestic architecture was rather defence than the comfort of the inmates?—Yes; decidedly.

1427. And there are no traces in the buildings of the oldest architects of any means of ventilation, or lighting, or warming?—None that I am aware of in mediæval times; in the more ancient

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ancient times of the Romans there is an abundance of evidence as to warming, but ventilation, I imagine, was suffered at that time to act from natural causes.

1428. There is no trace of anything of the kind in the buildings erected by Lord Burleigh, at Burleigh, Hatfield, Theobalds, or at any other palaces?—None whatever.

1429. Nor subsequently even in those by Sir Christopher Wren?—None at all.

1430. Nor even later, in the time of Inigo Jones?—None that I am aware of.

1431. In building it is necessary to know something of the science of mechanics?—Most certainly.

1432. That is to say, so far as regards the carpentry and the construction of roofs and steeples, and those sort of things?—Yes.

1433. Is it also a part of the study of a young architect to learn chemistry?—According to the maxims of Vitruvius it ought to be a part of the instruction of every architect to make himself acquainted with chemistry, as well as other sciences; and I think it would be a very great advantage if all architectural pupils were to take the advice of Vitruvius on that subject.

1434. May I ask whether, when you first began to study, that was one of the things taught you?—Yes, as is commonly the case with youths before entering into the business of life; I did not take up the science of chemistry professionally.

1435. So far, for instance, as the composition of cements?—Decidedly.

1436. The persons who have made the greatest discoveries, I believe, in the composition of cements, were engineers, were not they?—Yes; I think so.

1437. For instance, I believe the best work on the subject is the preface to Smeaton's Eddystone Lighthouse?—That is an excellent work. There are some works also by architects and surveyors; amongst them is a very good work upon cements by the late Mr. Higgins.

1438. The strength of cement depends altogether upon chemical principles, does it not?—It does.

1439. You have spoken of the double glazing; does heat permeate through atmospheric air?—Yes, I should conceive so.

1440. Mr. *Stephenson.*] By radiation?—Yes.

1441. Mr. *Drummond.*] Is not this room warmed, supposing there to be nothing but a fire in it, not by the heat permeating the whole mass of the air, but by warming one layer,

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layer, and that layer being succeeded by another, and so on?—By radiation from the fire, but by permeation also through each layer of air.

1442. By warming each successive layer which changes its place, but as the air is a non-conductor heat will not pass through it; you stated the other day that atmospheric air was a non-conductor?—I am not aware that I made that statement, although it be true to a certain extent.

1443. The difference of the illuminating powers of different substances during combustion is a question of chemistry, not of architecture, I suppose?—It is.

1444. Is the quantity of light always equal to the quantity of heat given out by substances during combustion?—I am not prepared to answer that question, but I believe it is so understood.

1445. So that a lamp, for instance, may give an inferior quantity of light, and a greater quantity of heat, or *vice versâ*?—Not if what is generally understood on the subject be true.

1446. The radiation of heat then, in point of fact, is not a question of architecture, but is a question of chemistry or natural philosophy?—Yes.

1447. Also with respect to the conducting powers of different substances made use of, for instance, in the construction of chandeliers or lamp stands; that is not an architectural question?—Not strictly so, but it is a question with which most architects are to some extent familiar.

1448. That is to say, they may or may not be?—Certainly.

1449. You have spoken of one set of holes in the roof to make good air descend, and another set for the foul air, to make the foul air ascend; no doubt if the good air will be so good as to do so, and the foul air, we are very much obliged to them, but the specific gravity of gases is a question to be taken into consideration, I suppose?—Decidedly.

1450. That is hardly a question of architecture either?—Not strictly a question of architecture, but it is a question that had to be considered in deciding upon the system of ventilation to be employed; the supply is always kept a few degrees colder than the air of the House, in order that it may have the advantage of gravitation in its descent.

1451. Do all gases expand equably?—Such I believe to be the general understanding; that is certainly not a question of architecture.

1452. But when there are many gases mixed with the atmospheric air, and these all pass through the same heating apparatus,

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apparatus, it alters very much the result when they come out on the other side of it?—No doubt it does.

1453. Is there any proof that the gases evolved by the decomposition of vegetable or animal matter are deleterious to health?—I should say there is proof to that effect.

1454. Can you destroy that deleterious effluvium?—It may to a certain extent be counteracted by chemical applications, but not entirely destroyed.

1455. Can you do more than overpower one effluvium by another?—I think not.

1456. So that, if you take any of these deleterious effluvia arising from decomposed animal or vegetable matter, the chlorine by which they are counteracted is as destructive as the original deleterious matter?—The chlorine may enter into combination with the odour upon which it acted, and so change the nature of that odour.

1457. To destroy the effluvia from cesspools you must employ, in fact, another deleterious substance, which is the chlorine?—Certainly.

1458. Are not all these subjects, however, which I have enumerated necessary to be considered in any question of warming, ventilating, and lighting buildings?—No doubt about it.

1459. And is it not true that although these subjects are connected with every building, they are much more complicated in a building of this size, and a building which contains rooms and apartments for so many, various, and almost contradictory uses?—No doubt they are.

1460. But if I understand you rightly, these subjects form no part necessarily of the profession of an architect?—Certainly not.

1461. You have spoken of the particles of matter that are always floating in atmospheric air, which you say are to be purified by passing it through water; if they are not completely purified, and if there are any remaining, if you have not obtained perfectly pure atmospheric air, without any of these mechanical substances, is there not great danger in heating the air to a considerable extent lest, if the air be so heated, they should burn or oxidize, or decompose in some way or another?—No doubt there is.

1462. Is that the cause of the oppression which is felt from what is commonly called overheated air?—It may be one of several causes.

1463. The want of a due proportion of moisture is another cause?—Yes.

1464. Mr. *Bankes*.] Have you inquired into the cause of the

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the policeman's complaint in respect of the ventilation of the cloisters?—I have; and I find the cause of it to be this: that between the outer door into Westminster Hall and the inner swing doors there are means of supplying warm air, and the cause of the escape of warm air which is described by the policeman, and which had been pent up between those two doors the whole night, was occasioned by opening the inner or swing doors in the morning. The remedy for this is obvious, namely, the setting open of the inner swing door when the outer door is closed, by which the warm air would enter the cloisters.

1465. Do you mean the door opening into Westminster Hall?—I mean the door opening into the cloisters, which is the inner or swing door.

1466. *Chairman.*] Are you aware that this morning the state of the ventilation there has been worse than ever?—I am not aware of it; perhaps it may have arisen from the cause I have mentioned.

1467. Are you not aware that this morning the rooms for the Members to wash, and the parts adjacent, were so hot that the attendant there was not able to exist, and was obliged to run out of them?—I am not aware of that circumstance. I can undertake to say that there is no reason why it should be so, unless owing to some defect of management.

1468. Mr. *Bankes.*] Were the structural arrangements required by Dr. Reid for warming and ventilating the New House of Commons carried into effect under your direction?—They were.

1469. In what manner were the arrangements so required by Dr. Reid carried into effect?—The requisitions of Dr. Reid were committed by him to paper, and forwarded either to the Department of Works or to the Commissioners for the completion of the New Palace, and upon their authority those requisitions were complied with.

1470. Were all Dr. Reid's requirements complied with?—All for which authority was given by the Commissioners or the Department of Works, and that amounted, I should say, to nearly the whole.

1471. Were these works executed under Dr. Reid's constant supervision?—They were.

1472. Would any alterations in the mode of construction have been made, if they had been desired by Dr. Reid during the progress of the work?—Most undoubtedly they would, if there had been no objection to them on the score of instability as regards the building.

1473. In

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1473. In point of fact, were any requirements of Dr. Reid made which were not attended to by you during the progress of the work?—Not that I am aware of.

1474. Do you believe that the works which Dr. Reid describes in his Report to The House as defective, exercise any injurious influence on the ventilation of the House?—I have not the least conception that they can exercise any injurious influence whatever upon the ventilation of the House of Commons; for with respect to the House of Lords, where the supply of air is obtained from sources that are similar, and through channels similar to those of the House of Commons, no complaint has ever yet been made in the House of Lords of bad odour, or of the imperfections that are complained of in the House of Commons.

1475. Was the apparatus employed by Dr. Reid for working his system of ventilation ordered or carried into effect under your direction?—No, it was not; I had nothing whatever to do with it.

1476. We understand that a steam-engine was put up in the ventilating chambers of Dr. Reid, and taken down again as being unfit for use: was that steam-engine supplied and fixed under your direction?—It was not.

1477. By whose orders and under whose directions was the whole of the apparatus supplied that has been used by Dr. Reid?—I imagine by his own orders; I have had nothing whatever to do with it.

1478. Is the whole of that apparatus now in use?—I believe not.

1479. Are you perfectly satisfied with the mode which you have adopted for lighting the House?—I cannot say that I am satisfied; the mode adopted for lighting the House is too complicated, and is attended with many inconveniences; I had however no alternative but that of adopting the mode which I employed, because the conditions upon which the lighting of the House was placed were, that the lights should not interfere with the ventilation of the House, under the direction of Dr. Reid, nor should the space immediately above the ceiling, appropriated to his exclusive use, be occupied by any portion of the lighting apparatus; it was therefore necessary that the products of combustion, arising from the lights themselves, should have separate ventilation, totally independent of the ventilation of the House.

1480. Could the removal of the panels from the ceiling to try the experiment of Dr. Reid, be easily effected, and could they be easily replaced if the experiments were not satisfactory?—

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tory?—The removal of the panels from the ceiling of the house would be attended with much difficulty and expense; it would not only involve the taking down of the panels themselves, but the removal of the smaller ribs between the main ribs of the ceiling, and it would take some time to effect that properly. I may perhaps state that with respect to the construction of the ceiling of the House of Commons, that the ceiling joists are floored over and channels are left for the escape of vitiated air through the ribs; that the panels themselves are secured to the ceiling joists before the ribs below them were fixed; the ribs were then added and secured by screws through the bosses of the ceiling; it would therefore be necessary in removing the panels to take down the ribs and the bosses in order to get at them.

1481. Do the panels extend beyond the ribs?—They do so, and therefore they could not be removed except by either destroying the panel or removing the ribs.

1482. Would removing the ribs be a considerable interference with the construction of the roof?—It would be an interference with it to a certain extent.

1483. Would it entail considerable expense in replacing it?—The operation of removing the whole of them would entail a considerable expense in unfixing and refixing both the ribs and the panels.

1484. Supposing that you were directed to make such an experiment, and for that purpose to remove these panels, what course would you pursue; would you cut the panels, or would you remove a portion of the ribs?—I think it would be less costly, perhaps, to remove the ribs, and to preserve the panels.

1485. Would it require the application of much scaffolding?—It would.

1486. So as to make the apartment not fit for use for some period of time?—During the period of that operation the House could not be in use.

1487. Can you name any time, according to your judgment, which would be occupied by such an experiment?—Am I to understand you to mean the time that would be necessary to remove the whole of the ribs and pannels of the central portion of the ceiling?

1488. To remove so much as would be necessary to make full experiment of that mode of lighting?—I am not aware to what extent the removal of these panels might be required, and therefore I am not able to answer that question.

1489. We learn from you that it would be practicable to effect the object by cutting the panels?—No doubt it would.

1490. That

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1490. That would be a less expensive work than removing a portion of the ribs, would it not?—It would take, perhaps, a greater amount of time. I do not know that there would be any very great difference of expense in the two operations, but the removal of the panels as proposed would occasion the waste of them, which would increase the cost.

1491. Are those ribs essential to the support of the ceiling?—Yes, they are essential; the ribs take the four corners of the panels, and there is a space between the rib and the panels of the ceiling for the escape of vitiated air. The panels therefore are supported at the four corners only by means of the bosses in the ceiling, and therefore they are essential to the construction of the ceiling.

1492. It has been stated in evidence as one of the causes of the bad ventilation of the House, and the smells occurring in the House, that the air is drawn in part through urinals and water-closets; under whose control is the ventilation of those urinals and closets?—Under that of Dr. Reid.

1493. Is that portion of the ventilation wholly and entirely under his control?—Entirely so.

1494. What is your opinion of the suggestion made by Dr. Reid in his report as to a new mode of lighting the House of Commons?—As far as I can understand the suggestions of Dr. Reid, which appear to be experimental, I cannot say that I have much confidence in them.

1495. Have you any particular observations to make with regard to those suggestions?—Only that I think it would be necessary, before any alteration is made, that those suggestions should be more accurately explained in detail, otherwise they might lead to very extensive alterations of the building.

1496. *Chairman.*] You contrived the system of lighting which the House found when it took possession of the House at the commencement of this session, did you not?—I did.

1497. And you state that it is not satisfactory. What means should you propose, were it placed under your superintendence, to improve it?—I should propose to get the light through the ceiling in certain portions, avoid the complication of chandeliers, and thereby avoid the necessity of entering the House for the purpose of lighting; there are various modes which might be suggested; some have been adopted of late years in Liverpool with very great success; the light which is called the sun light or the rose light now used for the purpose of lighting public rooms in Liverpool; that light is in the ceiling, and wholly manageable from the ceiling.

1498. Could you draw out a paper upon that subject and put

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put it in, so as to explain it more fully to the Committee?—I should be happy to do so. I may, however, take this opportunity of stating that I have not witnessed this mode of lighting in Liverpool, but it is very probable that before the next meeting of the Committee, after the holidays, I may take that opportunity, and in that case I should be happy to afford any information that my visit to Liverpool will enable me to give.

1499. It is under your superintendence that the House of Lords is lighted, is it not?—It is.

1500. Will you describe how that is lighted?—The lighting of the House of Lords is by means of brackets attached to the piers between the windows, each light being ventilated upon Faraday's principle; that of withdrawing the whole of the products of combustion from the House, without allowing their admixture with the air of the House. The House of Lords is further lighted by means of wax candles, which are placed in candelabra at the Throne end as well as at the Bar end of the House.

1501. Are those wax candles usually lighted?—They are not.

1502. Then, practically, the lighting of the House of Lords is by means of gas, is it not?—It is ordinarily.

1503. In those brackets which you have just mentioned, upon Faraday's principle, are you aware at all of the state of heat to which the tube gets, which conveys the gas?—Yes; I am quite aware of that, and as far as that goes it is an objection to the principle.

1504. Do you consider that the lighting of the House of Lords is more easily managed than the lighting of the House of Commons?—Upon the system adopted there it is certainly more easily managed, because all the lights are fixed lights, and they are within reach of the attendant whose business it is to look to the lighting of that House.

1505. Is there any difference between the structure of the House of Commons, and of the House of Lords, and the various circumstances applicable to it, that makes the lighting and ventilation of the one more easy than of the other?—I am not aware of any structural difference that need occasion any difficulty in lighting or ventilating either in the one House or in the other.

1506. Do not you consider that the area of the House of Lords being so much larger, and the attendance so much less numerous, those are elements of facility in the House of Lords which do not exist in the House of Commons?—They may be so, but I think the difficulties are not worth consideration between the one and the other.

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1507. I wish, in reference to the structural arrangements for ventilation, to which Mr. Bankes alluded, to ask you this question; is it true that, essentially, the whole of the structural arrangements with regard to the ventilation of the entire New Palace at Westminster, so called, were contrived by Dr. Reid, and so executed by you?—Yes; that was the case up to the period of Dr. Reid's dismissal.

1508. At that time the House of Lords was nearly finished, was it not?—The House of Lords was very far advanced towards completion.

1509. So that it may fairly be said that, although not in his hands, it is in fact ventilated upon his structural designs?—Not entirely so; because various modifications have necessarily been made under my direction; and those arrangements that had been previously carried into effect by Dr. Reid have been adapted to the purpose now employed; they are no longer used as they were intended to be by Dr. Reid.

1510. I wish particularly your attention to the answer to this question; are those modifications really such as may fairly be called complete alterations of a system; I am speaking now of the structure?—The arrangements which were made by Dr. Reid have not necessarily any relation to the system that has been adopted. Such arrangements as had been made I availed myself of, as far as I could do so, but it was necessary to make many modifications in those arrangements, and to make others which were then not existing.

1511. Have you added very much to the structural arrangements as proposed by Dr. Reid?—Yes, I have, particularly in the roof of the house; they are entirely my own arrangements.

1512. Can you give the Committee any idea of any essential variation which you have made in the structural arrangements proposed by Dr. Reid?—It would be difficult, without going into detail, to give the Committee any conception of the numerous modifications which have been made in the flues and other arrangements; I think it would be almost impossible to convey an idea of the extent of them by verbal description alone.

1513. Could you really say that they were of an essential character?—Yes, I could say that.

1514. Then being of an essential character, is there so much difficulty in informing the Committee, either by separate paper or by evidence before them, what those essential alterations have been?—I think there would be no difficulty in drawing up a statement which would give a general idea of the modifications

tions which have been made, and if that is the wish of the Committee I could do so.

1515. In what do you consider that your principle of ventilation differs from that of Dr. Reid?—I am not aware that there is any difference as regards upward and downward currents, both of which Dr. Reid has provided for, except that in the House of Lords the main supply is by a downward current, and the main discharge is by means of an upward current. The mode of warming and ventilating the House of Lords, as I have effected it, is by the downward current alone, but by a modification of the arrangements which are made there would be no difficulty whatever in reversing that system and having the upward current. I prefer, however, the downward current, and therefore the House of Lords is always ventilated upon that principle, making the Chamber itself a plenum on all occasions.

1516. Were not those facilities which you mention of introducing the downward or the upward current afforded by the structural arrangements proposed by Dr. Reid?—No, not entirely; the structural arrangements by Dr. Reid were very far from completed at the time when I took possession of the House of Lords. A very considerable portion of those arrangements were made by myself, independently of any that had been previously made by Dr. Reid.

1517. In 1846, did you not give evidence before a Committee of the House of Commons?—I did.

1518. Is it in your recollection that at that time you were waiting to construct the fittings of the House of Lords, and that you stated at that time that the building could not go on because you had not got the plans of Dr. Reid with regard to the fitting up of the House of Lords?—Yes.

1519. That, I believe, as far as the body of the House of Lords goes, was the only thing wanting to complete it for the reception of its members?—That is not the case, for many of the arrangements in the ceiling were not then in existence, and have been made since.

1520. As you have stated that essential deviations have been made from the plan proposed by Dr. Reid, will you have the goodness to put in a paper giving the Committee an idea of what they are?—Yes, I will do that.

1521. Has not the system of lighting adopted in the House of Commons prevented Dr. Reid from employing the downward current?—I am not aware that it has; I understood that Dr. Reid had, on some occasions, applied the downward

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current, but was prevented from doing so owing to the heat of the chandeliers.

1522. Would not, in fact, the downward current bring down into the House, upon the Members, the heated atmosphere of the chandeliers?—To a certain extent it would, no doubt.

1523. Viscount *Palmerston.*] If I understand you, you propose to improve the mode of lighting the House of Commons by an arrangement, by means of which the radiating light should be above the ceiling?—A little below the ceiling, but very close; within a few inches of it.

1524. You would not propose to remove any part of the ceiling in order to place the light above it?—It would depend upon the extent of light that might be necessary for lighting from the ceiling; upon the principle to which I have adverted it might, perhaps, not be necessary to remove more than a very few panels.

1525. Do you conceive that removing any portion of the existing ceiling, for the purpose of lighting the House, from the space above it, would have any effect upon the hearing of the House in the transmission of sound from the speaker to those who listened?—I am very much inclined to think that if the ceiling were full of apertures, and the upward current were adopted, or were usually in operation, it would affect the acoustic properties of the House.

1526. Do you conceive that the direction of the currents connected with the ventilation may have an effect upon the facility of hearing in the House, and the transmission of sound?—I do.

1527. Are you aware that complaints are made by many Members of the difficulty which is experienced by persons sitting below the gangway in hearing what is said by persons near the Table, unless they speak very loud?—I have heard that such is the case upon the two seats on the floor of that portion of the House, but upon the seat immediately above no such difficulty exists; whether that is caused by currents occasioned by ventilation, or from what other cause, I am not able to state.

1528. Would the further lowering the ceiling, do you think, or the making it a flat surface, tend to improve the facility of hearing?—I should say not; the ceiling is as low now as it ought to be under the circumstances. With reference to the acoustic properties of the House, I do not think that a further lowering of the ceiling would be any improvement.

1529. The lowering of the ceiling has improved the acoustic properties

properties of the building, has it not?—I believe that is the general impression; I am not prepared to say that I think it has.

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1530. It is the opinion of Members in general that they hear better now?—Yes; I have heard that expressed generally as the opinion of Members.

1531. Do you conceive that a ceiling in the shape of that of the present House, or a flat ceiling, like that of the old House which was burnt down, is the best adapted for transmitting sound?—The ceiling of the old House, in my opinion, was not unfavourable in respect of acoustic properties.

1532. Do you conceive that any change could be made in the arrangements of the House which would improve its acoustic properties?—I am not aware of any suggestion which I could make with that view that would be attended with any improvement.

1533. Mr. *Drummond.*] Is it not true that sound always propagates itself in concentric circles?—That is the theory which is usually acknowledged.

1534. Therefore with every building, the wider it departs from a circular building the more difficult it is for the persons sitting in it to hear?—That is to say, that the more oblong a building is, the more difficult it is to hear, for that reason.

1535. Is it not true that large rooms have been erected in Edinburgh, Liverpool, Manchester, Glasgow, and a variety of other places, and that every one of them has turned out differently from what they were expected, so far as enabling persons to hear, without any one being able to discover why?—I am not able, of my own experience, to say that such has been the case, but as far as report goes, undoubtedly that is the general impression; rooms which are built of exactly the same size have been sometimes found not to answer equally well as regards their acoustic properties, but that I believe to have been occasioned by perhaps differences of material employed, and by differences in the localities of those buildings.

1536. Viscount *Palmerston.*] Peculiar fittings?—Peculiar differences of construction and other circumstances.

1537. Mr. *Drummond.*] If a room were plastered, for instance, or stuccoed, or faced with marble, the reverberation would be much greater than in a room covered with paper, like this?—No question about it, simply because the sound would travel with greater facility upon hard, smooth, and non-vibrating surfaces than it would upon wall framings and serrated surfaces.

1538. Have you ever heard of a lecture room in Edinburgh where

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where they had great difficulty in hearing, and where, being accidentally required, for some other purposes, to break down a part of the wall, and hang up a green cloth to keep out the air, they heard perfectly afterwards?—I am not aware of that particular instance, but I can easily imagine that the acoustic improvement might have been the effect of such an alteration.

1539. Therefore, in point of fact, you cannot say beforehand what the effect of hearing in any building will be until it is tried?—Not exactly; but there are certain principles which, if attended to, would, to a certain extent, ensure the result of a good hearing room; certain proportions, the use of certain materials, and a variety of other principles of form and construction.

1540. You are aware, no doubt, that at the time of the rebuilding of Drury Lane and Covent Garden Theatres this matter was much discussed, and that they endeavoured to gain the object by what is called the horse-shoe shape, building the house in the shape of a horse-shoe, but that that failed also; that is to say, not totally failed, but failed according to the expectations of the architects who constructed them?—Yes, I understood that to be the case.

1541. Where you cannot get a perfect circle, or even a semi-circle, as in the ancient amphitheatres, would it not be best, as much as possible, to approach an ellipse, so getting the speaker in one of the foci?—If it were possible to put the speaker in one of the foci, undoubtedly it would; but according to the forms of the House of Lords or the House of Commons that would not be practicable.

1542. And so the difficulty exists in the Members themselves, not in the construction of the room?—To a certain extent, from the circumstance of the Members speaking from all parts of the same apartment.

1543. Sir *D. Norreys.*] Did you hear Dr. Arnott's examination on Friday?—I heard a portion of it.

1544. In respect of lighting?—I did.

1545. Did you approve of the general principles which he recommended?—I approve of the principle of lighting from above, and of the interposition of glass as a means of preventing the radiation of heat.

1546. Might not the general principle of the railway carriage lamp be adapted to the principles which Dr. Arnott recommended?—Yes, undoubtedly.

1547. And such a system might be made entirely independent of the ventilation?—Unquestionably.

1548. Dr.

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1548. Dr. Arnott stated that by the adoption of the fan as your moving power it was impossible to obtain that regularity of action, and that certainty which you could obtain by means of an air forcing machine, such as he recommended. What is your opinion on that subject?—My opinion on that subject is, that it is quite practicable to attain a uniform velocity, and perhaps more uniformity by the fan than by a pump, which I believe has been employed by Dr. Arnott.

1549. You conceive that you have a more continuous current than you would obtain by means of the reciprocating motion of the pump?—I do.

1550. Do you conceive that you are able to measure as accurately the quantity of air, and to regulate that quantity by means of the fan, as you would be by the pump?—Yes; I conceive that there is no difficulty whatever in measuring the quantity of air produced by the fan in its passage through a given area, by the instruments which are used for that purpose.

1551. The mode in which you would do it would be by measuring the area through which the air passes, and its velocity?—Yes.

1552. You have stated in your evidence that you only employ eight persons in your system of ventilation?—I mentioned eight, but upon referring to the list I found that there were only seven paid upon my own certificate; there are two other persons whom I have mentioned, who are paid by the House of Lords.

1553. This appears in strong contrast to an answer by Dr. Reid as to the number of persons he employs in his operation, but Dr. Reid not having a steam-engine as you have to give the forcing power, how many men would you have to employ had you not that steam-engine?—The abandonment of the steam-engine might make a difference of one engineer and perhaps one labourer.

1554. Does not that steam-engine work your fan?—It does.

1555. What is the power of that steam-engine?—20 horse power.

1556. That steam-engine is worked at full power, as the engineer informed us?—No, it is worked at the power of 12 horses ordinarily.

1557. Then what do you mean by saying that the absence of the steam-engine would only require you to have one or two more men?—I meant that if the steam-engine were not employed it would make a deduction from the present staff of an engine-man and a labourer, but other means of turning the

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fan would, of course, be necessary, if the fan were not to be abandoned also.

1558. Mr. *Stephenson.*] How would you work the fan, supposing you had not the steam-engine?—In that case I suppose the fan would have to be worked by manual labour.

1559. Then that would have to be equivalent to 20 horse power?—That would of course require a great number of men; but only equivalent to the power at which the engine is ordinarily worked.

1560. Sir *D. Norreys.*] In fact you cannot perhaps give an answer to the question?—I cannot without determining exactly the force which would be required to work the fan.

1561. How many steam jets do you employ about the House?—There is a steam jet in every smoke louvre in the building, and there are steam jets also in the ventilating shaft of the House of Lords.

1562. How is it that frequently the steam jets are heard, and sometimes create a disagreeable sensation in some of the rooms; for instance, in the washing-room at the head of the cloister stairs, sometimes the steam jet makes an exceedingly loud noise, and on Friday the attention of the Committee was drawn to the state of the Committee Clerks' room, in which this noise was going on to a very great amount, and also there appeared to be an escape of steam into the room; that is to say, the room generally had the smell of steam, or as if washing had been going forward?—That is from a jet in the louvre of the Speaker's Court, which has only very recently been put up, and has not yet received its casing; when that is done no noise will, I trust, be heard.

1563. That would correct it?—Yes.

1564. *Chairman.*] Supposing the whole House were under one superintendence, would a single steam-engine, such as that which we saw the other day working your fan and other works, be sufficient for the whole building?—I imagine not.

1565. Must you increase the power of that, or must you have another somewhere else?—That would be a question for consideration which, without knowing all the circumstances, it would be difficult at once to decide.

1566. Mr. *Locke.*] Do you use the boiler of that steam-engine now for the purpose of supplying the steam for your jets?—Yes, a high-pressure boiler.

1567. Is that the only boiler which you have, or have you sets of boilers for all the purposes of warming?—There are two high-pressure boilers from which the jets are supplied; the rest are low-pressure boilers.

1568. Are

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1568. Are they all in the same locality?—They are.

1569. Do you suppose that those two high-pressure boilers, and the low-pressure boilers which you have, would be sufficient for all the purposes of ventilation, supposing both House and all the committee rooms were placed under your manages ment?—I should say they would not be sufficient for all purposes, but not a very large increase upon the power which they afford would, I think, be necessary.

1570. Do you think it would be necessary to have more engine power or more boiler power?—Both, I imagine.

1571. You do not consider that the use of the jet would probably dispense with any more power of the engine?—No; as I think it would be desirable to employ one or both occasionally.

1572. Then you are in favour of the double system, of using the vacuum by means of the jet, and also the plenum system by means of the fan?—I am in favour of the plenum system.

1573. Of the system accordingly as it is established now?—Yes.

1574. If you adopt those two powers, am I also to infer that you are in favour of the system now employed in the House of Lords?—I am most decidedly in favour of it.

1575. What security have you for drawing the air to the bottom of the House of Lords, when it is admitted by the force of your plenum at the top?—The security is the impulsive force of the fan with respect to the air which enters through the ceiling of the House, and its gravity; that has been proved by experiment.

1576. You have already traced the air into the House of Lords?—Yes.

1577. And you would therefore consider that your fan is sufficient for the purpose of forcing it?—I do.

1578. I am told that an experiment was tried the other day, in which, by closing the apertures of two egresses at the side of the House of Lords, the air immediately ceased to be affected by your fan?—That I have before explained; I have stated my conviction of the effect of that experiment, which is, that in consequence of the chamber of the House of Lords being made a plenum equal to the force of the fan, and in consequence of the air not being able to escape by the usual orifices of discharge, the extra supply of the fan escaped by other channels out of the House, and so for a time stopped the supply of the House itself.

1579. Have you not an exit communication at the floor of the

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the House, which is made principally for that column of air which you put in at the centre?—Discharge apertures are provided in the floor of the House of Lords; they have recently been made, to meet possible emergencies; but the principle upon which that House is ventilated would equally work without those discharge flues; that is, that the discharge would alone take place on the sides of the ceiling, and the supply would be effected in the centre.

1580. Have you confidence enough in that double system to justify you in closing the bottom exit, believing that the column of air coming in from the top would descend to the floor and be drawn to the sides, and ultimately make its escape at the roof again?—I cannot say that; I should not like to dispense with the exit from the floor, because I think on occasions it would be a speedy mode of getting rid of the air. It has been used as an additional means of discharge beyond what was originally provided through the ceiling.

1581. Supposing that the quantity of air which the House of Lords required could be drawn in at the top, and that exits at the floor could be made sufficiently large to take it out, where would be the difficulty of adopting that system of keeping one current only rather than the mixed system which you employ at present?—There would be no difficulty whatever in discharging the vitiated air wholly from the floor, but it was considered better, in order to avoid apertures of all kinds, which might be inconvenient and form back draughts occasionally, as well as a too rapid descent of the down current, that the air should be both supplied and discharged from the ceiling.

1582. Do you conceive that there would be more draught in the one case than in the other; I am supposing this case: if the two exit areas, which are now at the sides of the House of Lords, were placed at the bottom, in addition to what you have at the bottom, and the air-supplying aperture at the top were so far enlarged as to compensate for the doing away with those under the seats and the areas for supplying the air below, do you think that there would be more disturbing causes by that single operation of the air passing in one direction only, than by the system which you adopt now?—Yes; if there should be any back currents, or the descending current should be too rapid, there would be draughts. I do not mean to say that such draughts would be very probable, neither do I mean to say that the system proposed, under proper regulation, might not work well; but with the aid now obtained from the fan for propelling the air in at the ceiling,

I find

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I find that there is no difficulty whatever in carrying out the principle which has been adopted, that of supply and discharge from the ceiling, independently of any discharge from the floor.

1583. What I was anxious to know was whether there was a greater or less risk by the system which you adopt, or by the system which I am suggesting, which would be one continued current, instead of having various currents, and those variations and counter currents of which complaint is made now in that building?—I think either system would work well, under proper regulation.

1584. Can you show me any advantage in the system at present established, as compared with that which I suggest?—There would be this advantage, that with the downward current only you would run the chance of having some of the heated and vitiated air brought down with the current, if it were very strong, which in the other case is not likely.

1585. You bring a part of that air down with you now, do you not?—No, I imagine not. I think the vitiated air goes off to the sides of the House, and does not mix with the downward current.

1586. Then would your objection extend to the system of just reversing the simple operation of drawing the air in from the bottom, and allowing it all to go out at the top: what should you say to that system of ventilation?—I should prefer the opposite system of ventilation, in order to avoid all local draughts to the feet from the floor.

1587. Viscount *Palmerston.*] Would not that produce draughts on the head?—It would depend entirely upon the temperature of the air from the centre of the ceiling, and the velocity of its current, which is, in fact, very gradual.

1588. Mr. *Locke.*] I did not understand you to say that the employment of the pump or the employment of the fan would at all affect the principle of ventilation?—It would not affect the principle; it would only afford the means, on extraordinary occasions, of assisting the principle.

1589. Do you think that you could get all that you want, either by the employment of a pump or the employment of a fan?—I think I could.

1590. Therefore we may look upon the fan or the pump as merely a means to obtain the ventilation, totally irrespective of the principle to be employed?—Quite so.

1591. In reference to a question put by the Noble Lord as to the Cloisters, you were understood to say that the cause of complaint mentioned in the evidence of the policeman, given here

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here the other day, had been remedied, inasmuch as it had been found that the heated air had been allowed to accumulate during the night by the non-opening of the door. It is in evidence that we have the very same complaint made to-day?—I did not say, I believe, that it had been remedied; I merely said it could be remedied by the opening of the door.

1592. Would it not be very easy to make an opening in that door?—Certainly.

1593. Whose duty is it to make that opening?—If such an opening were desired, of course I should give orders to have that opening made; but the same effect would be as well produced by leaving the door open at night.

1594. Whose duty is it to leave the door open by night?—The duty of those who have the charge of the Cloisters.

1595. Who have the charge of them?—I suppose the policemen; I am not aware who are the persons appointed to look after the Cloisters.

1596. When defects in ventilation occur, are there not persons under the direction of some one, I will suppose under your own direction, who can find out an excessive temperature of the air; and is it their duty, or is it not their duty to suggest to you that such is the case, and your duty to suggest a remedy?—Decidedly.

1597. Was that one particular fact mentioned to you, that there was an excessive heat in the Cloisters, and that it required some alteration?—It had not been mentioned to me.

1598. Do you know how many days it is since that evidence was given before the Committee?—I am not aware; four or five days, perhaps, or more.

1599. Do you think that a remedy so simple might not have been applied in two hours after the evidence was given, instead of the defect being allowed to continue till this moment?—Yes, but I was not aware of its continuance till this moment.

1600. We have the evidence of the Chairman that the policeman to-day felt it as bad as ever?—I was not aware of the circumstance.

1601. At all events, do you consider yourself so much in charge of the ventilation of this House that upon any complaint of that sort coming to you, you would see that a remedy was applied?—Certainly.

1602. In reference to the lighting, I did not understand you to say that you proposed by your new system of lighting at all to interfere with the roof of the present House of Commons?—

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mons?—With the exception of, perhaps, removing a few only of the panels in the central portion of the ceiling.

1603. That, I suppose, you do not apprehend would make any difference in the hearing properties of the House?—No, I do not conceive that it would.

1604. You spoke of the new system of lighting which had been introduced into a large room at Liverpool; did you mean the large Music Hall there?—That is a novel system, but that is not the system to which I particularly alluded.

1605. What is the system to which your mind is at present directed as being applicable to the lighting of the House of Commons?—I have before stated that I have not seen the system in operation, but I have had sent to me a description of it sufficient to convey to the Committee a notion of what it is.

1606. You know enough of lighting to describe it to this Committee?—I can give an idea of what it is, if the Committee wish to know.

1607. What is the nature of the light to which your mind is directed as being applicable to the lighting of the House of Commons?—The light, which I believe is known by the name of the sun-light or the rose-light, is applied to the ceiling within a cone; a certain number of gas-lights are so arranged at the bottom of the cone as to shed a very powerful light downwards. The origin of the term "sun-light" or "rose-light," I believe, is owing to the nature and arrangement of the burners, and the form which they give to the light; there are seven or more descending gas pipes in each of these cones, and at the foot of each pipe a circular chamber, from which there are seven or eight jets; these are placed a little below the level at the foot of the cone, and having nothing whatever to intercept the light between those jets and the chamber below you have the full benefit of the amount of light given by them, and the intensity of it is very considerable, so much so, that in a room of large dimensions, a church for instance, it is only necessary to employ two of these lights, excepting perhaps under galleries. The light is so intense that the shadows are equally so, and it is necessary under projecting galleries to have the additional aid of bracket lamps. The lighting of the Music Hall is by a different principle altogether, namely, by a series of jets from a pipe which run rounds the cornice of the room, communicating with a ventilating flue above it. The light is understood to be most agreeable, and is very equally diffused.

1608. In point of fact, it is one jet of light completely encircling

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encircling the ceiling of the room?—It is a series of jets very near to each other.

1609. They are almost as close as my hand?—They are within three or four inches, I understand, of each other.

1610. *Chairman.*] What is there between the eye and the light?—Nothing, but the jets are so well regulated, and so extremely steady, that they do not painfully affect the eye.

1611. Is it some peculiar gas?—The gas used in Liverpool is, I understand, a very superior gas, made from cannel coal.

1612. Mr. *Locke.*] Those cones of which you spoke would be almost similar to a chandelier if they projected below the ceiling; do you propose them to project below the ceiling?—A few inches only.

1613. Something like the lamp of a railway carriage?—Yes, something upon that principle; in order not to interfere with the operation of a downward current for ventilation, it would perhaps be necessary that these cone lights should be enclosed below by glass.

1614. How many, in fact, do you suppose it would require for the lighting of the House of Commons?—From the report made to me of the intensity of light by this mode of lighting, I should say, two.

1615. Do you propose to place them in the centre of the flat part of the ceiling?—Yes.

1616. I understand you that neither that system nor the other would interfere with the principle of ventilation, whatever mode was adopted?—The system of open lights would probably interfere, but to a limited extent only, with the ventilation by the downward current.

1617. Do you think it would interfere with the upward current?—No, certainly not.

1618. You think that if the system of lighting employed at the Music Hall of Liverpool were adopted, the upward current would be better as a means of ventilation than the downward?—Yes; I consider that it would be better adapted to that mode of ventilation.

1619. Mr. *Greene.*] Could not you easily cover with glass the whole of those gas lights passing round the cornice of the room?—Yes; if that were done there would, of course, be no inconvenience.

1620. Mr. *Locke.*] With respect to the practice upon discovering defects in the ventilation, have you reports sent to you by your officials at stated periods?—I have reports from time to time.

1621. At what periods are those reports made?—They are not

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not made at any definite periods. I take an opportunity of looking occasionally at the statements kept by the engineer when I visit the building.

1622. Who gives the temperature at which each building is to be kept?—That depends very much upon the wish of the parties who occupy any particular room. The Committees have the power of directing what temperature they would like to have in each room, and any orders coming from the Committees are attended to. General orders are given to the engineer by myself.

1623. Those orders would be issued to your subordinates? —They would.

1624. Then each subordinate has an order to keep up each particular room at a particular temperature?—Yes.

1625. Can you tell us what variation has been made during the last two months, since the time that we have had these east winds; has there been any change made whatever in the temperature of any one of the rooms under your charge?—I could not tell that without having recourse to the record which has been kept of the thermometer.

1626. Would it not be easy for you to give the Committee the lowest of the temperatures at which each room has been kept during that period?—I think there would be no difficulty.

1627. *Chairman.*] Will you have the goodness to furnish that?—I will.

1628. Mr. *Locke.*] I understand you to say that you have had no report made to you of the complaint which has been alluded to down stairs in the corridor during the last five days?—I have not.

1629. *Chairman.*] If in all the portions of the building under your charge there is an escape of vitiated and hot air, how does it happen that that hot air can accumulate in any one particular place, as has been repeatedly stated with regard to the Cloisters?—Simply, because the hot air has been improperly suffered to be pent in between the two doors, to which I have before alluded.

1630. Is there not an ingress of fresh air and an egress of foul air there?—No; at present there is only an ingress of warm air, assuming always that either the internal or the external door would always be open; but there would be no difficulty in stopping that supply of warm air, if it should be deemed necessary, or making an egress for air.

1631. Is it your intention eventually to make a perfect system of ventilation there, or to leave it in the manner you have

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have described?—I intend to make it perfect. I propose that there should be the means of preventing at pleasure the ingress of fresh air in the space alluded to, and also allow any air that did enter by the inlet openings during the night to escape by apertures for the purpose.

1632. Is that contemplated in your present structural arrangements or not?—Yes.

1633. Are the Committee to understand that the defect exists simply because your arrangements are not yet completed, or why?—Partly so, and partly to want of management in those to whom the superintendence of the Cloisters is confided, for really nothing could be more simple than to leave the inner door open during the night, and no such accumulation of heated air as that complained of could occur.

1634. In point of fact, then, the Cloisters are not ventilated in the way in which the committee-rooms are ventilated?—Not altogether to the same extent. A discharge of air is, however, provided in the Cloisters, and there is also a supply.

1635. I think you stated that the building is not yet quite in that state for you to determine finally upon the extracting shafts for the foul air?—The arrangements are not entirely finished.

1636. In short, the foul air that goes away from the House of Lords goes away at present from a place which may be afterwards altered?—No alteration there will be necessary at present. I am alluding to the foul air shafts for the discharge of smoke.

1637. Do not you intend to make use of the Central Tower?—Undoubtedly.

1638. Who suggested the building of that tower?—It was suggested originally by Dr. Reid.

1639. Did you not try a pump at one time for the ventilation of the House of Peers?—I did.

1640. What was the size and construction of that pump?—I have not the size by me, and without the aid of a diagram I could scarcely make the nature of it intelligible to the Committee. It was found, however, to be insufficient in power for the purpose; it did not give that command over the atmosphere of the House of Lords which is desirable.

1641. Then I rather understand it to be your opinion that without some such mechanical aid as the pump, or the fan wheel, you could not with your present system properly ventilate the Houses of Parliament?—I could not whilst the air is taken from below and has to be forced through restricted channels.

1642. Mr.

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1642. Mr. *Locke.*] You do not mean that you should not have the means of ventilating if you had all the appliances which you have at present, namely, the jet and the fan?—I think it will be perfectly easy to ventilate from the fan alone.

1643. Would it be as easy to ventilate with the jet alone?—I think not. There are mechanical difficulties in inducing the ascent of air from the basement of the building into the roof, owing to the want of capacity in the flues by which the air is transmitted from one place to the other.

1644. Mr. *Stephenson.*] Referring back to that part of your evidence where you spoke of the ascending and descending currents in the House of Lords, if the ingress of the air was entirely from the floor of the House, would the transitions of temperature not be much more sudden in that way, than by the descending current from the roof?—I think they would; that is to say, they would be more likely to be suddenly felt.

1645. One great advantage which you suppose would arise from the descending current is, that there is a certain commingling of the air, and a change of temperature takes place between the outgoing and incoming air, so that before it reaches that part of the House occupied by human beings, of course the temperature is very much moderated?—The temperature is to a certain extent moderated and kept uniform, more so than it probably would be by admission from the floor.

1646. With reference to a question by Mr. Locke as to the egress taking place entirely through the floor, when you avail yourself of the levity of the vitiated air in the House, do you not thereby reduce the power necessary to ventilate when you have the ascending column of warm air compensating in some measure for the descending column?—Most decidedly; that is a certain extent of power gained.

1647. Therefore in point of fact it is more easy to maintain a plenum in the House by the double column than by making the egress entirely through the floor?—I think so.

1648. Do you know at all what number of cubic feet per minute or per second is discharged at present by the fan?—I have a statement in which I could give you the discharge upon each portion, but in round numbers, the discharge would amount to about 100,000 cubic feet of air per minute.

1649. What proportion of the entire building is at present ventilated by the 20-horse engine?—I should say about four-fifths.

1650. You are aware probably that the discharge of air, or

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rather the efficiency of the fan, depends not so much upon its own construction as upon the nature of the apertures through which the air is forced?—Unquestionably.

1651. Therefore, in stating that an engine of 20-horse power would not be capable of ventilating the entire building, have you taken that into account?—Yes; that I have considered. The areas of supply are, in many instances, so much restricted that I think it might on occasions be necessary to employ even a greater power.

1652. Merely on account of the areas of the passages being too small?—Yes.

1653. Probably you would only require five-horse power more?—I cannot tell.

1654. Are you aware at all of the power which would be required to ventilate a coal-mine, for instance, where the passages through which the air has to be driven, say, are equal to 50 miles in length?—I am not aware of that from my own experience.

1655. Are you aware that a power equal to 20 horses would be sufficient to drive a larger quantity of air than you have mentioned, through a coal-pit, where the passages extend over a distance of 50 miles?—There would be this difference between a coal-mine and this building, namely, that in the mine the areas are large and uniform, whilst in this building the passages are restricted, as I have before stated, and the supply of air for the several rooms is by flues of very small dimensions in the walls, requiring considerable motive force to convey the air through those small passages, where the friction is considerable.

1656. Have you ascertained what the density of the air is on the two sides of the fan, as upon the one it must be rare, and upon the other rather denser?—Yes, that has been ascertained; there is three quarters of an inch of vacuum and an inch of pressure.

1657. Three quarters of an inch of water, you mean?—Yes.

1658. Mr. *Drummond.*] It has been stated in evidence before us that if there are two columns of air, one of considerable temperature, and the other much lower, the temperature passes so rapidly from one to the other that in a very short time they are nearly equal; how do you ensure that the foul air shall come out in the place intended for it; its specific gravity is greater than that of the atmospheric air, is it not?—I should say that its specific gravity is less, and therefore it would naturally flow out.

1659. It

1659. It only rises in consequence of its superior heat?—Yes.

1660. If the cold air then comes in at the top will it not cool this foul air, and make it fall again before it gets out?—I imagine that would not be the operation of the system, because the fresh air coming in would displace to a certain extent the vitiated air, and would give it a different direction; it would carry it off to the walls where the apertures of discharge exist.

1661. Would not they mix?—They might, to a certain extent, but not I think to any considerable extent.

1662. And inasmuch as the foul air was cooled, it would fall down?—Yes, if that were the case.

1663. Mr. *Locke.*] Would those small passages to which you have alluded be more felt by the use of the plenum system than by the vacuum, or the contrary?—I think the plenum system would be more calculated to overcome the difficulties of the restriction of the apertures by the use of the fan.

1664. Does that arise from your having more control by the plenum system, or because there would be less friction?—By having more control.

1665. You suppose that there would be more friction arising from the compression than from the exhaustion?—There might be more friction, but it would be more easily overcome.

1666. Have you used the jet in combination with the fan, on account of those small passages?—Yes, I have, in order to have a superabundance of power to be used on occasions, both for extracting air from and supplying it to the House.

1667. Had you found a difficulty in the ventilation of the Houses of Parliament, before you applied that jet, in the use of the fan alone?—I have not made use of the fan until within this last few months.

1668. Then had you used the jet before you used the fan?—Yes.

1669. Had you used the jet alone then before you used the fan?—I used the jet, with the aid of the pump which has been mentioned, and which had not sufficient power to produce the motive force required for the supply.

1670. Was it a forcing pump or a vacuum pump?—The pump was for the purpose of forcing.

1671. And at that time you did not find the pump and the jet sufficient?—I did not.

1672. Since then you have applied the fan?—Yes, I have since applied the fan, and have now an entire command over the movement of the atmosphere in the House.

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1673. Had you the steam engine applied to that pump which you now have to the fan?—No; the steam engine was not then erected.

1674. You do not know what the steam engine might have done, even without the fan?—No.

1675. Have you any particular reason in your own mind for using the jet as well as the fan; do you suppose that it arises from the contraction of some of the flues in the smaller passages?—Yes, I do; that is the principal cause of adopting those two sources of motive power both in the supply and the discharge.

1676. Supposing that difficulty did not exist, and your air passages had been such as you might have desired yourself or would now adopt, would you adopt the double system in preference to the single one, notwithstanding that alteration?—For the reasons I have already stated, I should adopt the double system; that is, the descending and the ascending currents.

1677. Mr. *Stephenson.*] Are the steam jets worked from the same boiler that works the steam engine?—Yes, from the high-pressure boiler.

Samuel Whitfield Daukes, Esq., called in; and Examined.

S. W. Daukes, Esq.

1678. *Chairman.*] YOU are an Architect, I believe?—I am.

1679. Have you been long engaged in that profession?—About 18 years.

1680. I believe you have been a competitor, have you not, for several works of some magnitude?—I have.

1681. When did you gain your first competition?—About 18 years ago.

1682. How old were you then?—Twenty-one.

1683. That is the time you gained your first competition, and since that time you have also successfully competed, have you not, for some very large buildings?—I have.

1684. Were you a competitor for the building of the Colney Hatch Lunatic Asylum?—I was.

1685. Were you successful?—I was.

1686. Has it since been built?—It has.

1687. Is that one of the largest buildings in England?—I should think so.

1688. I believe, as it now stands, it is of greater length than the Great Exhibition, is it not?—About 50 feet longer.

1689. Sir *D. Norreys.*] Were you the architect designing it,

it, or the contractor?—I designed it, and, as the architect, carried it into execution.

1690. *Chairman.*] Were you requested, in the construction of that very large building, to give your attention to the ventilation of it?—I was.

1691. Have you been successful in ventilating the building under your charge?—It is considered very successful.

1692. What buildings have you constructed with a view to ventilation besides the Colney Hatch Lunatic Asylum?—Several churches, the Sidcot Schools in Somersetshire, and private houses.

1693. I am speaking now of public buildings; have you constructed any public building in the Metropolis, for instance?—The Small Pox Hospital is one, and there are only two churches built by me, that have been ventilated upon the principle.

1694. Have you inspected the system of ventilation adopted by Sir Charles Barry in the House of Lords and the Committee-rooms?—I have.

1695. Have you made yourself acquainted with that principle?—I believe I am fully acquainted with the principle.

1696. Do you consider the system effective for the required object?—I should say not.

1697. In what particulars do your objections consist?—I object both to the principle and to the manner in which it is developed.

1698. Why do you object to the principle; in what do you consider the principle defective?—I think the system is opposed to the natural principles of ventilation, forcing the air contrary to its natural movement, and requiring the constant application of powerful machinery to obtain results that may be obtained by allowing the air to take its natural course.

1699. Will you explain to the Committee the system upon which you carry your own ventilation into effect in the buildings which have been committed to your care?—The object has been to approximate as nearly as possible to the principles of natural ventilation; I presume that in natural ventilation, air, rendered warm by radiation from the earth's surface, ascends, its place being immediately supplied by air of a lower temperature; in artificial warming and ventilation the object is to maintain an agreeable temperature of pure air, about 63°, upon the same natural principle, fresh air of modified temperature continually entering at the low level to supply the place of the vitiated air which is escaping at the high level or ceiling of the room.

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1700. How should you propose to introduce your fresh air?—I should introduce it through channels beneath the floor, entering the House at places where it would not be inconvenient to any person sitting or standing; for instance, in the risers of the steps forming the approaches to the various seats. That would be the mode of admitting the fresh air into the House. The mode of warming it would be by allowing the air to pass between flat vessels in which warm water would circulate, and from thence into flues conducted to these openings in the floor.

1701. Will you more particularly describe the sort of machine by which you propose to heat the air?—The machine is formed of a series of flat vertical vessels, enclosed in a chamber, the cold fresh air entering beneath them, and having passed between them and become warm in its passage, it is discharged into a flue, and thence into the House.

1702. You saw the machine which was produced by Mr. Goldsworthy Gurney the other day?—I did.

1703. Is it by the system of conduction that you propose to heat these vessels, or do you propose that each of these flat vessels should be full of heated water, and that the air should pass between them on to the flues?—In each of these flat vessels the water circulates, and it is not by conduction, but by the water circulating in each vessel, that the surface becomes of the temperature required to warm the air sufficiently to enter the room, according to the state of the external atmosphere.

1704. Having brought that hot air into the building, how do you propose to extract the vitiated air?—The vitiated air escapes from the ceiling, in channels provided for that purpose, communicating with an external shaft.

1705. By an external shaft, do you mean simply a chimney, or do you mean to use some mechanical power for the abstraction?—The same description of apparatus is applied for rarefying the air in the extracting shaft as for warming it in the lower part.

1706. Have you tried that successfully anywhere?—I have not tried it. I have seen it tried successfully, and should have tried it at the asylum at Colney Hatch, but it is so seldom required to be used, that the expense there was considered an objection; a furnace rarifier is used instead. We rarely apply the furnace rarefier, and I believe it has only been used on one occasion since the building has been erected.

1707. Upon what occasion?—In the wards occupied by the epileptic patients, called "the dirty patients," the air became

became rather offensive, and immediately the extracting shaft was operated upon by the rarefier, it was successful in increasing the ventilation.

1708. In what case would you use that, supposing, for instance, you applied it to the Houses of Parliament?—I should keep it in use, under control, and obtain a greater rarefying power, as it would be found necessary.

1709. Am I to understand you, then, to mean that this rarefier is the command which you have over the amount of fresh air which you wish to admit into the House?—Not the command; there are times when it would not be required at all; at those times it would be under control and used at a very low temperature, hardly influencing the ventilation; when greater ventilation was required, then it would be immediately used for the purpose of extracting the air, indeed to draw the current through the House.

1710. Then, as I understand you, you do not propose to use any tractive power at all, but you consider the natural upward passage of the vitiated and hotter air to be adequate to produce a sufficient and constantly recurring supply of fresh air into the building that you ventilate?—My experience leads me to think that that would be sufficient.

1711. Is the rarefier limited to the heat of boiling water?—The rarefier is limited in heat to boiling water.

1712. Do you consider it impossible to apply successfully a forced ventilation, as introduced in this building?—I think so.

1713. Why?—I think that it requires regulation, which is not at command in forced ventilation, to ventilate uniformly. I think in the development of the system of forced ventilation in the Houses of Parliament, the air channels, to begin with, passing through vaults, naturally throw off a damp and unpleasant air. You always find that in the lower vaults of a building there is constantly escaping from the surface a very damp and unpleasant air, which in this case is of course carried into the House. Then after passing the fan, the application of steam, as a warming medium, obliges you to keep up a temperature at all times of 212°, so that you warm the air to 212°, to reduce it hereafter in the mixing chamber. Then, I believe that air under force will not mix and diffuse in the way that it will in its natural currents; that the air is carried forward according to the force applied to it, and it enters the ventilators in the various currents in which the force takes it. It may be a cold air or a warm air; and so there is a want of uniformity in the temperature.

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1714. Do you mean that the various temperatures do not mix?—The various temperatures do not mix.

1715. I think you said that the system which you mention has not been carried out by yourself, but that you have seen instances in which it has been carried out?—With regard to the rarefier worked by hot water at Windsor Castle, I have seen it. At Colney Hatch it is by furnace heat.

1716. Sir *D. Norreys.*] It is only by the vacuum principle?—Only by the vacuum principle.

1717. At what distance from the furnace do you get that vacuum principle to act?—Two or three hundred feet.

1718. What is the distance of the extreme cell or room from that furnace that you act upon by means of the furnace?—Nearly 400 feet.

1719. Is that in one line, or are there radiations of the building in different directions?—It is one angle, a right angle; there are two lines of buildings forming a right angle.

1720. How many separate cells or separate rooms are you able to act upon with your furnace?—I think about 72.

1721. Do you find that by the air furnace you can regulate sufficiently the temperatures of all these 72 rooms, and the entire of the length of 400 feet to which you have referred?—Yes; there are two and a half millions of cubic feet in the whole building; the length of the corridors altogether is about a mile. The difference of range of temperature from one end of the building to the other, allowing for some parts of the building being three stories while others are two, did not exceed two degrees upon one occasion when it was tried through the whole building.

1722. Would you keep the corridor, in which the patients take exercise, at the same temperature as the cells in which they rest, and could you regulate the temperature of the corridor as distinguished from the temperature of the cells adjoining?—Yes.

1723. *Chairman.*] Are there any portions of that building in which they congregate in numbers sometimes, and afterwards in smaller bodies?—In each ward, the ward is empty sometimes, when the patients are at exercise, and filled immediately afterwards.

1724. Is there more fresh air supplied when they are congregated together, and less when they are not so?—It is not regulated at all; we find but very little difference in the temperature when the room is full and when it is empty.

1725. To what cause do you ascribe that?—Those corridors are

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are very large and there are only 35 patients in each; the ventilation is very good there, and sometimes the windows are open and sometimes they are closed; they seem to regulate it at their own pleasure.

1726. Have you inspected the system of ventilation adopted by Dr. Reid in the House of Commons?—I have.

1727. Do you understand the principles adopted?—The principle adopted in the House of Commons is incomplete at present; the principle ultimately will be exactly the same as that in the House of Lords, but the development of it is different.

1728. In what is it not entirely developed?—It is designed for the plenum principle, and at present it is being acted upon alone by the vacuum, excepting a downward current, to take the smell of paint away, I believe over nearly two-thirds of the floor of the House, the apertures of which were intended originally to admit the fresh air; therefore at present I should say there is a deficient supply of fresh air; it is not adequate at all, I should think, to the requirements of the House.

1729. How do you account for the variety of temperatures felt in the House of Commons?—Because the air is unequally discharged into the chamber from which the ventilators which feed the House with air open. The surface for warming the air is immediately under the first chamber beneath the House, and there are also gratings for the admission of cold air into that chamber; when you wish to reduce the temperature in the House these gratings are opened and a flow of cold air enters, and inasmuch as the whole floor of the House is not affected with an upward current, some portion of the cold air enters at some ventilators while at others the air is escaping. Therefore you have an inequality of temperature, sometimes warm and sometimes cold.

1730. How do you account for the imperfect ventilation in the House of Commons?—I think there is an inadequate supply of fresh air, and consequently there is not an escape of the vitiated air; it circulates in the room, and there being a downward current by reason of the extracting shaft, I think the tendency is to counteract the effect of the ventilation of the ascending principle.

1731. Is there much downward admission of air?—There is not any downward admission of air; the extracting shaft operates upon a portion of the air downwards. It was with the view of taking the smell of the paint away; a portion of the air has a descending tendency, the extracting shaft operating upon it, and therefore that, I should say, prevents the

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the air ascending, and keeps a kind of stratum of vitiated air in the lower part of the House.

1732. In abeyance, do you mean?—In abeyance.

1733. From a conflict between two currents?—A conflict between two currents.

1734. You have stated that you consider the ingress of fresh air not sufficient. Is it not sufficient for the power of the extracting shaft, or not sufficient for the ventilation of the House?—Not sufficient for the ventilation of the House; the admission of fresh air is stifled very much by the perforated floor being covered with a carpet; I think there would be plenty of fresh air passing through if the carpet were removed.

1735. Then it is a deficiency in the channels which bring fresh air to the House?—Yes, decidedly.

1736. How would you account for those smells which have been so complained of in the House?—I cannot account for those, unless it is that the vitiated air has not means of escape sufficient, and that the alleged fresh air is impure.

1737. Have you examined the ventilation of the corridors?—I have; the upper corridors I can scarcely fancy can be warm, because the warm air comes in just under the ceiling and goes out at the ceiling; I believe Dr. Reid stated that those corridors were for the accommodation of Members who wished the air to be cooler.

1738. Do you consider that when the works now incomplete are finished, and the whole principle is in force, the ventilation will be satisfactory?—No, I do not; I cannot reconcile at all the two currents, the ascending and the descending currents, at the same time; I can scarcely fancy any room ventilated properly with those two currents operating at the same time. In the House of Commons it is intended to have the steam pipes as the medium of warming the air which is to be on the descending principle.

1739. Have you been in the House of Commons or the House of Lords, during the time of the sitting of the House, so as to be yourself sensible of what sort of air it is that is breathed there?—I have only been to the House of Lords once for the purpose of seeing the effect of the air, and there was nothing unpleasant in it excepting the downward draught, which was very perceptible.

1740. What portion of the House were you in?—Just outside the Bar. In the House of Commons I went for a few minutes into the seats reserved for the Lords, and there was then a decidedly cold current coming up from the floor; the ventilation of the House at that time was very imperfect.

1741. Do

1741. Do you consider that the gas lamps have a prejudicial effect on the ventilation?—Not in an upward current at all; in the upward movement of the air upon the ascending principle.

1742. You were the architect employed, I believe, in the alteration of the roof at Exeter Hall?—I was.

1743. Did you do anything there which you consider might be applied to the House of Commons?—The ventilation of Exeter Hall is natural ventilation; entirely so; we have no artificial means at all. It is pretty well ventilated, excepting in the winter, when warmth is required. The only mode of ventilating is by forming open ventilators over each of the gas-lamps; and when the hall was first finished, a space of six inches was lef round the roof at the bottom of the coved ceiling, which had afterwards to be stopped, for the cold air descended, which was so inconvenient that it was obliged to be stopped; since then there has been little complaint.

1744. You have completed nothing at Exeter Hall which would enable you to pronounce definitively upon the success or failure of any plan there?—No, except that the effect at present is this, with an upward current the Hall, with 3,000 people in it, is really very comfortably ventilated. For six weeks after it was first opened I was there nearly on every occasion, and regulated it so that it was very comfortable; it was pronounced to be so.

1745. I believe you have already described the artificial system of ventilation which you have adopted in several buildings, and which has been found successful?—I have.

1746. Is the apparatus very simple in construction, and easy of regulation?—Exceedingly simple. We have seven for the asylum at Colney Hatch, and they are under the charge of three persons, and we find that they manage them very well indeed. The last time I went round they varied only one degree in temperature; the waters in all the seven stood only at a difference of one degree in temperature, proving that it is very easy of management.

1747. Is that what is called Mr. Price's plan?—Entirely so.

1748. Will you inform the Committee what it costs; that is, how much coal is consumed daily at Colney Hatch?—I cannot at present; I could obtain that.

1749. You will perhaps obtain it, and inform the Committee how much coal is consumed, and how many persons are employed, with their wages?—I will obtain that.

1750. Viscount *Palmerston.*] How is the air uniformly diffused?—

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diffused?—There are ventilators in the skirtings through which the warm air is admitted into the room, and the diffusion is exceedingly rapid. The other day I tried one of the wards, and five feet above the actual ventilator it was the same temperature as in every other part of the room.

1751. How many of these apparatuses are there?—There are seven to two and a half million cubic feet.

1752. Sir *D. Norreys*.] Are they placed in the extreme parts of the building?—Centrally for each division, one commanding about 400 or 500 feet, being centrally situated, with 250 feet on each side.

1753. Does one furnace or one tractive power act upon all those seven heating apparatuses?—No; there are seven fires; there are seven different apparatuses.

1754. Viscount *Palmerston*.] Can you carry the heated air any considerable distance without its cooling very much? There is a provision made to prevent its cooling by a pipe in the centre of the flue, in which warm water circulates, and in the extent of 300 feet there is a difference perhaps of two degrees; no more.

1755. Sir *D. Norreys*.] It is hardly fair to compare the ventilation of a building like Colney Hatch, which is divided into seven compartments, with the ventilation of a building such as the House of Commons?—There are 900 rooms in Colney Hatch Asylum, all heated.

1756. But with seven different apparatuses?—With seven different apparatuses.

1757. And I think you have stated that in any of the corridors or rooms you seldom have more than 35 persons collected together?—Thirty-five or forty.

1758. Whereas in every committee-room of this House, there are great numbers; in the House of Commons there are sometimes over 600 persons?—Yes.

1759. The one is a mere boy in comparison to the other?—I was at Windsor the other day; the whole of Windsor Castle, or the greater portion of it, is ventilated upon the same principle. There in the theatre there are sometimes 100 lamps and 200 people in a room about 60 feet long by 25 feet wide, and there by the power of the extracting shaft it was pleasantly ventilated.

1760. If you have to ventilate a room which is filled with a certain number of persons, it is comparatively easy to ventilate that room if you know how long those persons are to be together, as in a theatre, for instance, where you know that those persons will be together for four or five hours, and that

that probably there will be very little change of numbers; but in the House of Commons and the committee-rooms numbers vary at every moment, and it would require continual regulation?—Yes. I think that the apparatus to which I am referring is under complete control; you can regulate it.

1761. *Chairman.*] How can you regulate it?—By preventing the circulation through the plates; directly the room is too warm you stop the circulation of water through the plates, and then the air passing between very soon cools, and you can as readily resume the circulation.

1762. Sir *D. Norreys.*] In point of fact, your evidence resolves itself into this, as I apprehend, that you prefer the tractive power of ventilation to the forcing power, or the union of the two?—The tractive power only.

1763. Mr. *Locke.*] You know all the apparatuses connected with this building for the ventilation of the House of Commons and the House of Lords?—Yes.

1764. Have you seen them all?—I have.

1765. Would they be applicable for your notions of ventilation?—Not to effect a complete system. The pipes, I think, are not at all equal as a warming medium (I am speaking now of the House of Commons) to the flat vertical vessels.

1766. Then would a part of your system be, that you would substitute for those pipes your flat plates with hot water?—Certainly.

1767. Then would you alter all the warming apparatus which there are under each of these committee-rooms; you recollect the artificial warming apparatus going out of the warm air channel; there is an artificial warming apparatus for each committee-room?—There is an apparatus for every room here. I should say that one apparatus would take the whole range of these rooms.

1768. One apparatus of the same dimensions as one of those, do you mean?—No; it would have to be a matter of calculation as to the surface required.

1769. You would not be able, you think, to put it in the size of one of those?—Not for a range of rooms, certainly.

1770. When you say that one would be as good as all those together, you mean that you would combine them, so as to give you the same heat as you have by each of those?—Quite so. Those at present are heated by steam; the other would be heated by warm water, and therefore be much better regulated, and under control. The temperature, of course, of the pipes of each of these apparatuses, heated by steam, is obliged to be maintained at 212°; while the water will circulate

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late at much lower temperatures, according to the required temperature of the room.

1771. What is the temperature at which you usually circulate the water through your plates?—One hundred and forty.

1772. By your system would you dispense with the steam engine?—Certainly.

1773. Would you dispense with the boilers?—Yes.

1774. All the boilers connected with the steam engine?—All the boilers connected with the steam engine.

1775. The fan?—The fan.

1776. Would you use the air courses connected with the Victoria Tower?—I should do so by constructing an inner independent flue through the vaults on purpose for the cold air, and equal in dimensions to the quantity of air which would be required to be discharged in the various rooms. I should not allow the cold air flue to come in contact with the adjoining walls as a vault.

1777. Then you mean by that, that you would, in point of fact, case the present vaults?—I would case the present vaults, or rather form an independent flue.

1778. With what would you propose to case them?—With brick, leaving a hollow space round, and make it hollow altogether.

1779. Take the present large vault which leads from the Victoria Tower to the first heating chamber, where the fan is; would you propose to do anything with that?—Yes, certainly; I should case so much of it as would form a dry fresh air flue the size required.

1780. Then your system would not be to dispense altogether with drawing air from the Victoria Tower, and to take it from the court yards, or from any places where you could get it; as I understand you, you would get your air, and would still continue to use it, from the Victoria Tower and the vaults beneath?—Yes; I think the only advantage of using it from the Tower is the difference in the kind of air which you would get from a higher altitude as compared with the courts; in one case you would be free from dust; I think in the other case you are liable to dust passing through with the fresh air.

1781. Do you think that it is at all material as to which source you adopt?—No, I do not think so. In ordinary buildings the air is obtained from outside the building on the same level.

1782. Do you think that where there is a current of air passing through a vault of that kind the disagreeable smell

to

to which you alluded in the former part of your evidence would be discoverable?—I think so.

1783. In the air itself?—I think it would. A vault which is closed for a very short time will prove to you that there is a very disagreeable close smell, arising from the dampness of the walls and the want of circulation of air.

1784. Where the vault is never closed, but has a perpetual current of air through it, are you still of opinion that that damp disagreeable smell would be found?—I can only judge of it from what I smelt myself. Certainly under the Victoria Tower, the other day, there was that same smell, though the fan had rested only a few minutes; but still you were in a cellar, and you could perceive it very distinctly from the smell of the air.

1785. I understood you also to account for the inconveniences felt in the House of Commons from a deficient supply of air to the House?—Yes.

1786. You said also, if I understood you, that the air is drawn from the floor, and that it is also supplied by the floor?—It is.

1787. Is it not supplied also at the roof?—No, not at all.

1788. Nor is there any drawing off from the roof?—There is a drawing off from the roof.

1789. In its present state?—In its present state.

1790. Where are the accesses in the roof?—Just round each panel; the panel is elevated about an inch or an inch and a half; I did not measure it.

1791. You are quite sure that that is used only for vacuum purposes?—I am quite sure of that.

1792. And you also say that there is a certain part of the floor now used for similar purposes?—Yes; when I say it is used for a vacuum purpose, that is the intention of it, but if the rarefier from the floor overpowers the rarefier in the ceiling, of course the tendency is to draw the air down.

1793. But you say that you know from the present working of the ventilation of the House of Commons that not only is there a supply of air for the House at the floor, but it is also drawn from the floor for the purpose of ventilation?—For the purpose, as represented by Dr. Reid, and as he informed me, of removing the smell of paint from the floor; and you cannot balance the power of the extracting shaft so exactly as just to take the smell of the paint, you must take the air in the lower part of the room with it.

1794. Do you think that that mode of operation, namely, the drawing from the floor, in order to get rid of this paint,

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is prejudicial to the general provision of ventilation in the House?—Decidedly; that is my impression.

1795. Then if this drawing down in order to get rid of the paint were not done at all, but the air were permitted to ascend and circulate through the panels of the roof, you think it would improve the ventilation of the House?—I think it would improve the ventilation of the House, more particularly if instead of the air passing through the whole floor you could pass it into flues and discharge it into the House, through ventilators not covered by carpets.

1796. Do you know the construction of the House of Commons sufficiently to say whether, under the seats of the House and the raised benches, there are facilities for admitting a sufficient supply of air for the proper consumption of the House?—I think so.

1797. You think there is a sufficient area?—I think so.

1798. Then according to your view, if they were to cease drawing the air from the floor of the House at present, the other system of ventilation, namely, your system, would immediately come into operation?—It would come into operation provided you could open or relieve the present supply of fresh air, and provided it came in freely; it is now stifled by the carpet.

1799. You have already admitted to me that there are plenty of areas under the seats for the admission of fresh air?—Yes.

1800. And you think the system is prejudicial in point of drawing the air from the floor in other parts?—Yes.

1801. If any draught were taken away from those parts, and the air were allowed to ascend to the ceiling, would your system then be in operation?—Yes; I think if the whole area of the floor were to be used for the passage of the air throughout, then there would be ample and more, indeed, than would be required.

1802. *Chairman.*] Without the carpet?—Without the carpet.

1803. Mr. *Locke.*] Your objection now is simply as to whether there is sufficient area to admit the fresh air?—Quite so.

1804. But that being settled, which I thought I had made sufficiently clear before, because I supposed that those areas were sufficiently large, then by ceasing to draw from the floor into the House, your system of ventilation would be in operation entirely for the passing into the room?—It would not be my system of ventilation; I say it would admit sufficient fresh

air

air into the room to improve the ventilation of the House of Commons.

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1805. Where would you propose to draw your air from the House of Commons after it had been admitted?—At the ceiling.

1806. There are the accesses?—Quite so.

1807. Then you would warm your air again, or apply a jet or some other mechanical contrivance for the purpose of drawing it away from the ceiling?—Yes, it would naturally pass off, but if it required it I should apply a proper contrivance to rarefy the air in the extracting shaft. The mode which I should adopt for improving the warming and ventilation of the House of Commons would be this: I should adopt the plan, as in the House of Lords, of covering the whole floor over with lead, and the carpet exactly as in the House of Lords; then I should calculate the quantity of air that would be necessary to pass through the House thoroughly to warm and ventilate it, and have a sufficient number of openings where it would not be inconvenient to any of the Members sitting, and I should admit the air in those parts through ventilators; I think then there would be a very gentle radiation from the floor itself, and that the admission of air through the ventilators provided for it would be sufficient to sustain ample ventilation in the House, and warmth too.

1808. You know the mode of heating the air which you alluded to as being in the second storey below the floor of the House of Commons; would you propose to change that apparatus also for warming the air?—I should propose to change that also.

1809. If the present pipes can be made effective to produce a certain degree of temperature, and that temperature is higher than you have contemplated, why should there be a change?—The vertical passage of air at all times is more under control than that of circulating round the pipes. It is a matter of experience and of calculation how far the warm water will warm the air in its passage; and I believe that, admitting the changes of temperature from the lowest to a gradually higher degree, it never can be controlled in the same way, passing amongst the pipes, in the way they are arranged in the present House of Commons, as passing between flat vessels about an inch apart, in the way I should propose.

1810. It may be admitted that that system would perhaps be better than the round pipes; but supposing there is the desired surface in the round pipes at present, and that those pipes could be made to answer for all the purposes of heating,

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do you see any reason why they should be destroyed, seeing that they are there?—I think that for perfecting a plan, I should like them changed; but for making a trial of the system, they might do.

1811. Do you suppose that you could try your own system with them, as they appear, in order to satisfy either a Committee of the House of Commons, or the House of Commons itself, that you could make your plan answer?—I think if there is heating surface enough, it would be worth the trial.

1812. In reference to the facility of mixing the cold air with the warm air, do you think that there is facility sufficient in the warming apparatus for that purpose without any great additional expense?—No. I think the whole plan must be altered as to the admission of the air if the trial is made which is spoken of. At present there are ventilators below this coil of pipes, and ventilators at the top, one, of course, for the admission of cold air, and the other for the exit of warm air in the chamber above; but also in case it should be too warm, there are side doors to open into channels made to what is called a mixing chamber. Now I fancy that it is impossible to warm the air efficiently round those pipes, passing in an oblique direction out at the side valve.

1813. What you mean by efficiently, is uniformly?—Uniformly, and to get the temperature you require; and when it is delivered from this hot air chamber at the side, I do not think it will mix, but come into the room in different currents, as it may meet the ventilators into the House.

1814. As it does now, in fact?—As it does now.

1815. And that is one of the causes why it does so?—Quite so. The plan I should propose would be to admit the cold air under the apparatus, and command the temperature of the water in the pipes, to reduce or to raise it; at least it would apply so in flat vessels; I do not know what control there is over the pipes, as at present arranged there, but with the flat vessels the cold air would pass below between the flat vessels, and then into the room; and if you wished to alter the temperature, you would immediately stop the circulation, or regulate the circulation in such a way that it would be very soon perceptible upon the air.

1816. You think you have space enough for that?—There is space enough for it no doubt; space enough to contain a sufficient number of vessels for that purpose.

1817. Viscount *Palmerston*.] What is the size of your flat vessels; how high are they?—In proportion to the surface required for heating the air; they are about three feet square.

Martis, 6° die Aprilis, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Deedes.
Lord John Manners.	Viscount Palmerston.
Mr. Thomas Greene.	Mr. Stephenson.
Sir Denham Norreys.	Mr. Locke.

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

6 April 1852.

The Chairman stated that he had received the following letter from Baron Parke, in answer to a communication addressed to him containing certain queries in reference to the Ventilation of the Court of Exchequer, and the Law Courts at Liverpool; and the same was delivered in and read as follows:

My Lord, Park Street, 3 April 1852.

I HAVE the honour to acknowledge the receipt of a letter from your Lordship of the date of April 1, containing the following queries in reference to the Court of Exchequer, and the Courts of Law in St. George's Hall, Liverpool, and requesting my answer.

The queries are these: 1. Is the temperature equal? 2. The quality of the air agreeable? 3. Are there currents? 4. Are there at times disagreeable odours? 5. If causes of complaint exist, and are mentioned to those in charge of the ventilation, are they speedily remedied?

I have to say in answer, that with respect to the Court of Criminal Law in St. George's Hall, in which I sat during a week at the last winter assizes, I found that the ventilation was perfect in all respects; there was a total freedom from all disagreeable odours, and the temperature was lowered and raised immediately on request. It appeared to me, in the seat which I occupied, to be as well ventilated a Court as I ever sat in.

With respect to the Court of Exchequer, the principal cause of complaint, during the several years I have sat there, (since the year 1834), has been the disagreeable odour of the so-called fresh air introduced; and that has been caused by the proximity of the sewer which it has passed in being brought into the Court. Sitting on the bench I have myself not suffered at all from currents of cold air, but I have heard others who have sat in the Court below complain of them. The ventilation has been better the last year, when some alterations were made by Mr. Gurney, as I believe.

The Court of Exchequer Chamber is a much more confined Court, and I have been much inconvenienced there from the want of proper ventilation, especially when sitting at *nisi prius* in the summer

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term. There has been a want of cold air, and occasionally some of a bad odour, and altogether I have had much more cause to complain than in the larger Courts.

I have &c.
(signed) *J. Parke.*

Major-General Sir *George Bowles*, K.C.B., called in; and Examined.

Major-Gen. Sir *G. Bowles*, K.C.B.

1818. *Chairman.*] YOU, I believe, were formerly Master of the Household to the Queen?—I was.

1819. And therefore are perfectly acquainted with the state of the ventilation of Windsor Castle?—Generally speaking so.

1820. Have you had occasion to complain of it in any way?—It was very imperfectly ventilated up to the year 1847, I think.

1821. Are you aware what means were employed, or under whose superintendence the ventilation was placed up to that period?—Up to that period, I am not quite sure; I can hardly say under whose authority it was.

1822. Subsequently to 1847 have the warming and ventilation been more satisfactory?—Much more; it was warmed by Mr. Price, with hot air produced by hot water, and ventilated by the joint efforts of Mr. Turnbull and Mr. Price.

1823. Previously to that time were there disagreeable currents of air in the various rooms?—Yes; they were extremely disagreeable, because they were so cold, and without any ventilation at all; there was neither heat nor ventilation.

1824. Sometimes there was cold, sometimes I presume heat, and sometimes a disagreeable air?—Exactly so.

1825. Are you at all aware of the number of chambers in Windsor Castle that are under Mr. Price's system?—I am not exactly aware.

1826. There are many large rooms, and some smaller ones, I presume?—Yes.

1827. In some of them, at times, a great number of people are assembled, are they not?—Yes, at times.

1828. And there are a great number of lamps and lights?—A great number.

1829. Has the system proved satisfactory upon those occasions?—Perfectly, I should say.

1830. Are you aware whether much dust has been brought into the Castle by the operation of this plan?—I do not think that any very great inconvenience has been felt, but there has been certainly a little more dust than before.

1831. Has

Major-Gen. Sir *G. Bowles*, K.C.B.

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1831. Has the housekeeper complained of it?—She has.

1832. Did she complain of it more after 1847 than before, do you think?—Yes; I think there has been more dust there since the ventilation; it comes in with the hot pipes.

1833. Since the ventilation has been more complete, there has been more dust?—Yes; rather more dust.

1834. That refers rather more to cleaning than it does to any sensation in breathing the air?—Certainly; it is merely a little more trouble for the housemaids.

Samuel Whitfield Daukes, Esq., called in; and further Examined.

S. W. Daukes, Esq.

1835. *Chairman.*] YOU stated yesterday that the temperature, by the system of warming which you would recommend, was under command, so that it could be raised or lowered at pleasure; have you ascertained that by actual experiment?—We have had no difficulty at all, whenever the temperature has been increased, in lowering it.

1836. Have you ever had to lower it very rapidly?—Not very rapidly.

1837. Have you ever tried whether you could do so?—Yes.

1838. Can you state at all the result?—We have frequently tried the difference of temperature in the room; after it has been a certain temperature, we have closed the ventilators a little, in order to test how far that would reduce the temperature of the room, and it has succeeded in doing so.

1839. Have you made any observations with thermometers to ascertain exactly what the reduction was, or how rapidly the reduction came into operation?—No; there were observations made, but I have not them at command; it is a long time since; it was in the Royal Agricultural College, at Cirencester; when I mentioned yesterday that I had not ventilated another public building, that building was ventilated by a hot-water rarefier, and a portion of it warmed by the hot-water apparatus, about 10 years ago.

1840. Was that building erected by you?—It was.

1841. You have stated how you warm and ventilate how; do you propose to cool the air in summer; by the same apparatus when the external temperature is high?—By allowing the fresh air to pass through the flat vessels containing cold water instead of warm, so that it enters in the floor of the house at a cooler temperature, and is drawn from the ceiling by the extracting shaft.

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1842. The extracting shaft, I presume, when the temperature is very high out of doors, will not operate fully without some artificial assistance?—It would require some artificial assistance in the summer months.

1843. I think you have stated that you would contemplate perhaps two methods, the hot-water coil and the furnace?—No; the hot water only.

1844. Did you hear Mr. Gurney's examination?—I did.

1845. Did you hear his statement as to the necessity of preserving a balance between the internal and external air?—Yes; I am not clear as to his remark upon that; I did not understand it at the time.

1846. Did you ever contemplate the necessity, in ventilating a house, of preserving the barometric balance, to which I understood Mr. Gurney to refer, between the internal and external air?—I should think it would be very difficult to accomplish, I confess.

1847. Why?—It must be regulated just according to the state of the external atmosphere and all its changes during the day, to make it preserve a balance internally and externally; you must be constantly changing the treatment of the air.

1848. Then you consider that passing the air through heated iron destroys that balance to a certain extent?—Very slightly with low temperatures.

1849. Do you suppose that it is as good for human respiration after that balance has been destroyed as before?—No; I think that in winter, and when the external temperature is very low, after the air has passed over the heating surface, which is necessarily higher, to warm the air, it should have some effect which would moisten it.

1850. Some compensation?—Quite so.

1851. How do you propose to give that compensation by your apparatus?—By vapourizing the air after it has passed between the flat vessels.

1852. That is, mixing it with a certain quantity of moisture?—Mixing it with a certain amount of moisture, which is provided for in the apparatus.

1853. Is that so in what is called Mr. Price's system?—It is so in every instance of which I am aware; in every instance that I have been connected with, that is one arrangement, and I consider it very essential.

1854. Can you declare to the Committee that you never heard any inhabitants of houses or buildings warmed by Mr. Price's system complain of the quality of the air which they breathed?—Not in one instance; just the reverse. In several private

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private houses I have introduced it; both ladies and gentlemen have concurred in the purity of the air, as well as the agreeable temperature.

1855. Did you understand Mr. Gurney to say that by his system the barometric balance could be preserved to such a nicety, that even in the coldest weather a window might be opened without the air rushing in with sufficient violence to cause discomfort; did you hear such a statement?—I understood it to be so, but I fancied I must be mistaken.

1856. Were you present when this question was put, "Supposing the door of the House of Commons, the House itself being at 65 degrees, were to open directly on the external air, that being at 32 degrees, would there be a rush of air?—*Answer*. No, certainly not. I have no hesitation in answering the question in the most emphatic language; there would be no rush of air." Were you present when that question and answer were made?—I heard Mr. Gurney state that.

1857. Do you understand it?—I cannot understand it at all.

1858. What is your belief, supposing that state of things were to exist?—There would be a feeling of cold air immediately.

1859. You believe that the cold air would rush in?—Quite so; to create an equilibrium in temperature, the air would immediately rush in, and all those within its influence would feel it.

1860. You have examined the air channels which are made use of in this building?—I have.

1861. I think since you have seen those channels your opinion has a little altered. You are now of opinion that it would be better to take the air from a high level than from a low one, is it not so?—No. I stated before that I thought it was better to take it from a high level, although I should be satisfied, as far as the success of the mode of heating went, with taking it from the courts.

1862. Your objection to the channels that you saw was that of passing through subterranean vaults?—Quite so.

1863. Which might affect the quality of the air?—Quite so.

1864. Have you any other objection to make to the sources of supply here than that one which you have already made?—No further objection. In all the works in which I have been engaged in ventilation there has been the most exact calculation as to the size of the channels both for the admission and

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the discharge of air, most particularly so, and that no person should enter them, but that they should be kept exceedingly clean and sweet, and free from damp.

1865. In inspecting the air channels here, does it appear to you that that calculation has not been made?—No, because the vaults form the air channels. I found the men working in them, and sweeping and watering, and I fancy that where there are men engaged, of course there must be a little impurity in the air, and also that you cannot get a uniform supply, unless you have the channels so arranged that they are of proper size both for supply and discharge.

1866. Do you contemplate any peculiar construction in your supply of air to avoid friction, or merely to insure purity?—Merely to insure purity.

1867. And a sufficient amount of cubical contents?—And a sufficient capacity for the object, quite so.

1868. Mr. Price is here, I believe, and can give any more detailed account of the system?—Yes.

1869. Mr. *Greene*.] You spoke of moistening the air after it had passed over the plates?—Yes.

1870. How do you do that?—By passing the water into a shallow pan, and letting it gradually moisten the air by evaporation; that is the way that is chiefly adopted.

1871. The only plan adopted is that of evaporation?—That is the only plan I have adopted.

1872. Do you conceive that that would be better carried out by means of passing the air through water jets?—I have not had an opportunity of testing that at all; it is sufficiently so by the evaporation.

1873. Do you think that would be sufficient in cold air passing over it?—There would be no cold air passing over it; the mode of moistening the air is by placing the water for evaporation in the warm air flue, and there would be no cold air mixing with this warm air; it would be merely fresh air passing into the room moderately warmed on its passage through the apparatus to the required temperature.

1874. And that you have found sufficient for the purposes of moistening the air?—Quite sufficient.

1875. Sir *Denham Norreys*.] Have you examined the mode adopted by Dr. Reid to diffuse the cold and fresh air, so that it shall not rise by currents, whatever the force which you choose to employ, whether the fan or the tractive power of the furnace, and does it seem to you adequate to its purpose?—Not at all so.

1876. Will

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1876. Will you state your objections to it?—The objection is that the air is stifled in its very first discharge; there is a carpet covering the whole of the orifices, and it is stifled in that way.

1877. Have you examined the carpet, and do you know of how exceedingly open a texture it has been formed for the purpose of allowing the admission of fresh air?—I have.

1878. And you think that insufficient?—I have taken the carpet up, and tried the floor without it; and I have placed my hand on the top of the carpet after it has been put down again, and there is such an evident difference that I cannot be mistaken as to the manner in which the air is stifled, as far as its passage through the carpet is concerned; that can be ascertained at any time.

1879. Supposing that any substance could be devised which should be in effect like perforated zinc, but still not be so dangerous for persons walking upon it as metal would be, would that be a superior substance?—It would be superior to the carpet, but I do not think that it would be adequate where you want great ventilation. I think, wherever you want great ventilation, there should be passages appropriated on purpose, where the air can come up in larger bodies than it can through any perforated surface.

1880. Would not that have the effect in the House of creating currents of air?—I think not. If it is very warm air, or very cold air coming in, it may for a short space round the ventilator be warmer or colder, but it is astonishing how very quickly diffusion takes place to adjust the temperature of the air. I stated in my evidence that I tried it at Windsor the other day with three or four thermometers round the ventilator, the temperature of the warm air being 80°, the thermometer a foot above was 72°, between five and six feet above it was 61°, the temperature of the room.

1881. Dr. Reid's theory appears to be to make the entire floor of the House a channel for the uprise of fresh air?—Yes, that was evidently the original intention.

1882. Your plan would be to confine that uprise of tempered air to certain portions of the House?—It would.

1883. The amount of air which rises through the entire floor at present must then be confined to these particular passages?—Yes.

1884. And it must acquire a certain amount of velocity, equal to the difference of area through which you would make it pass?—Quite so.

1885. That velocity which it would acquire would carry up the

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the air in proportion to its velocity to a certain extent into the House, in the same form, or nearly so, as that in which it had passed the openings which you would propose?—No, it is not perceptible after it has escaped the ventilator about one foot; from that to 18 inches.

1886. Would it not have the same effect as a rapid current passing into a lake, that for a certain distance the current which entered the still water would keep to a certain extent separate from the surrounding water?—I think the diffusion of air would be very much quicker than that of water.

1887. Should such be the case that there were a current produced, would not any cause which acted particularly on that current have a disagreeable effect on the Members who happened to be near it?—They would feel any impurity in the air which formed that current?

1888. Would not the air be driven towards them as a current?—Not perceptibly so. I should not place it under the feet, or to the inconvenience of any person. I think they would feel it at the feet if they were sitting there; I have no doubt about it; but I should place the ventilators in such a way that the air would enter the room without inconvenience; for instance, on the risers of the steps in the gangways to the seats, where few Members would be standing, and it would very seldom inconvenience anybody.

1889. Would not those be peculiarly inconvenient positions to place them, inasmuch as a great number of Members are always sitting on both sides of those gangways?—It would never be felt on either side. I think I may assert that positively.

1890. Then your belief is, that the body of air which now passes up through the entire floor, if it were confined to certain spaces on each side of The House in the gangways, would create no current, and produce no disagreeable effect on the Members sitting close to it?—There would be a current, but not a current to be inconvenient to anybody.

1891. At present currents are found, or at least the sensation of cold is produced by currents rising through the floor. Although if examined by the thermometer it will show that the air may not be lower than 62° or 63°, still the sensation of cold exists; would not that sensation be gradually increased by the entire entry of air being confined to the separate portions which you now describe?—It has not been found so in experience; the temperature of the room at the floor varies very little from the temperature near the ceiling.

1892. It may not be so much a question of difference of temperature

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temperature as that peculiar effect which a current of air passing over the body, of whatever temperature it may be, produces, namely, a feeling of cold by the evaporation created by the current on the body?—There will be a current, but, I suppose from quick diffusion, it is scarcely perceptible within a foot or 18 inches from the mouth of the ventilator. I have been in several private houses where the application of the system has been experienced daily, and the sensation of cold to the feet has never been at all complained of.

1893. Supposing your system were carried out, and that the admission of fresh air were confined to those portions of the House which you have described, where would you form the outlet for the lighter air?—At the highest point in the ceiling.

1894. Would you diffuse that outlet through the entire ceiling, or would you confine it to particular points of the ceiling, in the same way that you confine your ingress of air to particular points?—I should confine it to particular points, giving it as large a capacity at each point as I could possibly afford, consistently with the architectural effect of the ceiling.

1895. Then it would be that at some three or four points in the ceiling there would be a current created of sufficient intensity to draw the air from those points of ingress which you have stated?—Quite so.

1896. Would not the tendency of the air being acted upon strongly from particular points be to draw up the air from below, and rather to form currents through the House in the direction in which it was drawn?—It is not found so at all.

1897. Have you measured the air channels by which the fresh air is brought to the present tempering room?—No; the channel varies in size very much. I did measure the smallest size of the channel to the House of Lords, but it was merely measurement. I did not go into the calculation at all as to whether it was sufficiently capacious.

1898. May I take the air channel to be more than 100 feet?—About 100 feet.

1899. Would you propose to keep an air channel of 100 feet in action, such as the present air channel for the House of Commons, to supply your apertures in the gangways?—It would be a matter of calculation. I should retain as large a channel as would be necessary, according to the calculation which experience has proved to be necessary.

1900. Have you calculated the size of the present gangway?—I have not.

1901. Would you think a channel of a foot to 18 inches too

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too small and too likely to create a current?—Twenty inches by six inches would be ample, I imagine. The great difficulty at all times is that very question of the suitable places for the admission of air; that is the great difficulty of the system. If you can once get over that difficulty, it is as simple as it can possibly be; as far as its being efficacious for ventilation there is no doubt of it.

1902. Assuming for a moment the correctness of your general principle, why confine yourself to the gangways; is there not a space in the centre of the House, which, supposing your principle to be correct, would be more applicable to a purpose of that kind?—I have understood the centre of the House to be sometimes filled with Members standing or walking about there.

1903. Merely walking about?—Then I should say that that would be a very good position for the admission of moderately warmed air.

1904. *Chairman.*] Do you think that the present lighting of the House is injurious to any contrivance for ventilation?—Not at all so, on the ascending principle of ventilation.

1905. Do you wish to give any opinion to the Committee as to how you would light the House?—Not at all. The opinion given by Sir Charles Barry was one that came under my notice in Exeter Hall. I was going to adopt the very same suggestion which he threw out yesterday, namely, to see the light adopted at the Liverpool Town Hall, and then to be in a position to recommend it or not, according to the result of the inspection. The plan adopted at Liverpool is spoken very highly of.

1906. You have not seen it?—I have not.

1907. Sir *D. Norreys.*] Supposing you anticipated that there would be from 500 to 600 persons in the House of Commons, and that the sitting would be a long one, and you wished to keep up a temperature, say of 66°, through the House as nearly equal as you could, at what degree of temperature would you admit the air into the House in order to maintain that temperature?—I should lower the temperature sufficiently to make the air in the House of an agreeable temperature. When the Members first entered, I should immediately begin to lower the temperature, which, with the apparatus I am speaking of, can be done.

1908. Can you form any idea of the number of degrees you would wish to lower the temperature in order to keep the general temperature as has been stated?—No, I cannot tell you that. Sometimes the apparatus would be of very little use for

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for the application of warmth; I should use the extracting shaft only for drawing the fresh air through the apparatus.

1909. You would admit the air into the House at a temperature of four or five or six degrees lower than that at which you wished to maintain it in the House?—Yes.

1910. If so, would not that still have the effect of producing those currents, and that disagreeable sensation to the feet of those who sat near?—Not when the temperature was so high as to render it necessary; I should reduce it very gradually four or five degrees.

1911. Inasmuch as the air would be entering the House at some four or five degrees below the general temperature of the House, would not for a certain height the stratum of air above the ground have a chilling effect upon the person?—That I cannot speak to, but I can say that the ventilation acting in the way that it would act, properly arranged, would not require the air at any period of the year to be so many degrees below the temperature of the room; the ventilation, as operated upon by the extracting shaft, would be sufficient to remove any unpleasantness or any great warmth from the room; the change of air would be quite sufficient to ventilate thoroughly.

1912. *Chairman.*] The air that you propose to admit at the risers would not necessarily spread along the feet of the Members sitting upon the benches, would it?—No, not at all; it would diffuse through the room generally.

1913. Mr. *Stephenson.*] I confess I do not quite understand you; if I understand you correctly, you propose to let a certain portion of the air into the House under the seats?—Not under the seats.

1914. The gangways?—Yes.

1915. It is the same thing?—Excepting that it is not underneath the Members.

1916. You assume nearly the same thing; but I cannot understand how the diffusion takes place so rapidly as to exempt the party sitting in that immediate locality from the effect of the change of temperature?—It really has the effect. If you saw the thing in operation you would see decidedly that effect produced; it enters at a comparatively low temperature.

1917. In reply to an honourable Member, you said that if more air was requisite in the House, the floor of the House might be made available for the admission of a larger quantity. When you have air at the floor of the House in that way, where will be the difference between your proposed plan and that

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that now followed by Dr. Reid?—The question was this: "Whether, as well as in the gangways, there could not be ventilators in the floor down the centre of the House?" Yes; similar ventilators in the floor, to be used with the others, so that, instead of admitting the air only in the gangways, you should admit it in the gangways and in the floor with these ventilators.

1918. That would be an approximation towards the plan which Dr. Reid is now pursuing, would it not?—By the present plan, the air is supposed to enter over the whole floor, and pass out at the ceiling.

1919. In the building at Colney Hatch, you stated that you divided the system, I think, into five or six distinct portions?—The same system is preserved throughout, but there are seven different apparatuses; the building is so enormously long, that it would be impossible for one apparatus to extend over the whole of it.

1920. Have you had any experience by which you have ascertained that such subdivision really accomplishes more perfect ventilation?—No; if it could be possible for the heat to pass through a flue of that enormous extent, which would be a mile in length, if you could retain the heat through the whole of that length, of course you would have the same effect in one apparatus as you now have in seven, but you cannot do that.

1921. You explained that you could regulate the temperature of the air passing into any of the rooms, and that you did so, in fact, by a warm water pipe in the centre of the flue?—Quite so; that is to a certain extent, 200 feet.

1922. Am I correct in supposing that you adopted the division of the system into small portions because you could not regulate the temperature of the air by one system so well?—No; there are many other reasons; the flues would have to be so enormously large, having to supply two and a half million cubic feet from one apparatus, that they would be inconvenient every way for the distribution through the building; for instance, the flue at the commencement from an apparatus of that extent would be something enormous, and also the discharge or extracting flue would be the same.

1923. Do you bring the different systems which you have into one discharge aperture?—No, we have seven or eight discharges.

1924. And seven furnaces?—And seven furnaces.

1925. Are any of the rooms in which you said that you could regulate the temperature with perfect precision large rooms?—

rooms?—The galleries are 180 feet long by 14 feet wide and 14 feet high, besides a space in the middle about half the size of this room.

1926. When you admit the warm air into those rooms, what means of exit have you?—Into an extracting shaft; into a channel in the ceiling to which these flues are connected communicating with a shaft.

1927. With regard to a question, upon which I think there has been some misconception, respecting Mr. Gurney's opinion, when he spoke of the barometric medium between the external air and the internal air, you said that if the external air were at 32°, and the internal air say at 60°, or any other temperature much higher, when a door was opened, necessarily there must be a rush of air into that room where the temperature was high?—Not necessarily, unless the temperature were low immediately outside the room; if the whole of the apartments were of the same temperature, of course there would be no rush of air, but if the temperature outside the room were 32°, and the temperature inside the room 60°, then I should say necessarily you would feel the cold air.

1928. Are you not confounding temperature with pressure, because the rush of air is totally independent of temperature; it is pressure?—Quite so; but I think the movement of air to create an equilibrium in temperature would be quite sufficient to create a draught; directly you opened the door, there being cold air outside, and warm air inside, you would find an immediate draught.

1929. Supposing the fan to be in operation, forcing air into the room at 80 degrees, if there were a pressure of something like a quarter of an inch of water, would the difference of temperature between 32° and 60° produce a contrary current against the pressure from the inside to the outside?—That I am not prepared to answer at all. I should like to see an experiment tried.

1930. Sir *D. Norreys.*] Are not density and temperature so connected as to be very difficult, on a question of that kind, to be separated?—I should hardly be prepared to answer that question. With regard to the effect of the plenum influence which Mr. Stephenson was referring to, if, in preserving the equilibrium of temperature, the rush of cold air into the warm was not perceptible, and did not take place, I do not see how, when the cold air passes into the mixing chamber, according to the plenum system adopted here, the warm and the cold air would mix; they would be in separate currents,

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and take their course under the plenum influence, and so you would have cold and hot draughts.

1931. Viscount *Palmerston.*] If this room were at 65°, and the corridor were at 32°, and you were to open one door of this room, would it not happen that there would be a current into the room at a certain distance from the floor, that it would be stagnant in the middle of the doorway, and that there would be a current of hot air outwards from the upper part of the doorway?—Yes, that is the effect; if you take a candle and place it at the door, at all times you will see the currents operating in that way.

1932. I apprehend that the difference of pressure between two columns of air, one being at 65° and the other at 32°, would be utterly insensible to the barometer, that barometer being subject to the whole pressure of the atmosphere?—Yes, I suppose it would be so.

1933. Mr. *Stephenson.*] Am I to understand you to consider the method adopted by Dr. Reid for admitting the air into the House by the floor a good one or not?—Not a good one.

1934. Therefore do you suggest the adoption of apertures, in situations which you point out, rather as an expedient under present circumstances than as the best plan of ventilating the House?—I should say it is decidedly the best plan of ventilating the House.

1935. Then you do admit that bringing air in through the floor is a good mode of ventilating the House?—In the apertures which I describe, not through the floor. This is a perforated floor, and the difference between bringing it through the floor, and bringing it through apertures, is just the difference which I should make.

1936. I thought, from a conversation which I had with you on this subject, that you preferred bringing the air into the room rather above the heads of the parties occupying the room; if I am mistaken you will correct me; do you not admit into Exeter Hall a large amount of air above the heads of the people?—Yes, in the window sills we have made communications with the external atmosphere; there are two, which consist of perforated zinc, one horizontally and the other placed vertically, so that there is a kind of indirect channel under the window sill; that was found to supply sufficient air for ventilation during the summer months; we required it in the summer particularly; it has been closed through the winter.

1937. Do you admit a large quantity of air into Exeter Hall through the floor, or near the floor?—Through the floor, in the risers of the steps.

1938. When

1938. When you referred to the gas apparatus at Liverpool, did you refer to what is called the sun-burner?—I did.

1939. *Chairman.*] I presume that you do not give Exeter Hall as at all a perfect specimen of the application of your principles?—Not at all; it was merely to show what little assistance to natural ventilation is required, because there is a room entirely ventilated without any means at all excepting the warmth of the persons assembled there, and the openings in the ceiling, with the admission of air in the risers of the steps to supply that which escapes from the ceiling. It is complained at times that it is very cold, because there are no means of warming it. A little application of warmth to the air underneath the floor in these risers would be sufficient to make it a very comfortably ventilated room.

1940. I presume you do not mean quite to say how little is needed, but what a little will do?—What a little would be required.

1941. I rather understood you before to say that if you were allowed to do what you pleased at Exeter Hall, you would do a great deal more than has been done there?—I should do more; I should apply the system that I am now speaking of to Exeter Hall. I should warm the air which would come in at the bottom, and I should extract it by the application of a gas jet in the cowl at the top.

1942. Which is not done now?—Which is not done now.

1943. Mr. *Locke.*] I understood you yesterday to say, that your objection to the present system of ventilation was more towards the double system of letting the air enter the floor and drawing it out at the floor also?—I said that that must operate very much against the ventilation.

1944. And you said that another cause was, that the air passages in the roof of the House were not sufficient?—No, I did not intend to say so; that is a matter of calculation which I have not gone into. I said, I think, that the air channels in the roof are not of any regular form, that the air escapes into a large open roof, and that it finds its way to the extracting shaft without being directed there in regularly formed channels of calculated dimensions.

1945. Is that so, do you think; do you know that fact?—I know that fact.

1946. You know that the fact is, that there are no channels now existing from the roof of the House of Commons to conduct the vitiated air into the upper air shaft?—No direct channels made for that purpose; it escapes into the open roof, and there are doors which are opened and shut, and so forth,

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for the air to pass through. I feel sure, that if you formed regular channels of the dimensions required, according to the calculation which experience has led to be found sufficient for the purpose, the ventilation would be very much more complete than it is at present.

1947. You see no objection, I suppose, to the admission of air above the heads of the persons occupying the building, if found necessary?—I should see great objection if that were the only place for the admission of air.

1948. That was not my question: I said, if it were necessary. Supposing there were as many apertures as you could reasonably get in the landings or steps of the gangways, and you had not a sufficient quantity of air, would you then see any difficulty in obtaining it from the upper portion?—Certainly not.

1949. And would not that be the means which you would adopt in preference to the means now used of taking the air through the carpet?—Certainly.

1950. Will you tell the Committee whether, in what you propose in the steps, you take the air from the tread of the step, or the side of the step?—From the riser of the step.

1951. Which is the upright portion?—Yes.

1952. Do you think that a certain portion of the floor, even up the centre of the floor, might be made use of for the purpose of the admission of air?—Yes, I think it might, if it is not occupied by persons standing on it.

1953. Do you recollect that in the Courts of Westminster Hall there are now iron gratings through which the heated air passes into the Courts?—There are iron pipes round Westminster Hall.

1954. Still there are iron gratings admitting the heated air into the building?—There are.

1955. Would a grating of that sort, placed anywhere in the floor of the House of Commons, facilitate you in giving larger accesses for the admission of air?—Certainly.

1956. I take it upon the whole that you are in favour of ventilating the House of Commons, or any building of that kind, from the floor, or near the floor, and relying solely upon natural means of ventilation?—Yes, with the assistance of an extracting shaft, with a rarefier in it in case of need, decidedly so.

1957. Mr. *Stephenson.*] You have observed that a great portion of the floor of the House of Commons is employed for drawing the air downwards?—Yes; Dr. Reid informed me that, in consequence of the perforated iron being painted,

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at least, I think, two-thirds of the floor communicated with an extracting shaft. *S. W. Daukes*, Esq. 6 April 1852.

1958. *Chairman.*] I believe you stated that yesterday?—I did.

1959. Mr. *Stephenson.*] Have you made any experiments to ascertain what proportion of air goes down through the floor?—I have not.

1960. *Chairman.*] Can you give the Committee any opinion as to whether the paint upon the floor, which has been the subject of some question, would really interfere with the ventilation of the House?—I cannot imagine such a thing at all; of course, if it is really perceived, I cannot dispute it, but I cannot imagine it.

1961. That is your opinion?—That is my opinion.

1962. Mr. *Locke.*] What area, in your judgment, would be necessary for the ingress of air supplied properly to the House of Commons?—That is a matter of calculation; I cannot tell at this moment.

1963. Supposing it is a building with 600 Members and 200 or 300 additional persons, say 800 or 900 people, what would be the area of your accesses for a building of that sort?—I am not able to tell you that, as in all these operations I have followed Mr. Price's principle; he is quite familiar with those calculations, and I have no doubt he will tell you.

Mr. *John Turnbull*, called in; and Examined.

1964. *Chairman.*] YOU are Clerk of the Works at Windsor, are you not?—I am. Mr. *J. Turnbull.*

1965. How long have you held that office?—Six years.

1966. Was the system of warming and ventilation at Windsor Castle altered subsequently to your having that office?—A portion of it was.

1967. To what proportion of the Castle does that new system apply?—It applies to the corridor, Her Majesty's private apartments, to the state apartments, and the round tower.

1968. To the libraries?—And the libraries and print rooms, and the great staircase and hall.

1969. Does that include the whole of the north front?—Yes, the whole of the north front on the principal floor.

1970. Was that put under the superintendence of Mr. Price?—Yes.

1971. And also under your own?—Yes; all the north front was done under my superintendence.

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1972. The system was his, and it was done under your superintendence?—Yes.

1973. Have you been able to test the success of that experiment?—I consider it very successful.

1974. Have you had any complaints made to you of the want of good air, or the want of sufficient warmth?—Never; on changes of the weather, particularly at this season of the year, on a violent change from cold to warm, the rooms may have been felt a little too warm, and we have had orders to lower the temperature, but we have never any difficulty in keeping it under proper control.

1975. When complaints have been made to you that the rooms have been too hot or too cold, have you found those complaints repeated directly afterwards, or has the remedy applied been successful?—I have always found the remedy applied successful.

1976. Do you consider it an expensive plan?—I am not prepared with any statement of the expense of it; I do not consider it expensive for such an object; when you consider the expense that it would be to warm these rooms with fires, I consider it a cheap plan.

1977. Could you furnish the Committee with a paper, stating what the annual expense is?—I could not at the present moment, because I had no expectation of being called.

1978. Could you, from documents in your office, furnish the Committee with a statement of the amount of fuel consumed and the attendance required?—Yes, I could; there are twelve stoves in the Castle, these stoves are managed by three individuals, and two or three common labourers; one is a superior person, a carpenter.

1979. Can you furnish us with full information upon that point?—I can.

1980. Are you in the habit of going through the rooms to see whether they are properly ventilated?—Yes, constantly.

1981. Have you been there upon occasions when there has been a great deal of light, and when there have been a number of people congregated?—I have.

1982. Has an equality of temperature been preserved upon these occasions?—The only occasion on which I have known of complaints being made when there were large parties at the Castle was on the occasion of the theatrical performances. There have been sometimes as many as 17 or 18 performers in the room at one time, about from 80 to 100 (I am speaking in rough numbers) guests of Her Majesty, and perhaps about 30 of the servants of Her Majesty's household, and about

about 100 lamps. On these occasions there have been complaints. I also had a complaint on one occasion of the Victoria Chamber, when there was a concert; there were 130 performers, besides Her Majesty's guests; but I have never heard any complaints during any dinner party, or evening party, except on those rare occasions. Mr. *J. Turnbull.* 6 April 1852.

1983. On those occasions was any attempt made to remedy the inconveniences complained of during the time that the performance was going on, or during the time that that number of people were in the room?—Yes; there were frequent attempts made to modify the evil by opening the doors, and also in the room where the theatrical performances were held I put an extra tube, with a gas burner, to extract the heat; but that is not at all required, except on those occasions of theatrical performances; it is never required when the rooms are in the ordinary occupation of Her Majesty's establishment.

1984. Mr. *Locke.*] What was the nature of the complaints that were made by the increased number of visitors upon those occasions?—Merely that the room was too warm, and that only in the one room where the theatrical performances were held.

Goldsworthy Gurney, Esq., called in; and further Examined.

1985. Lord *J. Manners.*] I UNDERSTAND that you presented last night your report to the House of Commons?—I did. *G. Gurney*, Esq.

1986. Did that report contain any specific suggestions?—It did. It stated that I had seen sufficient of the ventilation of the House to warrant me in stating that I perceived in what the present material evils consisted, and that if the House were placed under the control of the Office of Works for a short time, under their direction I would pledge myself to do away with them. By "the material evils" I meant doing away with the draughts arising from the disturbed state of the atmosphere of the House, and the present impurities coming in from foreign and contaminated sources. Of course in that time I could not be supposed to mean to change the lighting, nor could I be supposed to change the warming apparatus; but I should do that which would enable the atmosphere itself to find its point of rest, so that (if I may return again to the term "a feather balance") it might be so preserved without producing those currents which now exist in the House. I have stated in my report that this might be done at a very trifling expense, and disturb the present arrange-

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ments so little, that the House might be restored again to its present condition, if required, in a few hours.

1987. *Chairman.*] That, in point of fact, was pretty much the substance of the letter which you addressed to The Speaker?—It was.

1988. Have you made any additions to it?—In my letter to The Speaker, I said, "under my own control." I have no staff, if I may so express it, in London; I have only a personal servant with me. I have no persons whom I could command to make the change; and although I thought it would be understood that in my letter to The Speaker I meant that the Office of Works should carry out the change, I did not state it. In the report I presented last night to the House I made it an express condition that the House should be placed in the hands of the Office of Works for a short time, and that they should carry out the alterations which I proposed.

1989. Then the suggestion, as I understand, which you made, was, not that you desired to perform any particular experiments with a view to ascertaining this fact, but you asserted it to be the fact that you could make these alterations, if the House were placed under the Board of Works, for the purpose of carrying out your views, for a week?—Yes; the experiments which are necessary to enable me to measure and ascertain the actual amount of the disturbing forces, and other points, I wish carefully and separately to make before I send in my final report to the House. I think it due to the House that I should give the data upon which my opinions and calculations are founded; and to get those data, it is essential that I should have the House placed in its ordinary working condition; and then make my observations, particularly to measure the quantity of air going out and the quantity of air coming in at the same time, which we could then measure with great accuracy. There could then be no mistake about quantities or the state of ventilation; we should then arrive at the absolute amount of leakages, and of course that amount would be an exact measure of the extent and nature of disturbance in the House.

1990. Mr. *Stephenson.*] Have you stated in your report the expedients which you would adopt for the improvement of the ventilation?—I have not stated them in detail; I conceive they are self-evident. To any one looking at the conditions which I have shown in my evidence existing in the House, the remedy is simple and self-evident. Anybody acquainted with the common laws of pneumatic disturbances can see what they should be.

Martis, 20° die Aprilis, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Bankes.
Mr. Thomas Greene.	Mr. Henry Drummond.
Sir Denham Norreys.	Mr. Stephenson.
Mr. Deedes.	Mr. Henry Fitzroy.
Mr. Henry Hope.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

David Boswell Reid, Esq., M.D., called in; and further Examined.

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1991. *Chairman.*] BEFORE the Committee separated they authorized certain experiments to be made for the improvement of the lighting and ventilation of the House, which were suggested in your report; have those alterations been made?—They have been, so far as I found practicable within the time, or so far as authority was given to me.

1992. Will you have the goodness to state first, with reference to ventilation, what has been done?—In reference to ventilation the most important point that has been done has been the purification of the vaults. I was authorized by Mr. Stephenson, and the gentleman with whom he acted, Mr. Locke, and afterwards by Lord John Manners, to do about one-third part of the worst of the vaults; and on looking to the arrangements altogether it was finally determined that I should make one channel good. That has been done, and completed from the Clock Tower. There still remains a good deal to be done.

1993. Is that all that has been done in reference to ventilation?—No, that is only a part.

1994. Will you be kind enough to proceed and state what other changes have taken place?—The next part that was done with respect to ventilation was the arrangement of the supply of fresh air at the ceiling by the lateral panels, instead of the central; the central panels being appropriated for the lighting and made the principal source of discharge of vitiated air.

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1995. Previously to that the central portions contained a downward ingress of air, did they not?—They did, but it was not the sole ingress; the lateral panels could be connected with it.

1996. But they were not?—They were at times connected with it during the day season, but never when the lights were lighted, except for a very short period.

1997. Then those horizontal panels were altered to the extent of admitting light and allowing an egress of air, instead of what they formerly were, channels for the ingress of air?—That is the case. But permit me to mention that they were scarcely ever used previously, with the exception of one or two rare occasions, in consequence of the heat from the ascending lamps.

1998. That, however, is a change which has taken place?—It is; and the change has been effected essentially by the adjustment of valves, not by alterations in the panels themselves, except where gas-lamps have been introduced.

1999. Will you proceed to mention any other change which has been made?—The next point is the cleaning of the floor. A very large portion of the oil has been removed, so that the quality of the air ought to be very considerably improved in this respect; it was found impossible to undertake the removal of the entire portion.

2000. Mr. *Fitzroy*.] What oil do you refer to?—The oil paint. These form by far the most important points connected with the ventilation, exclusive of those dependent on the lighting.

2001. You state that those are the most important points; will you give us the whole of the points connected with the ventilation?—The whole of the points that have been executed may be included in those mentioned, though progress has been made in some other points, but these have not been finally authorized. For instance, I am prepared to show models of doors which I think ought, with due deference to the Committee, to form a very important item of consideration.

2002. *Chairman*.] With regard to the lighting, will you state what has been done?—Under the authority of the sub-Committee it was arranged that 16 panels, and not 64, should be supplied with lights, and I have accordingly proceeded under this direction. Each light is therefore about four times as strong as it would have been had the whole 64 been employed. Essentially the process adopted was this: a frame of copper was made, and that frame was covered with a cement; Martin's and Keene's cement were employed, as well as plaster of

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of Paris and other materials; and finally 16 such frames, not all copper at first, were arranged in the roof, all being made convex and hollow, so as to distribute the light as much as possible. The light is given immediately under this hollow pyramid, and the light being moveable, capable of being raised or depressed, any degree of intensity of light may be thrown upon the ceiling or upon the floor, according to the elevation or depression of the central light. A single illustration would show this in so marked a manner, that unless the Committee wish me I shall not enter into the detail of the mode in which it is effected; but I consider it one of the great elements of that light that I am enabled thereby, without bringing the light down before the eye, to illuminate to any extent either the floor or the ceiling, or to select a point between the two, which gives the adjustment that may on the whole be considered most desirable.

2003. What is the light that you employ for that purpose? —The light employed is the best cannel coal gas that we can obtain here. Under each hollow pyramid there is placed a flower, or some other ornament, which is constructed essentially in the following manner: a series of plates are taken and set at different angles, so as practically to form a cup, within which the light is placed, and which prevent, when properly formed, the naked light from being visible. At the same time, these different plates are set at various angles, so that though they may be each individually absolutely opaque, the reflection of the light from one to another, with the radiation directly from the light itself upon different portions of this cup, gives it the appearance of a transparent material. By those means I am enabled to attain (if I am wrong, at least it is the result of many observations and experiments) what appears to me to be an object of great practical consequence; namely, that the light shall be as homogeneous and equal as possible, never being twisted through curved glass, which always refracts light that passes through it.

2004. How many of these lights have you placed in the roof of the House?—Sixteen have been placed in the roof of the House; but I need scarcely mention, that to have that light properly developed, and the white matter tinted in unison and harmony with the design, and to have a proper artistic cup, is a matter that would require very great care and study, and the employment of parties who would enter on the requisite minutiæ to develope its nature and effect. All that I have at present attempted has been with such materials as were available to develope the chemical effect.

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2005. The light itself, I understand from you, is simply coal gas?—Simply coal gas.

2006. The cannel coal gas?—It is so; a special main was brought in for the purpose.

2007. Then this light has been applied together with those contrivances which you have already described, there being a certain number of these in each of the 16 squares, which formerly were of other material, and now are transparent?—It is so; the cup may be considered transparent, though the individual portions of which it is composed are opaque.

2008. Has anything else been done with regard to lighting?—Other arrangements have been so far advanced, but nothing completed. I found that to obtain these different instruments within the period required took so large a portion of the time, especially as the recess occurred during the Easter holidays, when it was exceedingly difficult to get workmen in London, that I was compelled to make a selection, and finish one in preference to the other; and being permitted to do one window outside, I thought I had better push on with that, which would be a complete body of light in itself from the centre, than attempt to complete before the House met what has been partially advanced on the outside.

2009. Have you now stated the entire of what has been done?—Not entirely. I should wish to add also, that some of those hollow cups which were made were absolutely, in some instances, made of wood in order to try the effect, having been disappointed with the proper material; and those that were most unshapely were in fact made of wood, which was made fire-proof at the time by proper materials when the right supply did not come. The other advance that has been made in respect to the lighting has been the removal, under the authority of the sub-Committee, of the stained glass from a complete window; that is, four panels on either side; and several arrangements have been made on the east window, which, I trust, may be brought into operation to-night. These are intended especially to diminish the shadow that is produced by the bulk of the light in the central panels, and also to give a certain amount of light upon the face of a Member rising in the backmost seat. It will be noticed that there is a very great shadow there at present; the projection of the second seat not being amenable, as it were, to the light from the ceiling, but being without its reach; therefore it is very desirable to give some addition there.

2010. These are amongst the alterations that you contemplated in your report which you made to The House?—They are;

are; I never anticipated that I could be able from the central panels to light the back seats to a sufficient extent for a Member rising to address The House, and therefore some mode would be required to increase the illumination there.

2011. But these are amongst the alterations that you contemplated when you gave The House the estimate of 2,800 *l.*?—They are.

2012. Will you have the goodness to say how much of that sum of money has been spent?—It would be difficult for me to do that, but I know that I have not nearly expended it all, nor anything like it; perhaps approaching to about one-half, or somewhere thereabouts.

2013. When you furnished the House of Commons with that estimate of 2,800 *l.*, had you a detailed estimate of all the various portions of the work which you contemplated?—I had such an approximate estimate as I could make out, with contractors, within the period given, and I believe that I am strictly within the sum expended upon all that has been done.

2014. From that detailed estimate I presume you will have no difficulty in furnishing the Committee at once with a statement of the sum which you have expended?—I could do so within a very short time on communicating with the parties.

2015. How soon can you furnish the Committee with that?—My impression is, that they might probably make up their accounts in a day or two.

2016. On Thursday, at the next sitting of the Committee, can you undertake to furnish the Committee with it?—If the parties who are employed will make up their accounts I will do so.

2017. Mr. *Fitzroy*.] What proportion of the 2,800 *l.* originally applied for to the House of Commons by you was contemplated in the works that have been done during the recess; what portion of the 2,800 *l.* did you intend to apply to that work now done?—It was my intention, had I received the authority, to have applied the whole.

2018. To those works which have been done of themselves?—No, to the whole mentioned in my report.

2019. What portion of the 2,800 *l.* would those works represent, a quarter, or one half, or three quarters, or what?—My impression is, that the amount expended is under one half; but if the Committee will look to the position in which I have been placed, they will see that having a certain knowledge of some of the tradesmen employed under the office, while others were entire strangers to me, I have had to act, to a certain extent,

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extent, as every other man in a similar position, upon a bare probability.

2020. But I imagine that when you applied for the sum of 2,800 *l.* you had formed some estimate of certain works to be performed which would cost that sum?—I had.

2021. In your estimate was there included the lighting from the ceiling, as now performed?—There was.

2022. What amount did you originally take in your estimate for that expenditure; what sum had you calculated that the lighting from the roof, as now done, would cost?—I could not mention that at the moment, without a reference to my notes.

2023. What sum did you originally contemplate expending in what you call the purification of the vaults?—£. 400.

2024. Has that sum been expended now?—It has not.

2025. What sum did you contemplate expending upon the supplying of fresh air from the ceiling laterally, instead of from the flat portion of it?—A very small sum upon that; that was one of the minor items; I should doubt whether it could exceed 10 *l.* to 20 *l.*

2026. What sum had you calculated to expend upon the cleaning of the floor?—£. 100 to 150 *l.*

2027. Was the lighting from the roof of the House, by the removing of the panels, to consume the remainder of the 2,800 *l.*?—No, it was not.

2028. What portion of it was to be applied to that purpose in your estimate?—I could furnish it, but I do not recollect it at the moment.

2029. In your estimate did you take into consideration the necessity of bringing a new main to supply cannel coal gas?—I did.

2030. That was included in the 2,800 *l.*?—It was.

2031. Have you any reason to imagine that the expenditure now made upon these improvements will in any way exceed the amount that you originally estimated?—I have not.

2032. What other items were to be included in the 2,800 *l.*?—There were in the first place arrangements at the doors.

2033. To what amount?—Without a reference to my notes I could not specify that amount; I was dependent there so entirely upon matters of taste.

2034. May I ask what you call arrangements at the doors?—For an improved mode of working the doors behind the Speaker, and also at the entrance to the House.

2035. What else?—There was the improvement of the smoking chimneys.

2036. Have

2036. Have you any remembrance of what you estimated that at?—That I estimated at about two to five guineas for the iron pipes, and whatever might be necessary for cutting through the walls by which these iron pipes were to pass.

2037. Anything else?—Arrangements at the table of the House; arrangements for the discharge of vitiated air at the Central Tower.

2038. Have you any remembrance of the estimate taken for that?—I put down a sum of 50 *l.* for that.

2039. Then the principal item in your expenditure was to be the system of lighting from the roof?—It was.

2040. If that remains in the state in which it now is, the saving upon that is three-fourths of the sum you originally proposed?—Nothing like it. I am not aware that there may be any saving.

2041. I understood you to say that whereas you had proposed 64 panels to be lighted, now there were to be 16?—It was 64, each of a power one-fourth of that power now in use. The increased heat in consequence of the concentration of the light and other arrangements connected with that, may rather make it, on the whole, before I have done, an increase than otherwise; but my impression is that there will be a decided saving.

2042. Sir *D. Norreys.*] The Committee have asked you once or twice the amount which has been expended during the recess in the alterations which you proposed?—The Committee have.

2043. To that you state that you have some difficulty in giving an answer?—None whatever, if I had been informed that that question was to be asked; but the Committee will bear in mind that I have been night and day entirely looking to the effects, and it was vain for me to attempt to do everything.

2044. You had to do probably with a gas company for laying down the main?—I had; but my impression is that there will be no expenditure upon that to a certain point.

2045. In reference to the expenditure which has taken place, the bringing a superior description of gas to the House will not be an item?—To a certain point.

2046. Then in what will consist the remainder of the expenditure which has taken place at the recommendation of the Committee during the recess?—There will be the expenditure for all the lighting arrangements in the ceiling.

2047. That will be divisible into the carpenters' work and the gas-fitters' work?—And the plasterers' work, and the modellers' work.

2048. Will

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2048. Will there be any difficulty in getting statements, within the next 24 hours, from the different master workmen whom you have employed, of the expenditure which has taken place for these purposes?—I do not see that there should be, but I know that it is often very difficult; I shall instantly ask for them if required, but I know that it is often difficult to extract them in detail.

2049. Will it not be simply a question for them as to the number of men that they each will have employed in their separate departments, and the quantity of material which will have been consumed; which accounts can be as easily made out by them at the present moment as they would be by leaving the account open for weeks?—I can see no reason to apprehend that they will not at once make it out; the materials should be all available; it is only a question whether, with a mass of accounts where there have been several hundred men working, and many minute details of modelling, they will put down the prices within the time. I have no doubt, myself, that I could give a satisfactory vidimus to the Committee. I cannot pledge what the contractors will do within the time.

2050. Will you state what modelling has been going on, which may be fairly taken as expenditure, during the recess?—In the first place, there have been several plasterers, Bernasconi and Riddell, and Mr. Kelsey, modelling, to get the flower for the reception of the rose in a proper condition.

2051. Then are you about to place in your statement of expenditure which has taken place, expenditure on work which has not been done, or not yet decided on being done; namely, for the models of work which is hereafter to be executed?—Permit me to mention that they are done, and that it was a necessary element, I considered, that I should show not only the plain light, but how it could be made the means of artistic decoration afterwards.

2052. At present, so far as the Members can see, there are nothing but certain circles of plaster, and certain cones above them; that is evidently work which does not require either the talents of Mr. Bernasconi or of Mr. Wingfield; those cannot be put down as a portion of the expenditure which has taken place during the recess?—Then the accounts will not be paid of the tradesmen whom I have employed under the authority of the Committee.

2053. Does not it come to this, that the account which you propose to send in will not be an account of expenditure for work which has been done in the House, and which is evident to the Members; but for work which may be done hereafter, should

should the Members agree to carry out these arrangements? —That is not my view of the case. I think that the Members who were present last night, and Mr. Stephenson before, will admit that there was a rose. That was the first one which was put up of all the lights, and it was only because the plasterers could not get on sufficiently quickly with the rose that the other things were adopted.

2054. Mr. *Fitzroy*.] As to the purification of the vaults, perhaps you can inform the Committee what has been done there?—I have not the accounts, but my impression is, that it is about 150 *l*.; and if we have exceeded that at all, I am quite certain we cannot have come to 200 *l*.

2055. Did you make any agreement with the person who was charged with doing that work for you?—I did.

2056. What sort of agreement did you make with him?—That he was to do it at the rate of so much per foot for the pavement, and so much for the concrete.

2057. And you knew the quantity that he was to do?—It is all to be measured.

2058. But it is not yet measured?—It is not; when he presents his account it will be measured.

2059. Then you can give the Committee no information whatever as to the amount which has been expended during the recess?—I consider that I can give the Committee this information; that as far as a man can do so in the position in which I am placed, and without having been directed to have the accounts ready for this meeting, I can give them the strongest assurance that my estimate of 2,800 *l*. is not exceeded in respect to the proportion expended upon the part of the work authorized to be executed.

2060. Mr. *Deedes*.] In the account which you will be able on a future day to submit to the Committee of what has been done, shall you be able to show distinctly how far it relates to work actually completed, and to show what, if any of it, relates to work which remains still to be done?—Most certainly; the accounts can be drawn up to this moment, or they may finish with this evening, and a note may be sent to every person employed requesting him to make up his account instantly to this night, and if that is put into my hands to-morrow it shall be immediately furnished to the Committee. At the same time I think I should be prepared with a night's leisure myself to go over everything.

2061. *Chairman*.] Will you have the goodness to desire those gentlemen to furnish their accounts up to yesterday evening,

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evening, at the earliest possible period?—I will take care that they do so.

2062. Mr. *Hope*.] Am I to understand you to say that any pattern has been prepared which has not been executed?—No. I am not aware of any pattern that has been prepared which has not been executed; but one particular pattern which has been the subject of much study by Mr. Kelsey, the modeller, has not yet been brought to me. I expected to have had it fitted up to-night, but it has not yet come.

2063. *Chairman*.] Will you now state to the Committee what your belief is as to the effect, with regard to the ventilation, of the alterations that have been carried into execution, whether they have been satisfactory or otherwise?—So far as I had an opportunity of examining them last night, under the very peculiar circumstances of the case, I have no reason to doubt anything that I have stated in my former report. If you would permit me, I would state that I suppose about 150 men stopped work at 20 minutes to four, five minutes before the Speaker came; and in the dismissing of those men, and the arrangements connected with cleansing and other matters, there was a very large door, exposing nearly 100 feet, left open at one place, which had been locked; how it came to be so, I cannot tell; we were hunting over the roof and everywhere to find out the cause of the very severe local currents which were produced, and that was found out about seven o'clock.

2064. Those are the peculiar circumstances which you have just mentioned?—Yes; I think that after that the ventilation became entirely under control and manageable; in fact, I have often had such difficulties with the doors, that unless I have a policeman stationed, as I have mentioned, at the doors, I cannot be responsible for the effect.

2065. Sir *D. Norreys*.] What was the difference of temperature last night between the galleries and the lower part of the House?—Not above two or three degrees after the House got into an equilibrium and the workmen were all away out of the chambers, about seven o'clock; 65° to 67° was the range.

2066. What was it at, say about nine o'clock last night, as to the galleries?—Sixty-seven degrees, as nearly as I could judge from the report; but I was so much occupied with the lighting, that I did not get once to the gallery; I only took it from the reports.

2067. Mr. *Fitzroy*.] Are we to understand that your arrangements, as far as regards the ventilation, are completed?—No; the arrangements with regard to the external lighting are not completed, which affect it very much. Until that external

external lighting is completed, I shall be compelled to work the superior illumination with more power than I would desire. You find that there are other items mentioned in my report. For instance, the chimneys of the Post-office, or other places; they are the cause of extreme annoyance. Though I have had the authority both of this Committee and of the Sub-committee to proceed as fast as possible, it has been found utterly impossible, with the system adopted in the works, to get through. At one time it is agreed that the fire-place shall be under my control; then the discharge should be under my control. But when I apply to the authorities, and do not get people to execute works, practically there has been a source of complaint for three months, from the want of a proper system of communication, which should be remedied in one or two days.

2068. Mr. *Stephenson.*] As to the post-office?—Yes. It was stated by the gentleman in attendance there that he had applied at Sir Charles Barry's office, and that he had said it was in my hands. Here is a memorandum which I received to-day:—"Post-office, House of Commons. My fire-place has not been put into order yet." This was the first day the House met, and I say that I could remedy it in 24 hours, if a proper communication was established.

2069. Mr. *Fitzroy.*] Can you account for the temperature in the House being so very unpleasant last night, so exceedingly cold?—I can account for the effects arising from the door.

2070. You are aware that many representations were made to you by Members and by the Serjeant-at-Arms as to the state of the House?—Most certainly.

2071. Was there any reason for the temperature being so exceedingly low, and there being that tremendous rush of wind into the House?—There was; there is a door having nearly 100 feet area to the open court, which was found to have been opened; while the attendants were engaged in the ceiling with the workmen, or in the House, or in different places, this door had been opened. At first we thought the currents were from the roof, and hunted in every direction, and then we found that this door, which should have been locked, and which had been locked, had been by some means or other opened.

2072. Mr. *Drummond.*] Under whose charge is that door?—It is directly under my charge, and it was attended to particularly by William Patrickson, who assured me most positively that he had locked it, and that it was altogether incomprehensible to him why it should be open.

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2073. Who had the key; was the key left in the door?—I am sorry to say that there is not a place to which I have a key where there may not be 20 master keys that turn it over.

2074. Mr. *Stephenson.*] When you commenced to ventilate the House yesterday at, say, four o'clock, with what intentions did you commence; what inlets and what outlets did you intend to avail yourself of in the first instance?—I intended to avail myself solely of the ascent in the first instance, with as little descent as would come through the leakage of the unfinished work.

2075. In what position is this door with reference to the roof of the House of Commons?—The door which I refer to is on the ground-floor, on the level of the ground. It is towards the east.

2076. That door being open, where did it take the air from, and where did it pass to?—That door being open, the air entered from the court between the House of Commons and the refreshment-rooms, and it passed into the chambers under the House—not into the vaults.

2077. Then that draught of air upwards was caused entirely by the ascending force of your furnace through the roof?—I cannot say that, for there was an easterly wind; and that wind, driving in at any open door, might produce a local effect, independent of the furnace.

2078. That would produce immediately a plenum in the House, from the pressure from without?—It would.

2079. Do you believe that there was a plenum in the House when those draughts took place suddenly yesterday?—That is my impression.

2080. What amount of furnace had you at work last night; how many square feet of grate, for instance?—During the mass of the night there was not more than one square foot of fire at work.

2081. Then the ventilation of the House was solely dependent upon the levity of the air in the House?—Yes.

2082. You had no force applied to the ventilation of the House last night at all?—The shaft was warm; the fire in the shaft had been a little larger at first probably. It might have exposed about four feet of surface at the commencement, but afterwards I found it too strong, and I had it covered. I took some plaster myself that was at hand, and had it reduced till there was one foot of surface. The warmth which the chimney had previously acquired would for a short time operate, but the gas was burning from the commencement, though

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though only lighted to the blue, or very little above the blue; simply enough to make the burners keep steadily in, and that, no doubt, accelerated the action.

2083. Were the valve-doors between the top of the House and the gallery leading towards the furnace full open or not? —You mean the discharge from the House to the furnace?

2084. I do?—They were not.

2085. In what condition were they when these draughts took place?—Strictly speaking, these valves were not even completed. There were boards laid over the place where the valves should have been; it was covered by a tarpaulin of a certain amount of surface, and that tarpaulin was placed back so as to give whatever amount of discharge was considered the proper quantity: the average discharge was about four feet area.

2086. Therefore the whole of the air passing through the House last night had to pass through an aperture between the House and the furnace of not more than four square feet?—Yes.

2087. Did you try the velocity of the air at that aperture last night at all?—I did not. I was entirely occupied, and it took every one that we had to attend to the local arrangements; but we tried it so far as to work by the thermometer, and ascertain the movements dependent upon that current.

2088. Then you attribute the gusts which were felt in the House last night entirely to the pressure of the air upon the passage leading from the door fronting the east to the cavity underneath the House?—I do, and to the coldness that it produced in the air chambers.

2089. Could you point out upon the plan where this eastern door was?—Yes, it was at the Commons court.

2090. This open door opens into a courtyard which is surrounded by walls upwards of 50 feet high; I apprehend therefore that no pressure would be created by a wind from the east, or in any direction?—I may state I know no court into which, when the wind blows, a pressure of wind may not enter under particular circumstances. Permit me also to add, that this court has communications at both ends below, through which carriages can drive, in perfectly free communication with the external atmosphere.

2091. *Chairman.*] Do those archways communicate to the east or to the west?—They communicate finally with the west; but if the current were passing over most strongly at the roofs of the houses, being deflected by the perpendicular wall of the river front, the wind striking it at a particular angle would

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blow down from the top into the court, and might escape on either side.

2092. Mr. *Stephenson.*] Did you find the temperature of the House change almost immediately after you discovered the fact that this door was open when you shut it?—I did; not only that, but considering the number of workmen, and the number of persons engaged in cleaning, I directed several to take the temperature of the House, and to watch them most closely, and we had the House up to 66° throughout the afternoon. I cannot exactly say at what period, for I was at times out in cabs; but the House had scarcely met when the temperature was much below, and we had it down to 59° and 60°; therefore there was an untoward cause, and we found out the circumstance which I have mentioned.

2093. Are you quite certain that your apparatus was so arranged as to prevent any downward current taking place in the House from the lateral panels?—I am quite certain that none could come except through the leakages of the doors. At the same time permit me to mention that some of the panels of these doors were covered with a porous canvas that would admit some air, but I consider practically so little that I never attributed the cause to that.

2094. *Chairman.*] Can you state at what o'clock this open door was discovered?—I really cannot at the moment, but it was at a time when Mr. Hindley spoke to Mr. Patrickson in going out; I have no doubt I could find out the time.

2095. About what time was it?—I should imagine some time between six and seven.

2096. Mr. *Greene.*] Is that door which you complain of one which is intended to be used for the purposes of ventilation?—It is, under particular circumstances. I can only mention that the thing would have been discovered in a moment almost under ordinary circumstances, but from the multitudinous number of men in all parts of the House, plasterers, coppersmiths, and paviours, above and below and everywhere, the attention of every one was engaged to an extreme degree.

2097. Is that door solely for the purposes of ventilation, or is it used for other purposes?—Solely for ventilation, and it ought to have been strictly locked.

2098. Mr. *Stephenson.*] Were you deriving all the air from that door at the time?—I have no doubt that our principal supply was from that door, and from leakages.

2099. Then when you shut the door, from whence did you derive the air with which the House was ventilated after the inconvenience was discovered?—From below in the vaults.

2100. But

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2100. But the air that comes in at this door passes through the vaults before it reaches the cavity below the House; where was the other external aperture from which you derived the air when this door was shut; had you two sources of supply? —No.

2101. If you shut that one up, where did you get the air from during the remainder of the time?—The air came in principally from the leakages at that time, for there were but few Members in the House.

2102. Were you deriving the whole of the air for ventilating the House from the aperture where this door was placed, in the beginning of the evening?—No; we had it from the leakages partly in the ceiling and partly below; there were many unfinished works that were not absolutely tight, and which could not be made tight within the period, and I considered that there was a sufficient quantity coming into the House generally at the moment.

2103. Where did it come from?—From the leakages at the doors, which are not all air-tight yet.

2104. Do you mean that the House was ventilated last night merely by the air rushing through small crevices?—Till the period when that door was shut, the supply that I was calculating upon, there being but a small House, was from that leakage above, which I considered very immaterial, and from below, but not from that door.

2105. When you say from below, you do not mean that you got the air from the vaults, which are all sealed up nearly I apprehend in that condition?—It must have come from them; I had no other source but the vaults, and the ground floor, from the numerous doors below.

2106. After the door was shut, was the ventilation of the House dependent entirely upon the accidental area that might be open from leakages?—No; the moment that that door was discovered it was shut; then I had found the cause of the evil that I had been hunting for, and I instantly went and arranged another opening.

2107. Where did you go to make another opening?—In the centre of the central vault.

2108. Have you a communication between the vaults and the open air at that point?—We have.

2109. By a trap door?—Yes; not with the open air directly, but we have a communication with the central vault and the open air at another place.

2110. Therefore you looked upon the central vault as a

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reservoir having communication with the external air by some other channel, no matter where?—Yes.

2111. And then you opened communication between the House and that vault?—Yes, and produced a discharge above.

2112. What was the area of the aperture which you opened at that time; after you had shut the door you went to make another opening, of course to obtain air for ventilating the House; what size was that?—I cannot mention it to an inch, but I can state generally; it is a wicket door in the centre of large doors; these large doors were shut.

2113. What ratio do you think it would bear to the four square feet which was the exit?—I should imagine at least double. I always prefer to have more means of ingress than of egress.

2114. How far is that aperture removed from the diffusing apparatus underneath the House; 50 yards?—I should say 100 feet.

2115. *Chairman.*] Does that aperture communicate with the Clock Tower?—Not as it was set yesterday; it communicated with the central vault.

2116. That central vault, as I understood you, communicated somewhere with the outer air?—Yes.

2117. Where?—At the Central Hall.

2118. Which side of the Central Hall?—The north-east side.

2119. In the Commons inner court?—Yes.

2120. Mr. *Stephenson.*] With regard to the tradesmen's accounts, you are in the habit, I suppose, of having their accounts once a month, or perhaps once in two months?—They come generally in quarterly periods; but permit me to mention, that in general the tradesmen's accounts go to the clerks of the works. I simply define what is wanted, and the management, execution, and supervision of the quantities, and the correct tradesmanlike execution of the work, are with the clerk of the works.

2121. Therefore, if you wanted at this moment to ascertain really what amount of money had been expended, you would go direct to the clerk of the works and ask him for an approximate estimate of what proportion of the work originally contemplated had been done?—As a general rule I would. In the present case, meeting the peculiarities of the circumstances with regard to those things which were done directly under my own hands to save time, I should of course communicate directly with the parties.

2122. Sir *D. Norreys.*] Have you your system now so perfected

fected that you are able to keep at any temperature which you shall desire beforehand, either the Lobby, or any portion of the House of Commons?—I consider that it is so far arranged as to enable me practically to attain that point on a much better footing than before.

2123. And in such a manner that there shall be no partial draughts and no foulness in the air admitted into the House?—Not at present, because it has been ascertained during the last few days that many closet-pipes have given way, and during the recess some of the principal pipes from the closets have burst all over the ground.

2124. Then your system would be perfect, so far as you could make it so, if the channels by which you supplied air to that system were as perfect as you would wish them to be?—Yes; and if the other matters mentioned in the report were completed.

2125. Mr. *Stephenson.*] In discussing the question of the vaults you remember a conversation which I had with you respecting the feasibility of accomplishing your object, that is, making them perfectly dry?—I do.

2126. You remember my expressing a doubt about the feasibility of accomplishing that?—I certainly do.

2127. You expressed a contrary opinion, did you not?—I certainly had a different opinion upon the subject.

2128. Since that time have you not opened a portion of the paving of the vaults?—I have.

2129. What was the result of that opening?—The result of that opening has been to show that there is water constantly, and in an apparently unlimited quantity, at one or two feet below the surface of the vaults; at all events on the first examination 600 pails were taken out, one after another, without producing the slightest difference worth mentioning as to the level, in the course of a few minutes.

2130. Do you feel that that confirms your opinion or mine?—I do not see that it materially alters the fact, because so long as I have been in the habit of working with chemical materials, I have always found it practicable, if the means have been permitted, to make an air-tight vessel; at the same time it shows that these preparations must be on an extensive scale; and in particular, the facts ascertained without the vaults show what Mr. Stephenson very strongly urged, namely, the absolute necessity of controlling the exterior as well as the interior, because the walls are not built in cement. The water was found one or two feet above the level of the vaults outside; the whole plaster is porous, so that in reality the foundation walls are

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injured; and as a general precaution for the building, independent of other circumstances affecting the ventilation, I should say that it is important to have that water question thoroughly examined. But permit me to mention that the fact of an unlimited supply of water from water springs was pointed out by me in 1843 or 1844, rising through the concrete and dissolving the lime, and that afterwards I brought it specially under the notice of the Government in 1847; and it is my conviction still, that if this question be not thoroughly entered into, it may cost very large sums hereafter.

2131. *Chairman.*] Am I to understand you to say, that those walls forming the foundation of the House in those vaults are not built in cement?—No, they are not in cement; and I can assure you that I have in the most public manner endeavoured to call attention to the foundations of the building, which is the root of all the evil.

2132. Mr. *Bankes.*] Is there now a steam-engine pump near the Clock Tower for the purpose of pumping up the spring water?—I am not aware that there is.

2133. Are you aware whether there was one in the earlier stage of the building?—Yes, there was a pump constantly used at the time of fixing the foundations.

2134. Has that been discontinued?—I have not seen any one lately; there might have been a pump connected with different places outside for all that I know, but I have not known of any lately.

2135. *Chairman.*] Do you believe it possible that the sum which you have stated in your report, now that you have examined the state of the ground underneath those vaults, would be sufficient to make those proper channels for air to be introduced into the House?—I do, if it was combined with a proper protection from external water, by means of a pump attached to the engine.

2136. Then you think that the sum which you calculated, notwithstanding what you have since seen, would be amply sufficient?—I think so; I have no reason to doubt it, if the building is put into a proper architectural condition.

2137. But I understand that that is a condition which involves another large expense?—Permit me to mention that that large expense, I presume, must come some time hereafter in the paving and adjustment of the floor of the Courts without.

2138. But my question goes to this, namely, that without that expenditure the other would be money absolutely thrown away?—I do not consider so; if you will allow me to mention this

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this point, that a hand-pump with a few labourers always brought down the amount of water that we have hitherto traced outside to a level below the vaults; I desired accordingly that in filling up those external portions of ground which had been removed to unfold the state of the walls, they should insert two iron pipes, so that I could at all times know the level of the water at the walls without; hence by simply having a small pipe connected with the engine, which is close at hand, whenever there is any rise of water outside from any temporary cause, I apprehend the engine would very rapidly reduce it and keep it down.

2139. Do you believe that, with this water perpetually there, these vaults could, at the sum which you mention, be put into a proper state to be an air-channel for the House of Commons?—I do consider so, with that area. At the same time, a more expensive operation would, of course, make them more perfect; but I should prevent the infiltration of water from below, which is the point that I consider most essential.

2140. Mr. *Stephenson.*] If the walls go down into the wet gravel, they will themselves act by capillary attraction to a very considerable height, will they not?—They will.

2141. And they have been doing so?—They have.

2142. What could you do to prevent that action going on?—I would make an interior coating.

2143. That would not prevent the inside of a brick wall, if you made it perfectly impervious on the surface, acting the part of a pump?—No; but it is conjoined with the use of a pump outside and another lining between.

2144. I am not speaking now of the outside at all. There is a stratum of wet gravel or wet concrete, upon which the whole of the House stands?—Yes.

2145. The walls go down to that; you have already ascertained that at that level, at least a very little below the pavement of the vaults, you do reach a stratum of water which you have said is almost unlimited in quantity; into that stratum the walls of the House do pass, and they are of brick-work; will they not, by capillary attraction, be wet constantly for six or eight feet in height above that foundation?—They will certainly to a particular height, but the concrete on which the walls rest is certainly not universally moist, though at a certain depth moisture may never be absent. I have seen more of it dry than wet in those places where it has been recently uncovered, but symptoms of moisture undoubtedly prevail in many places.

2146. Sir *D. Norreys.*] Suppose you ran a line of glazed stoneware

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stoneware pipes, of the requisite diameter, from your Clock Tower to your fan; is it possible that a tube of that kind would be affected by any moisture that was surrounding it?—I do not consider that a glazed tube, if properly cemented and joined, with due precautions, would be so affected. I think nothing is more important than what Mr. Stephenson insists upon; but I meet it in this way: the Clock Tower was originally arranged so as to be a supply, under certain conditions, both for the Peers and for the Commons, and for the committee-rooms. There is therefore a whole series of vaults; and for 400 feet in length, there are at least three, sometimes more, lines of vaults. Now, if I give up the two exterior vaults which Mr. Stephenson has objected to, and take the central vault, what shall I have then? I may have a floor covered with stone and cement, and I may have walls that are objectionable, most undoubtedly, so far as they come upon a damp basis; but then the walls have no direct contact with the outer air, or the outer ground, or the outer water, except through other vaults, which are a barrier to the external water. If then I use the central vault paved below, and keep down the surface of the external water, and if I find by actual examination that the central vault, when defended from water descending from the principal floor, is generally dry, I am in hopes that Mr. Stephenson will see that I do not urge a point which has not practically some foundation.

2147. How does that get rid of Mr. Stephenson's objection, that the foundation being virtually placed in water, the tendency of the water is continually to press upwards, and even without reference to capillary attraction the pressure of the water itself will make its way through the floors upwards, notwithstanding your having vaults on either side of that main vault, which you say you can depend upon?—It does not get rid of the objection at all, if the precise facts implied are *in toto* absolutely correct; but if the inner walls rest upon concrete, through which a crust has been formed, and if the examination of the inner walls proves that these are not subject to those appearances which are presented on the outer walls, and that they are practically dry, it may be true that the amount of porosity at that inner portion is very much below the amount of porosity at the outer portion, and that it is in reality the lateral water draining through the walls that does the injury to the external walls and the vaults, in a much greater degree than the lower water coming up through the concrete above it.

2148. Is it not the fact that the whole basement of the House

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House of Commons at present is like a porous vessel immersed in water, and that the water in which it is immersed will rise in that vessel in proportion to its permeability?—I am not inclined to go entirely to that length, because while I believe undoubtedly that you have concrete laid largely upon a quicksand, that concrete appears to me to harden more and more daily; and as that concrete has a large portion of iron mixed with it, in the process of time, as that iron oxidates, it may form a much firmer bed than it does at present.

2149. Practically did you not find water as soon as you took up the flags, to a most enormous extent?—No; we did not where we were not close in contact with water filtering through the sides from a higher level.

2150. Mr. *Stephenson.*] But you took out 600 pails?—I think a reference to my answer will show that we dug two feet down there before we got to that.

2151. Sir *D. Norreys.*] Were you not above the concrete which formed the foundation of the House of Commons where you found this water?—Not in that quantity. The water that affected the vaults most came in above the concrete.

2152. Was not the concrete to which you have referred laid down above the foundation of the entire of the House of Commons?—The concrete formed the foundation.

2153. If you found water to the enormous extent you have stated of 600 gallons, by raising a few flags in one of these air passages, would it not appear that the water must have got through that concrete by some mode, either by the defect of the concrete, or by some mode which you are not able to account for?—It might have got through so; but my statement was that this water was found on digging through the concrete to one or two feet. I did not find the water as you refer to in lifting a flag. I found the water on digging through the concrete.

2154. Mr. *Drummond.*] Was the concrete dry?—It was dry in many places at the top, and in many other places it was damp.

2155. Then in point of fact the water had come up through the concrete?—That may be so at times, but I have not proof that it comes through everywhere.

2156. But once having come through, it never would dry again?—I am not prepared to say that in a mixture containing lime, iron, and sand, when a certain portion of moisture comes through that mixture, it may not afterwards oxidate and form itself into a solid concrete.

2157. It

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2157. It will do that originally in hardening, but after the water has once got through, that has ceased?—It may have ceased to a certain extent; to what extent it has ceased is still a matter I should presume to be certified by minute examination; that minute examination I have urged since 1844.

2158. Will lime that has been once thoroughly slacked, in becoming dry form a concrete again?—It appears to me that when mixed with iron it does so; it will not form the ordinary concrete; for instance, there are springs where a solution of iron rises, and it will sometimes harden the whole of the sea-shore.

2159. But that is not this case?—It is not; the want of the aëration makes the great difference; the iron has imperfect means of oxidation.

2160. This is simply the case of concrete having been dry once and then becoming wet, and you suppose it possible for it to re-harden as at first?—That is my impression from what I have seen at the Houses; I have seen masses of concrete here laid in, in 1841 and 1842, that was soft for a very considerable period, land springs having risen through it; and on watching it attentively, I found that for years there was a solution of lime passing away by means of these land springs, so that the concrete was so far undermined and destroyed. But supposing the whole of the lime not to be taken away, and that the land springs brought with them a certain portion of oxygen, then that might harden the concrete; and this I know to be practically the fact, that after seeing this concrete water-logged, whether from water below or from land springs, I have found a two-feet thickness of solid concrete under these peculiar circumstances. Permit me to mention that these conditions have been the subject of daily examination with me. I admit entirely the principle that one does not attempt to build with old mortar, but the case here is peculiar.

2161. Mr. *Greene*.] Is there any material difference between the state of the vaults under the existing House of Commons, through which air passes into the existing House of Commons, and the state of the vaults to the House of Lords?—There was a great difference when I first examined the one and the other; the stones were laid quite solid upon concrete in many parts of the House of Lords, which was not so in the House of Commons; and further, on looking at the base of the Victoria Tower channel, delivering in air from a great altitude, it was thoroughly dry and covered with cement, and not porous; but if you looked at the parallel channels at the Clock Tower, they were in a very different condition.

2162. Is

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2162. Is there any difference in the actual state of the ground, do you imagine, on which those two sets of vaults rest? —I should have mentioned, not in respect to the state of the materials put in; but to what extent local springs may have affected one part more than another I do not know.

2163. You are not aware of any difference in the state of the ground on which the foundations rest?—I have had little opportunity of examining anything during the last six years, and can speak to nothing satisfactorily on this point.

2164. *Chairman.*] Are you aware what the temperature was in the galleries of the House of Commons during the time the chandeliers were there, at any time?—I am.

2165. What was the average?—From 67° to 69° was the average, and sometimes 72°. I should be glad if you would allow me to answer that by a return of the notes of temperature taken, which we have. I can strike the average, or give you the actual record from notes taken.

2166. Do you know what it was last night?—I do.

2167. What was it?—The general range was from 65° to 67° after the door was shut.

2168. Have the goodness to furnish the Committee with a paper, stating what was the highest and lowest temperature before, and the highest and lowest temperature last night, and this night?—I will do so. I may mention that the temperatures are taken by a messenger appointed by the Serjeant-at-Arms, and his record on the subject can be brought before the Committee as perhaps the most desirable; at the same time that might not give the highest temperature.

Jovis, 22° die Aprilis, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Bankes.
Lord John Manners.	Mr. Henry Fitzroy.
Viscount Palmerston.	Mr. Deedes.
Sir Denham Norreys.	Mr. Henry Hope.
Mr. Stephenson.	Mr. Thomas Greene.
Mr. Locke.	M. Henry Drummond.

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

Alfred King, Esq., called in; and Examined.

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2169. *Chairman.*] ARE you an Engineer?—I am.

2170. Are you resident in Liverpool?—I am.

2171. Has your attention been directed to the lighting of large buildings, and have you been employed in lighting them?—Yes.

2172. Will you state what buildings you have been so employed in lighting?—The most important building is the Philharmonic Hall at Liverpool, a very large music hall; it is lighted simply by a row of jets. I ought first to state that the ceiling is coved.

2173. How long has that music-room been built?—It has been completed about three years.

2174. About what are its dimensions?—It is rather more than 120 feet long, 60 feet wide, and about 60 feet high.

2175. Was that room built in such a manner as to give proper means of ventilation?—Yes; the ventilation excited a good deal of attention in the construction of the room.

2176. A good deal of attention was given to the construction of the room in order that it should be properly ventilated, so as to secure the comfort of the people who were likely to come there to listen to the music?—Just so.

2177. Who was the architect of that room?—Mr. Cunningham.

2178. Whose principles of ventilation and warming were adopted there?—I believe that it was the intention of Mr. Cunningham to use a fan, both to drive the air into the room and

and also to draw it from the room; but I rather think that that has not been carried into effect. I think the natural currents are trusted to for the ventilation of the room; and, I believe, successfully so: I never heard of any complaint.

2179. Are you stating facts, with regard to the system of ventilation, within your own knowledge, or only what you have heard?—From what I have heard; but I am pretty sure I am correct in stating them.

2180. You do not actually know, then, whether there is a fan there or not?—I do not.

2181. Will you proceed with your statement as to the method adopted under your superintendence for lighting that room?—I was going to describe to the Committee that the ceiling is what is commonly called a coved ceiling; the centre part is flat, but the sides are brought down by curves to the cornice, which surmounts the walls; on that cornice are placed the lights, which are simply a row of 942 very small burners; over the orchestra there is one large clustered light, containing about 170 of the same lights as those on the cornice; that lights the whole of the orchestra, but the rest of the room is lighted from the cornice by the continuous row of lights.

2182. I understand you that the number of lights round the room is 1,000?—1,000, or very nearly so.

2183. And the number of lights above the orchestra, 170?—Yes, 171.

2184. And that completely lights the room?—It does. I think every one who has seen it has been struck with the flood of light that there is there; at the same time there is nothing offensive in it, except from the clustered light over the orchestra; that has been a little complained of by parties sitting at the further end of the room, but the other portion of the lighting has given, I think, universal satisfaction.

2185. Are those naked burners round the room?—Yes.

2186. Are the burners above the orchestra naked also?—They are.

2187. How much nearer are the burners above the orchestra, to those people who play, than those round the cornice?—They are about the same height in the room, but nearer, of course, to the orchestra; inasmuch as there is a slope in the orchestra, the upper seats being very much nearer to the light than those nearer the floor of the room.

2188. Then the seats are ranged one above the other?—Yes.

2189. Have you ever sat there, or are you at all aware, so as

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as to be able to inform the Committee, whether there is much difference in the heat near the cornice and the heat at the bottom of the room?—That question will not apply to the cornice of the room, I think; it may apply to the light over the orchestra.

2190. I understood you to say that the light over the orchestra was no nearer the people than the light of the cornice?—It is a light of a different character altogether; it is a number of similar lights to those on the cornice, but clustered into the smallest possible space.

2191. Did you state that there was no ground glass, nor anything between those lights and the orchestra?—Nothing.

2192. Neither in the cornice nor in the chandelier?—Neither. The light which is used over the orchestra has been extensively used on a smaller scale in lighting places of worship in Liverpool; there are two places of worship close adjoining this Philharmonic Hall, which are lighted by means of these clustered burners; the chapel of the school for the blind is lighted by two of them; there are in each burner 63 lights, or seven clusters of nine each; now those perfectly light the whole of that building, which is about 90 feet long.

2193. What difference is there in the burners which you have described from any other burners which are used for the purpose of lighting?—The burner itself does not differ, but it is the arrangement of the burners; it is arranging them in a cluster, so that the flame extends horizontally; it is a horizontal flame.

2194. Is it an horizontal flame in the chandelier?—Yes; in these clustered burners, which are commonly called sun-burners, they are horizontal flames, and there is some little contrivance necessary for preventing the rush of air, from the rarefaction produced by the heat, from drawing these flames upwards; but I need not trouble the Committee with that arrangement; it is sufficient to say that we do succeed in making the flame burn perfectly horizontally.

2195. Are the burners so near each other that it is a continuous circle of flame?—No.

2196. How near is one burner to the other?—I should think it is about $1\frac{1}{8}$ inch from burner to burner, as nearly as possible, so that the flames shall not coalesce.

2197. What is the diameter of the orifice from which the gas issues?—It is a compound orifice. There are two gas passages which unite into one, producing a flat sheet of flame; there are two currents of gas which unite in one opening; these

these two currents rushing together produce a flat flame in an opposite direction to that in which those two passages are made.

2198. Will you explain to the Committee how the flame is horizontal?—Simply by placing the burner or the tube from which the flame issues horizontally. Supposing that my finger upright represents the burner which I have endeavoured to describe, the flame would be vertical, inasmuch as the orifice from which it issues looks vertically; but if I place it horizontally the flame would issue horizontally, except in so far as it is affected by an ascending current of air passing it.

2199. Sir *D. Norreys.*] That forms a curve?—Yes; if it is a mere naked light, the burner placed horizontally will produce a curved flame.

2200. Mr. *Stephenson.*] The curve is inappreciable, I suppose?—No, I think not.

2201. *Chairman.*] Will you inform the Committee whether it is a flat or a circular flame?—It is a flat flame.

2202. What becomes of the products of combustion?—In these clustered burners, the sun-burners, there is an arrangement made for carrying the products of combustion out of the building.

2203. In the ceiling?—Yes.

2204. What is the arrangement?—A series of tubes; there is a cone in which this cluster of burners is placed, a sheet-iron cone.

2205. Are you now speaking of the chandelier?—There is no chandelier, properly speaking.

2206. Mr. *Locke.*] Where is that cone fixed?—On the plane of the ceiling, or a little below it.

2207. On the highest part of the ceiling?—Yes; supposing this room were to be lighted by a sun-burner, the centre panel would be taken out, and that would be the position of the burner.

2208. *Chairman.*] It being in the horizontal part of the coved ceiling?—Yes, supposing the ceiling were coved.

2209. You have stated that the ceiling is coved?—Where there is a coved ceiling this clustered burner is not used, excepting over the orchestra; that is the sole light for the orchestra, so that when they are practising, and there is no audience, the sun-burner over the orchestra is the only light used in the room.

2210. My question to you was this: what becomes of the products of combustion by this gas light which is round the

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whole of the cornice?—They escape through the cove; the cove is filled with latticed work, behind which there are passages, and the products of combustion simply escape through the latticed work of the cove.

2211. Is that the horizontal portion of the ceiling?—No, the inclined portion.

2212. Mr. *Locke.*] At the back of the cornice?—Above the cornice.

2213. Mr. *Stephenson.*] At the commencement of the cove?—At the commencement of the cove.

2214. *Chairman.*] Is that a room which carries exactly the same shape from one end to the other, or is there any abscis or different shape where the orchestra is placed?—The orchestra is retired beyond the line of the square of the room.

2215. Is the room higher or lower immediately above the orchestra, or the same height?—The same height.

2216. Is it the same shape?—The room is a peculiar one; there are recesses in all parts of the room.

2217. Mr. *Locke.*] Independently of those recesses, are there galleries or private boxes in the room?—There are.

2218. All round the room?—Yes.

2219. And corridors at the back of those boxes?—There are.

2220. *Chairman.*] They are recessed, I presume?—They are recessed.

2221. Mr. *Locke.*] Probably scarcely any of the persons in the orchestra would be higher than the persons in the galleries?—No, not so high, I think; I regret that I am not prepared with some drawings; I am an accidental witness, if I may so say, and was requested to answer a few questions; I am not at all prepared with drawings, or any other information than my own recollection; the pleasing effect is, I think, produced by breaking up the light; it is so completely broken up into small portions, that although the aggregate effect is very striking and very powerful, yet, when the eye is directed to any one portion of it, it is not at all offensive to the eye; indeed, the effect, I think, which would be produced on most minds would be this: whence does this light come; is it possible that these small jets are producing this body of light?

2222. *Chairman.*] Do you state, then, that there is very little glare in this light?—Very little glare.

2223. Mr. *Locke.*] The appearance of it is one continuous light along the whole cornice completely encircling the room?—Yes; allow me to qualify my answer as to its being continuous; it is rather in clusters of three.

2224. But

2224. But the spaces between the lights are not great?—There are three in a linear foot; there is first the horizontal pipe on the cornice, there are next the branch pipes at right angles to it vertically, and then three lights.

2225. *Chairman.*] What is the length of the branch pipe?—I should think six or eight inches.

2226. Is it pretty nearly vertical?—Vertical; all the cornice lights are vertical, or a little inclined forward.

2227. Then the branches are vertical to the pipe?—Yes; or a little inclined forward.

2228. Sir *D. Norreys.*] Is the flame a conical flame, or a flat flame?—A flat flame.

2229. All round the cornice?—Yes.

2230. Does it issue vertically?—In the cornice; the ceiling above the cornice is curved.

2231. *Chairman.*] The Committee are not quite clear whether there is a difference between the flame of that light over the orchestra, and the flame of the cornice lights?—It only varies in its position; the burner used is precisely the same in each case; the little jet from which the gas issues is precisely the same in each, excepting that in the cornice light it is vertical, or a little inclined forward to the room, and in the other it is perfectly horizontal.

2232. And it comes out of a tube, so to speak, pointed horizontally?—Just so.

2233. Mr. *Locke.*] What is the diameter of the large light which you have?—I do not know that I can give you that; I perhaps may answer your question in another way; I can give you the dimensions of one which contains a cluster of seven, instead of a cluster of 19; or perhaps this will be a sufficient answer to the question; from centre to centre of the cluster is six inches.

2234. So that the diameter of the entire chandelier, or glass, would be what?—Eighteen inches or two feet.

2235. About 18 inches or two feet diameter?—Yes; in the burner, such as is used for lighting places of worship, where there are 63 burners, or seven clusters of nine, the mouth of the cone which contains those burners is one foot nine.

2236. Sir *D. Norreys.*] In respect of the clustered light which is over the orchestra, in a circle of what diameter do you suppose that the lights are set?—I should think it does not exceed two feet six.

2237. Then would two feet six contain 150 burners?—I think they would.

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2238. In a single line?—In a single arrangement; the appearance when seen from below is that of a beautiful flower, each flame is like the petal of a flower, and the effect is extremely beautiful when lighted.

2239. *Chairman.*] Is there only one single ring of light over the orchestra, or are there more rings than one?—There are 19 clusters.

2240. Upon one ring?—They are not arranged in a ring.

2241. Mr. *Bankes.*] Do these jets or burners which you are speaking of resemble those now used in Westminster Hall?—Yes, it is the same character of burner.

2242. Only varied in the arrangement?—Just so; nothing more.

2243. Those in Westminster Hall are about the same size as the jets of which you speak?—Just the same; there are two or three varieties of that burner, varying as to size.

2244. Mr. *Locke.*] Is there anything new in the application of the horizontal light?—It has been used in Liverpool some four or five years; I do not know that it was ever used anywhere else, not in the same extent; not to the same amount of clustering, if I may so say.

2245. Then the rose light you consider to be a combination of the principle of horizontal burners?—There is a light called the rose light, in which there is a collection of vertical flames.

2246. I refer to the horizontal flame which you said had the appearance of a flower?—That is called the sun-burner.

2247. Is that sun-burner simply a combination of horizontal burners?—Just so; nothing more.

2248. Do you know where it was first applied?—I believe that the lecture room of the Collegiate Institution in Liverpool was the first place.

2249. In what year was it applied?—I believe about five years ago; I can get to know it certainly if the information is important, but from recollection I should say about five years ago.

2250. Sir *D. Norreys.*] These lights are all exposed, are they not, to the eye?—They are.

2251. Will you state what practically would be the inconvenience of having the light issuing from these clusters, tempered by ground glass being interposed?—I should object to the interposition of ground glass, simply from the loss which you would sustain in the light.

2252. Supposing that a large room had such an amount of light clustered together in the ceiling, that its intensity would be

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be inconvenient, if not softened by the interposition of ground glass, what would be the effect of the ground glass on the lighting, supposing there was a sufficient quantity of light to produce a certain amount of illumination?—It would soften the light; it would effectually secure you from any of the products of combustion by any possibility entering the apartment lighted; but the course I should take would be to use less light, and use it naked, rather than a large quantity of light, and then cut off a portion by the interposition of such a material.

2253. Have you seen the contrivance adopted in the House of Commons at present for lighting?—Yes; I was in the House of Commons on Tuesday night.

2254. Instead of having those horizontal rings of an opaque substance, what inconvenience would arise if the intensity of the light, which is required for reflection from the coves above the light, were softened by having ground glass placed beneath them?—It would be simply a question of the loss of so much light; a question of the quantity of light lost in passing through the ground glass.

2255. Would it not be a simple question of experiment removing one of these opaque collections of rings and substituting ground glass?—Yes, I presume so.

2256. Must not the fact of the light being intercepted from the House by these rings, and merely reflected by the space between the rings, have the effect of absorbing a much greater portion of light than the interposition of ground glass?—I am not sufficiently conversant with the arrangement of that pendent screen, if I may so call it, to give an opinion about it.

2257. That screen or collection of rings which now surrounds the lights in the House of Commons is subject to the inconvenience, when any sudden increase of heat takes place, of expansion, and there is a cracking disagreeable noise; ground glass placed beneath in some convenient form, or in some ornamental form, would not be subject to an inconvenience of that sort?—No.

2258. *Chairman.*] How are the lights which you have described lighted?—In the case of the horizontal light a small jet of gas is always burning, so that when the large supply is turned on, it instantly lights it; it flashes at once.

2259. Do you mean that all these burners are alight?—No, I am speaking of the light over the orchestra; that large sun-burner is lighted by means of a small jet of gas being always burning, so that at any moment, in an instant, the

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larger light may be lighted by simply turning on the supply. The lights around the cornice are lighted in sections; the supply pipe is not a continuous supply throughout the building, but there is one large main supply from which there are branch sectional pipes; one pipe, perhaps, supplying 20 burners. A portion of the cove is made to open, and then by a staff the 20 lights, which have been turned on, are lighted, and the person goes to the next and turns on another section, and so lights the whole.

2260. Then, in fact, the burners round the cornice are lighted by hand, are they not?—They are.

2261. How long does that operation take?—I do not know, I am sure. I have never seen the operation of lighting them, but it cannot exceed half an hour at the very most, if so long.

2262. Mr. *Locke*.] Is the cornice broad enough for a person to walk along it?—Yes, it is possible.

2263. Do they so light them?—No; a part of the latticed work of the cove of the ceiling falls forward, forming a trap door, and then they can be easily reached from behind the cove.

2264. *Chairman*.] In stating the manner in which light was put to the great sun-burner, you stated that one portion was always kept just alight, and that by turning on the supply the rest became lighted; how does the light communicate from one of those rings, which you have described, to the other?—Each jet of gas is sufficiently near to the next, that, if one is lighted, it makes a train throughout the burner; it does not follow that they need necessarily touch to do that.

2265. Mr. *Locke*.] With an ordinary pressure, at what distance from the aperture may you ignite gas by simply holding a light?—The gas must come in contact with the light.

2266. The gas may be at a certain distance from the aperture; at what distance may it be?—It would depend very much upon the force at which it issues.

2267. I am speaking of an ordinary issue?—I do not know that I could answer that question with any precision; I do not know that my notice was ever particularly attracted to it.

2268. *Chairman*.] What is the colour of the cove, or walls, or ceiling immediately contiguous to the light?—They are white at present; the room has not been decorated; it is merely painted white.

2269. Do you consider that any advantage is derived, in the lighting of a building, from the colour of the wall?—Certainly; if that coved portion of the ceiling were ornamented with

with any dark colour it would affect the quantity of light in the room considerably, from the want of reflection.

2270. So that it would absorb a good deal of light?—It would.

2271. Therefore, in order to economize light to the utmost possible degree, the surface upon which it immediately strikes must be of a reflecting colour?—Yes, white is the best.

2272. Do you imagine that a great deal of the good effect of that light is owing to the circumstance of that colour so reflecting?—No; I attribute the great effect to the light which proceeds directly from this cornice light into the building itself; the greatest portion of the effect is produced by direct light.

2273. Still you think that the colour of the room economizes the light?—Certainly.

2274. The less light you can do with, the less the air will be injured?—Certainly. The cost of lighting that room, for a performance, is about 2*l.* 12*s.* per night.

2275. For what length of time?—For about five hours; about 11*s.* to 12*s.* an hour.

2276. Is it the very best gas possible?—I cannot venture to say that; it is very good gas.

2277. Mr. *Locke.*] Is it the cannel coal gas?—It is all cannel coal gas.

2278. Then it is very good?—It is very good.

2279. Mr. *Stephenson.*] Are there any galleries in this room to which you allude?—There are.

2280. Does the light reach underneath the galleries effectively?—Yes, I think so, except in the first tier, which are private boxes. They have a small light behind, but I should say that the box is divided into two portions; the back portion of the box is cut off from the general light by a curtain, and in that back part of the box there is a small jet of light, but that is only for the purpose of the occupants of the box, and it does not afford any light to the room.

2281. From what you have seen in the case of the Philharmonic room, are you of opinion that such a light will remove all shadow from underneath such galleries as exist in the House of Commons?—No, not all shadow. I think the lights might be so arranged in the present House of Commons that there should be no offensive shadow.

2282. Mr. *Greene.*] Have you had any complaints made of the smell of the gas in the room?—Never.

2283. And are you satisfied that the whole product of combustion passes directly off, both from the lights round the cor-

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nice and from the light which lights the orchestra?—Yes. I say with great confidence, especially as to the horizontal light, that no products of combustion, from the very construction of the apparatus, can possibly enter the apartment.

2284. I understand you that there is a cone of metal over the burner?—A cone of metal over the clustered burner, over the sun-burner.

2285. How much larger is the diameter of the bottom of that cone than the diameter of the lights?—The exit pipe for carrying off the products of combustion is only about six inches in diameter, and even that is obstructed by means of a valve. I must explain further, that that arrangement is necessary in order to get the flames of the sun-burner to burn horizontally; for if the full amount of draught up that central pipe were allowed, the flame would be drawn together up the tube; but when that tube is used for purposes of ventilation (and a very powerful ventilator it becomes) it is surrounded by other tubes of a much larger size; the rarefaction produced within those larger tubes by the heat of the central pipe is so great, that a very powerful current rushes up those exterior tubes.

2286. You said that there was a valve in the ventilating pipe over the clustered lights?—Yes.

2287. What acts upon that valve?—It is simply a circular disc, supported on an axle, which can be either turned in a vertical position in the pipe, or in a horizontal one, so that the quantity of draught in that pipe can be regulated by the position in which that disc of metal is placed.

2288. When that valve is closed, how are the products of combustion from the great light carried off?—It never is closed; it is only that the current is moderated; but even if it were closed, the products of the combustion would escape over the edge of the cone, and immediately flow up the surrounding tubes; they are concentric tubes, the burner being in the centre; then around the central pipe, or cone, which contains the burner, is placed a larger cylinder; and around that a a still larger cylinder. These arrangements are necessary to secure the building from fire; they are introduced not simply for the purposes of ventilation, but also for protection.

2289. *Chairman.*] In what way?—To prevent the heat of the central portion from being communicated laterally to the ceiling in which it is placed.

2290. You spoke of a central tube; is that a conduit for the egress of rarefied air, or is it the tube which conveys gas to the

the sun-burner?—I am speaking of the tubes of egress, the tubes which carry off the products of combustion.

2291. Mr. *Locke*.] I understand you that that tube becomes so hot, that you, as a matter of precaution, surround it by another cylinder?—Yes.

2292. And you again surround that by a still larger cylinder?—Yes.

2293. And all that for the purpose of preventing any danger arising from the over-heating of the inner tube?—Yes; and it affords at the same time an immense amount of ventilation.

2294. *Chairman*.] That is increased or decreased by means of a valve?—Yes, it can be so regulated.

2295. How near is the sun-burner to these tubes?—The sun-burner is the termination of the tubes; it is at the end of the tubes.

2296. You have just drawn upon paper a tube with a bell mouth, surrounded by other tubes?—Yes.

2297. Those are for carrying away the rarefied air, and the products of combustion?—They are.

2298. Is the sun-burner actually in the mouth of the tube which you have drawn with that bell mouth?—It is.

2299. Mr. *Locke*.] Can you state the temperature to which the products of combustion often rise in passing off?—In some cases the cone, the internal portion of that arrangement, is a dull red.

2300. *Chairman*.] You stated in one of your answers previously, that you were not so accurately acquainted with the means there employed for ventilation as to give an account of it to the Committee?—I cannot.

2301. Can you tell the Committee where the air enters the room for the supply that is taken out by these pipes?—Yes, I can state that.

2302. Where?—All along the walls; at the sides of the room.

2303. Are they perforated?—Yes; perforated zinc is introduced into the sides of the room, at about five feet from the level of the floor.

2304. How near is that to the places where people sit?—Within three or four feet.

2305. Is it above or below?—Rather above the heads of the persons seated.

2306. And those perforated zinc plates are the places through which the air enters to replace the air that is taken out in the manner which you have described?—Yes.

2307. That

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2307. That is cool air, or warm air, as the case may require?—As the case may require.

2308. You cannot tell the Committee what the chambers are below, nor the principle which is adopted?—No; I rather think that the heating apparatus consists of pipes laid in the cavity of the wall, under these openings.

2309. Have you examined the method of lighting the House of Commons sufficiently to give any opinion upon it?—Only what I have seen from the gallery of the House.

2310. What is your opinion of it; is that a better way of lighting the House than the one which you have described, or in what way would you light the House of Commons supposing it were placed in your hands?—I have no difficulty at all in saying that the House of Commons might be lighted very differently from what it is; I think it is an unfortunate attempt at lighting, I confess, and I should light it on the principle of the cornice lights, which I have been describing, by carrying a light round the lower part of the inclined portion of the ceiling.

2311. Will you have the goodness to state to the Committee your objections to the system of lighting now pursued?—Simply its inefficiency.

2312. That it does not give sufficient light?—I think not.

2313. Is that your only objection?—And it appears to me unsightly.

2314. Mr. *Locke*.] Are you speaking of the recently-introduced lighting?—The lighting that I found there on Tuesday night.

2315. Sir *D. Norreys*.] Are you aware that the quantity of gas which was turned on that night was very small in comparison with the amount of gas which could be turned on if it were desirable to have a stronger light?—No, I am no judge of that; I am not at all aware what Dr. Reid's arrangements are for giving any amount of light; I only judge from what I saw.

2316. Then, in point of fact, if the amount of light which happened to be turned on on Tuesday night was only one-fourth or one-half of that which was capable of being turned on, the opinion which you have given as to the inefficiency of the mode of lighting would not hold good?—Certainly not; if it was four times the amount which I saw, it might be sufficient.

2317. Mr. *Locke*.] But your objection to the unsightliness would remain, I presume?—Yes.

2318. Do you think you could arrange a system of burners round

round the lower part of the sloped roof of the House of Commons so as to be sightly?—Yes, I think so.

2319. Sir *D. Norreys.*] Are you aware that that slope is of timber?—Yes.

2320. Mr. *Locke.*] Have you any idea of what the temperature of the air is passing through the perforated roof in the building at Liverpool?—No, I have never tried it.

2321. You never took the temperature in those perforations?—No; it is very much diluted from the large quantity of air passing from the building itself.

2322. But you do not know what it is?—No.

2323. Should you have any apprehension as to that particular lighting of the House of Commons from any danger which would arise to the roof?—Not at all.

2324. Sir *D. Norreys.*] The ceiling to which your system of lighting is applied at Liverpool is, I presume, plaster?—The open work of the cove is papier maché.

2325. How near does that open work approach to the lights?—I should think no part of it is within two feet of the lights.

2326. Mr. *Locke.*] Could you arrange the lighting of the present House of Commons with a distance as great as two feet, do you suppose?—I do not know; I cannot say that.

2327. Sir *D. Norreys.*] Generally speaking, would you not say that, for persons who have to sit for many hours together in the House of Commons, a light of sufficient intensity which could be placed as much as possible above the line of vision would be more desirable than one which would come within that line?—Certainly.

2328. And, therefore, that the nearer you can approach the centre of a high ceiling, the more you escape that line of vision?—Certainly.

2329. Mr. *Locke.*] Can you tell us the quantity of gas consumed per hour in the building at Liverpool; you gave us the price, namely, 11 *s.* to 12 *s.*, but not the quantity; how many cubic feet of gas are consumed per hour for the thorough lighting of that room?—I should think 2,000 cubic feet per hour, which will cost 9 *s.*, and 500 feet for the other apartments, which will cost 2 *s.* 3 *d.*

2330. Mr. *Stephenson.*] If you wanted to light the House of Commons in the same way, it would not be necessary to confine the lights to the cornice at the bottom of the slope?—No.

2331. You might adopt the same system of lighting in the cornice in the square part of the House?—Yes.

2332. *Chairman.*] Did I rightly understand you to state that you

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you would introduce these lights underneath the gallery of the House of Commons?—Not the galleries.

2333. You stated that the products of combustion from the cornice light escaped through what you called the lattice of the cove, I think?—Yes.

2334. Therefore, there are no such tubes as those which you have described for the sun-burner, applied to the cornice lights?—No.

2335. Did you state that these cornice lights were about two feet from any point of contact with the building?—Fully that.

2336. Is there no danger, do you think, from those lights being so near a portion of the building?—If a measurement were taken perpendicularly from the top of the lights to where that line would touch the cove, it would be considerably more than two feet, the nearest point being a horizontal line from the burner.

2337. Vertically, what is the distance?—I should think four feet at least.

2338. Have you ever passed your hand along a point immediately vertical to the light?—I have not; but the room has been in use three years; it has been frequently lighted, and there is no discolouration.

2339. Mr. *Locke*.] The lights round the cornice have the appearance of being very nearly equidistant?—Yes, very nearly.

2340. Can you tell whether they are in clusters of three or six when looking at the stream of light?—Yes; you would see they are in clusters of three at once.

2341. Mr. *Stephenson*.] Only when you square upon it?—Yes.

2342. Mr. *Locke*.] There is probably not more than an inch between the clusters of three, and between the jets of each burner of three?—The lights are very nearly equidistant; the effect of the cluster of three is in a great measure produced by the centre one being placed a little above the other two; or else, taking the distance from centre to centre of the lights, I believe they are as nearly equidistant as possible.

2343. Sir *D. Norreys*.] In answer to a previous question, you stated that your system of lighting could be introduced into the ceiling of the House of Commons?—Yes; I think the sun-burner system could be introduced.

2344. It would, in point of fact, be merely clustering lights in the ceiling?—Just so.

2345. Which is done at present, but not by an arrangement of which you approve?—I believe, from what I could see

see the other night, that those lights are vertical lights in the ceiling of the House of Commons at present.

2346. Mr. *Stephenson.*] They are horizontal rings?—Horizontal rings, but vertical lights.

2347. Mr. *Deedes.*] As you say that you would have no difficulty in applying this system of lighting to the present House of Commons, have you turned your attention at all to the cost at which you could do it?—Do you mean the cost of the apparatus necessary?

2348. Yes.—I should think 50 *l.* would do it.

2349. *Chairman.*] Should you propose to light the House of Commons by sun-burners, or by lights round the cornice?—There might be a combination of both.

2350. Have not the lights which you describe at the Philharmonic Concert-room at Liverpool a certain amount of visible movement?—There is a certain amount, but the movement is so trifling, that it never could be observed by any person except by one who was looking out for the movement.

2351. Mr. *Locke.*] It does not distract the eye of the spectator in any way?—Not at all.

2352. Have you often been in the room yourself?—No, not very frequently.

2353. Viscount *Palmerston.*] Have you ever been at Guildhall on any of the great days?—I have not.

2354. You have not seen the flickering effect of light produced in the same manner there?—No, I have not; but from drawings which I have seen, those are similar to the illumination devices, if I understand it; crowns and anchors, and all those sorts of things, placed vertically on the wall.

2355. The light arising from streams of gas issuing from small apertures?—Yes; those lights must be unsteady; as one light is placed below the other, the current of air passing upwards must necessarily make them so.

2356. Those are placed in horizontal lines?—I did not know that.

2357. Mr. *Locke.*] What would be the expense of one cluster of lights, sufficient for one panel of the House of Commons, of about two feet to two feet six square?—I presume you refer to a complete sun-burner, with its cone and cluster of lights?

2358. I do. Supposing you were called upon to furnish one of those burners, with its pipe to be attached to a panel of the House of Commons in the ceiling, and leading in the room above to an ordinary gas supply, what would be the cost of it?—I should think not above 10 *l.* or 12 *l.*

Henry Cruger Price, Esq., called in; and Examined.

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2359. *Chairman.*] YOU are a Civil Engineer, I believe?—I am.

2360. And have been for very many years engaged in warming and ventilating buildings?—Yes, upwards of 20 years.

2361. Had you a patent at one time for any invention of yours?—More than 20 years ago I took out a patent for a new kind of hot-water apparatus.

2362. Has your system been applied to an immense number of buildings, both public and domestic?—A considerable number; but more important than numerous, perhaps.

2363. Has your system been applied at Windsor Castle?—It has.

2364. And at the Colney Hatch Lunatic Asylum?—Yes; throughout the whole of both of those buildings.

2365. Have you seen any reason to doubt the efficacy of your system, or have you gone on continually following the same method?—I have never changed my system; experience has taught me better modes of application, and inasmuch as there are scarcely two buildings that resemble each other in all respects, I generally learn from one some new point, which I can apply in the next.

2366. You have applied your system to many private houses, have you not?—Yes, very extensively.

2367. Are there any other large buildings besides those I have named, where you have introduced your system?—Yes, a very considerable number. I have applied it to many lunatic asylums, which are very large, independently of Colney Hatch, which is for 1,200 persons. I have also warmed several county prisons, and county lunatic asylums, and other public buildings. I may perhaps, with your permission, advert to an asylum which I have recently completed for the county of Wilts; I refer to that simply because at Windsor Castle I have depended almost entirely, and at all seasons, upon what is called natural or spontaneous ventilation and warming. At Colney Hatch, in the winter, we rely entirely, and obtain all the results that are required there, by natural ventilation also; but in the summer we have the artificial motive power of a furnace for occasional use; constant use of it, even in summer, is found unnecessary. But in the Wilts asylum the warming power is hot water, and the ventilating power is hot water also. I mention that particularly, because, in my own judgment and experience, that is the right combination.

2368. You

2368. You consider that the hot-water coil, as an extracting power, is preferable to the furnace?—Decidedly; there are none of the fluctuations in the one that there are in the other, and I think fluctuations in warming and ventilating are very objectionable.

2369. Are you aware that, in any place which has been warmed and ventilated according to your system, your apparatus has been removed, and another substituted for it?—It may be so; that is often done out of caprice, and sometimes it is done from presumed inefficiency; but if the question points to any particular instance, of course I should be glad to answer it according to the knowledge which I may have upon that particular case.

2370. Do you consider that there is anything in the actual requirements of the House of Commons, in respect to warming and ventilation, which presents any insuperable difficulties in the way of attaining those objects?—I do not; there are peculiarities, but they do not present, to my mind, insuperable difficulties.

2371. Will you describe the method which you would recommend of warming and ventilating?—One feature of my method of warming is to accumulate a large amount of warming power in a comparatively moderate space; I centralize it. I do not mean that if I have a very large building to warm I place the whole warming power at a central point; I do not; that is highly injudicious, and involves a great deal of expense and difficulty. Another essential feature of my system of warming and ventilating is to pay a scrupulous regard to the relative and proper proportion of the areas of the air-passages. For instance, the main ducts should be calculated with areas equal to the precise demand that will be made upon them; then all the tributary, all the branch flues, must have a relative proportion of area to the main; so that in fact the whole thing is systematized. If a heating chamber for a large building like Colney Hatch were to be centralized, you would scarcely be able to move the air through it. When I mention that at Colney Hatch we have 25,000 superficial feet of warming surface, and that that building is 1,800 feet long, if the power were placed centrally you would have to move the air horizontally 900 feet right and left; and as you would want to reach the remote parts to produce the same effect, as in the near ones, the channels for air must be of a uniform area throughout, which would involve enormous expenses.

2372. Then your plan is to warm and ventilate with a number of heating apparatuses, in preference to one central apparatus?—

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apparatus?—Decidedly. That is, however, a local question, to a great extent. At Windsor Castle I have one apparatus to which is attached nearly 4,000 superficial feet of warming surface; that is a very large amount of surface; it is equal to 4,000 feet in length of four-inch cast iron pipe, which attached to one boiler gives no ordinary combination of boiler and heating surface.

2373. Your method is by hot water?—By low pressure hot water; fixing the maximum temperature in most cases (I am speaking of the surface) at 170°, that is 42° below boiling point, because my experience teaches me (differently from what I have heard before this Committee) that you cannot bring atmospheric air in contact with the surface at 212° without impairing its healthy qualities.

2374. Do you adopt the ascending or descending movement of air currents?—The ascending, the natural movement always.

2375. What do you call the natural movement?—I mean the spontaneous movement of air produced by differences of temperature, the opposite of a compulsory movement. The difference of specific gravity between the external air and the internal is the moving power, so that if the air externally be 30° and the room be 65°, then the moving power is as the difference.

2376. What are your objections to the descending movement?—First of all, it necessitates artificial power; it will not act except under compulsion; then it brings the vitiated and breathed air, that ought to be carried away, and not breathed over again, down to the lungs, to be re-inspired. It also tends to subvert another natural law by keeping the head in the hottest medium and the feet in the coldest, and the ventilation is arrested altogether if the motive power is not kept in constant operation; whereas, in the greater portion of the year, nature will accomplish it, if allowed to do so.

2377. Are not the Model Prison at Pentonville, and other large buildings with which you are acquainted, ventilated on the descending principle?—The Model Prison originally was so, and a very bad example I think it set to the country, and other prisons also; but now the ascending principle is being introduced generally into prisons.

2378. Do you know that of your own knowledge?—Yes. I have been formerly obliged, against my own recommendation, to adopt the descending movement, but I have recently had instructions to ventilate some additional buildings in which the same authority has instructed the use of the ascending movement. In the Model Prison at Pentonville they have not

stopped

stopped the descending principle, but at times it would not act in summer, even with the ventilating power. *H. C. Price, Esq.* 22 April 1852.

2379. In your practice, do you rely principally upon the force of natural ventilation, or do you obtain your motive power from artificial or mechanical agents?—I rely chiefly upon the natural force of the differences of specific gravity which I have mentioned, and I only add artificial force at that point where nature fails to be sufficient; and whenever the warming power is in operation, which it is during the winter season, then I do not require artificial power to be added; it is only when there is a tendency to approximate in temperature, and when the specific gravity of the external air and the internal nearly approach each other, that it becomes necessary to assist nature by the application of artificial motive power.

2380. Do not all systems of warming tend more or less to alter the natural hygrometric and electric states of the air?—Yes, there can be no doubt about that; for every additional 27° of Farenheit that the air is raised in temperature, its capacity for moisture is doubled.

2381. Then you are of opinion that the low-pressure hot water disturbs the balance of the air much less than the higher one which you have described?—Yes; because with the low pressure, limiting the maximum of temperature to 170°, you can limit the temperature of the in-flowing air, which is of the greatest importance; and I have found that you can fix that limit at 80°. That is a most material point in the question of warming and ventilation.

2382. Have you been in the House of Commons to observe what is the state of the air there?—I have.

2383. Are you of opinion that the nature of the air there is not agreeable to breathe?—I am quite sure of it, as far as my own feelings go; I could not endure it when I was there.

2384. What do you suppose are the changes which have taken place in that air?—I think, first of all, that it has got mixed up with many impurities. I think it is over-heated, and there is nothing like that scrupulous attention paid which there should be, to preserving the purity and the cleanliness of the air-passages. I may be very fastidious on this point, but I see success in no other way. The air-passages are so huge that they should be called thoroughfares, instead of channels for the passage of air that is to be delivered at a given point with all the purity possible; I undertake to say that the air, before it reaches the House of Commons, is rendered unfit for respiration by the contamination it meets with as it travels from the towers into the House.

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2385. How do you propose to obviate that evil?—I should keep the air in totally different kind of channels; the subterranean vaults themselves are sufficient to spoil the air, in my opinion. I do not know in what state they are now, but when I went through them they were exceedingly damp and mouldy, and calculated to taint the air in various ways. Then I understand that there is a practice of washing the air in those vaults; I consider that a vicious habit, because, in the first place, the air is not at a proper temperature for mixing; it must mix with great difficulty with water; and in the next place, the water itself is not pure, it therefore taints the air. Water and air cannot be properly mixed in this way, in my opinion.

2386. Supposing you had to warm and ventilate the House of Commons, how would you obviate that inconvenience?—I would obviate it by mixing the air with vapour in the warm air chamber before it entered the House; the vapour and the air should always be nearly of the same temperature, and then they would mix intimately. Then they would readily and perfectly combine, and in that state would go on to the House.

2387. Where would you propose to get your air from, then, in order to preserve its purity?—The present sources of air, to my feelings and observation, are satisfactory. I was surprised, when I went into the towers, which are the sources of supply, to find the air so pure and so fresh, but every 50 feet I advanced in the tunnel I found it more and more tainted.

2388. Then I understand that your objection is, that although the air is pure when it enters these towers, it becomes impure in its passage through the vaults and other channels previously to its arrival at the House?—Precisely; I have no doubt whatever of it.

2389. Can frequent regulations of temperature, and continual changes in the amount of ventilation, be effected in a place occupied as the House of Commons is, without creating sudden and unwholesome sensations of heat and cold, and unpleasant draughts?—No; but I think that could be very completely guarded against.

2390. Am I to understand you to say that you think that the air which we breathe in the House of Commons now is also injured by the temperature of the hot water?—Yes, it is first of all raised too high in temperature, and then brought down again; it is raised to an undue temperature, and then mixed, or attempted to be mixed, with cold air, in order to reduce it to the temperature proper to be used.

2391. How would you meet the annoyance of dust which is now complained of?—I think by the exercise of that care which

which I have described as to not allowing the air to flow through any improper channels. When I went down to Windsor Castle, Mr. Daukes, who accompanied me, was extremely anxious to examine the air-passages, and did so. The clerk of the works stated, what Mr. Daukes will confirm, that those channels were perfectly free; there was no dust in them, and Mr. Turnbull said that they had never been cleaned from the time they were laid down, three years previously.

2392. How do you account for the absence of dust in those channels?—I do not mean to compare the air supplied in Windsor with the air supplied in London, because the former is a comparatively pure air; it is not mixed up with blacks, and soot, and dust, as it is here. I only mention that such is the fact, that at Windsor Castle, where the channel had been in operation for three years, it was as free from dust as when it was first put down.

2393. Are you aware that some complaints have been made of dust being brought into the house at Windsor Castle?—I heard Sir George Bowles say, in this Committee, that he thought the dust was greater than it was before. Of course I cannot dispute the General's opinion, who has lived there so long; but I believe that is a carpet question, not a warming one.

2394. Sir *D. Norreys.*] Is not it a fact, whenever a building is heated on the principle which you have described, that dust must come to a very great extent by the strong in-draft which is formed?—Of course, if the air which ventilates (and you cannot ventilate without a large supply of air) is charged externally with dust, you cannot avoid it; but what I say is, that if here there is a certain amount of dust prevailing in the air, it licks up, to use a vulgar phrase, two or three times as much more in the passages that convey it to the House of Commons, where it ought not to take up any additional quantity.

2395. Could not that be completely obviated by having either glazed tubes, or some other contrivance, to convey the air from the Clock Tower to the distributing apparatus so impervious to moisture and of so hard a substance that no dust could get in?—That is one of the things which I am so scrupulous upon, namely, smoothness of surface; the channels I use are all smooth; one of the most essential points with me is to have a perfectly smooth interior surface, to reduce friction and prevent adherence of dust.

2396. *Chairman.*] Are you able to say at what temperature the air was, immediately after passing the hot-water apparatus,

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when you made your observation in the House of Commons?—No, I had no thermometer, and no accurate means of judging; I judged very much by the sensation; and by the arrangement I saw what the inevitable consequence must be.

2397. Have you made any observation since the recess?—I have not.

2398. Did the observations which you made in the House of Commons apply to the House of Lords equally?—Yes, I thought so; if that is a general question, I can say that I see little substantial difference between the two systems beyond this, that the one uses steam as the warming power, and the other uses hot water; one uses a furnace draught for the ventilation, and the other a steam jet.

2399. With regard to the air-passages, do you consider them both to be objectionable?—Yes, they are both tainted the same.

2400. You consider, then, that whenever the external temperature is cold, and much warming is required, there will always be a vitiated state of the air in both Houses?—I should say at any time, if you draw your supply of air from these channels, you cannot avoid it, whether it be summer or winter.

2401. But whenever that air is required to be raised, the higher the temperature to which that air is required to be heated, the greater will be the vitiation; am I to understand that to be your opinion?—Quite so.

2402. Would you admit the fresh air, warm and cold, to the House of Commons through many or few apertures, and at what velocity, and when warmed, at what temperature?—I would admit the fresh air, warm and cold, from as few apertures as may be practicable; but they must necessarily be numerous in the House of Commons. The standing difficulty in warming and ventilating there, and the only respect wherein the House of Commons appears to me to be essentially and peculiarly different from other important buildings, is this, that there is such a vast disproportion between the area of the House of Commons and the number of persons that at times occupy it. I have made a calculation, which perhaps honourable Members would like to hear. I have taken the total cube, which I understand is 123,000 feet, which, with 800 persons (and I understand that at times there are as many, but if not, it would be in the same proportion), would only give 150 cubic feet of air to each person. Now the prison allowance is 800 feet, and you are not allowed in prisons to have a less cubical space than 800 cubic feet to each person; in the House of Commons you have only 150.

2403. Supposing

2403. Supposing the number were 600, and not 800, what would be the allowance then?—It would be just in that proportion; the amount which I have given would then be one-fourth less, say 200 cubic feet. But then it involves another serious evil, which is, that to sustain ventilation, which is a fixed demand, you must empty the House of Commons, to have a pure atmosphere, every 30 minutes. Now, in emptying the House every 30 minutes a serious difficulty is created with reference to the admission and extraction of air, so as not to cause any inconvenience.

2404. Then, in fact, you do see considerable difficulty in ventilating any building under such circumstances?—Yes. I am putting these difficulties, but they are not insuperable; they exist; but I think there would be a very practicable way of meeting them. I wish not to conceal the difficulty. I think that is a great difficulty.

2405. How do you propose to overcome the difficulty of clearing the House of Commons so rapidly of its air, and supplying fresh air, without creating annoyance and draught?—It would be by a judicious and proper distribution of the apertures for the admission and for the extraction of the air.

2406. Sir *D. Norreys.*] Diffusing them as generally as possible over the area?—Yes.

2407. *Chairman.*] Then I presume you must have your admissions of air, and your conduits for carrying the air away, made larger or smaller at will and command, according to the number of Members who are in the House?—The first guide that the ventilator would ask for would be the manner in which the floor of the House is occupied, because upon that depends this very diffusion and this distribution. There may be certain spaces, and I have no doubt it would be found, if they were sought for in the House of Commons, that there are spaces where you could admit a very large supply without inconvenience to anybody; but there are certain other places where you could not admit it at all.

2408. Will you state where in the House of Commons you might do so?—It appears to me that a considerable amount could be sent in from the central line of the floor of the House of Commons; then I think a large amount also might be sent in under the seats, and at the skirtings. With respect to the galleries, I should take the air underneath them; they could not be thoroughly ventilated by the air which rose from the floor.

2409. Is that in consequence of the projection of the gallery?—Yes; and from the difference of level, because if the

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air is breathed at this level a person sitting above it will be placed in a vitiated atmosphere, which should not be; therefore I think they should be treated as two distinct levels, and provided for accordingly.

2410. Is there anything peculiar in your system of ventilation which would enable you to overcome that difficulty, or must it be overcome by additional mechanical means which you would employ?—It does not require any additional mechanical means. My view of warming and ventilating the Houses of Parliament is not materially different from what I should do in a private house; I would take the same principles, but I should vary the application of those principles according to the extent or magnitude of the building, and likewise according to the usage of the particular building, because in most situations you are not tied by the difficulty of the almost total occupation of the floor; the nearest approach that I see to it is in churches. Many churches to which I have applied my system will present, for the time they are occupied, as much difficulty as the House of Commons; they are not subject to the same fluctuations of occupation; generally speaking, they are either empty or full; yet, at the same time, I should require a similar arrangement for a church with its 1,000 persons as I should for the House of Commons, because no one likes to have currents of cold or warm air playing upon the person.

2411. Will you state how you would successfully overcome that difficulty?—By first of all so distributing the branch flues, which are connected with the main supply, as to bring the air on certain points of the floor of the House.

2412. Is it merely by the use of distributory apparatus?—It is principally so.

2413. The system remains the same?—Yes; to be regulated by the particular occupation of the particular place which you have to deal with.

2414. Sir *D. Norreys.*] Have you made any experiments on the size of the perforations through which a current of air may pass without being inconveniently perceptible to the person?—The velocity is the main thing. I do not care how large the volume of air is, provided the velocity be of the right force.

2415. Supposing that the velocity were so regulated as to be the lowest velocity which could be attained, consistently with drawing in a constant imperceptible supply of fresh air, have you made experiments as to the size of the perforations for

for the entrance of fresh air, which should so reduce the current as to be diffused in a manner which would not be inconvenient to the persons of those exposed?—Yes.

2416. Supposing that a diaphragm could be interposed between the mixing chamber and the House of Commons, which should be equably perforated throughout, and supposing that the exhausting portion of the ceiling were so regulated as to act generally on this diaphragm, could such a supply of fresh air into the House be obtained as should be imperceptible in respect of currents, and yet be continuous and equal throughout?—I think the first difficulty which would meet you under those circumstances would be in getting any movement at all; the air would be so wiredrawn, and so resisted by the friction of these small apertures, that without artificial power, which would be altogether ineligible in other respects, the needful movement would not be got.

2417. What is the smallness of the aperture which would produce the effect that you are speaking of now; would apertures of one-eighth of an inch in the diaphragm supposed do so?—I should not use them so small.

2418. Is there not a point in the perforation of a diaphragm, such as I have supposed, where the out-draught might be so regulated as to create an equal pressure upon the diaphragm throughout, so as to give fresh air without a visible current in any one portion of the House beyond another?—I have found in practice, that when I have aimed at that sort of thing there has been a breaking of the current, but the quantity of air when throttled in that way is so reduced, that three or four times the provision of area must be made in some other way. I am informed, that in the House of Commons, in the panels which form the ceiling of the House, there is an amount of open area equal to 360 square feet; that round each panel there is a slot of an inch; upon the assumption that there are 360 square feet, and that the velocity is three feet per second, I make this calculation: with 360 square feet, the velocity being three feet per second, which is of course equal to 180 feet per minute, it is equivalent to a passage of 65,000 cubic feet of air per minute. Now that would empty the House in two minutes; inferentially, upon such a fact as that, there is an excessive amount of opening there; and if there be an excessive amount of opening, I defy anybody to control those currents, or to say which way they go, because unless your areas of all kinds are defined and proportioned to the amount of air that you desire in the passage, if they are too small, of course you fail in the object; if they

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are in excess, you then expose yourself to those kind of disturbances and those extraneous circumstances which defeat your object in that way. It is a matter of precise and accurate calculation; you may aim at doing these things, but if there is a natural law against you, they will not be done. I observed with respect to the floor, that the provision was altogether the other way.

2419. Ought not the area of your outlet to bear an immediate relation to the area of your ingress both as to position and as to actual area?—Most distinctly; there can be no doubt about that.

2420. In proportion as you deviate from that you create currents which must act injuriously?—Most unquestionably that is so.

2421. *Chairman.*] Should the vitiated air be drawn off at the ceiling by many or few openings, do you think?—I should prefer few in the House of Commons.

2422. At what temperature would you aim to keep the House of Commons?—Of course that would be subject to experience there, of which I have none; but from my experience in other cases, and from all I have heard and seen, I hould aim at keeping it at the temperature of 65°.

2423. What rate of ventilation per cubic foot for each individual present in the House would preserve a pure and healthful atmosphere?—I consider that five cubic feet per minute to each person would sustain a thoroughly pure atmosphere.

2424. Did you mention that you observed the air passing through the House at a certain rate, at a certain time?—No, I had no means of ascertaining that; I only assume what I consider to be a proper velocity; three feet per second, because that would be imperceptible.

2425. In short, you had no means of measuring it?—No; I could scarcely discover that there was any constant ingress; that was the thing which puzzled me.

2426. Is it important, that in the scheme of ventilating and warming the House all the adjoining corridors and other apartments should be incorporated?—I think most important.

2427. Do you attach much importance to the cooling effect of windows?—They must form an element in the calculation, because there is a fixed law of cooling, applicable to windows.

2428. Viscount *Palmerston.*] What is that law?—The law is, that it cools down the air of a room, from whatever temperature it may be, to the temperature of the external air, at the rate of a cubic foot and a half per minute; supposing the external

external air to be at 30°, and this room to be at 65°, for every superficial foot of glass you will have a cubic foot and a half of the air here cooled down 35°. *H. C. Price, Esq.* 22 April 1852.

2429. In what time?—In a minute; so that in this room, taking the multiplication of its cubic contents, you would ascertain directly, if there were no warming power, how soon the whole mass of air would be of the temperature of the external air. It is that law which necessitates the application of such a large amount of heating power in glass houses, hothouses, and greenhouses; they have comparatively small cubic contents, but the cooling power of the glass being of this fixed kind, unless the warming power be proportioned to it, the plants will be frosted or killed. It is the same law that you have to consider with ventilation.

2430. What you have said applies to glass placed perpendicularly, does it not?—No; under any form.

2431. It would operate more quickly in cooling the air if placed slantingly, I presume?—No, it would not; for instance, if this window, instead of being vertical, were sloping, the air condensed by the glass would still fall vertically. Supposing it were extended 20 feet into the room, then the condensing effect would be operative in the form of cold draughts 20 feet into the room; but if, on the other hand, the window were placed vertically, then this cold current of air would be felt only by persons close to the window, and standing immediately near it; the law is the same.

2432. *Chairman.*] You are assuming, of course, that the window shuts tightly?—Certainly; but still persons complain of draughts; the draught they complain of is the condensation; and I have found in the large windows at Windsor Castle that the only way of meeting it, and it has effectually met it, has been to have the discharges of warm air in the bays of the windows; then the ascending current of the air keeps the inside of the glass at a higher temperature, and prevents the inconvenience.

2433. Has the mode of lighting the House any practical influence upon the plan of warming and ventilation?—Yes; I think it is a very important ingredient, because if the mode of lighting be one that generates a large amount of heat, it may produce a greater power of rarefaction than you require for ventilation; there would then be great difficulty; you would be obliged to draw an excess of air in to answer that rarefaction; that would be one difficulty. But there is another which has been suggested to my mind, from some discussions that I have heard during my attendance here, and which, I think,

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think, has been rather overlooked. I think that the radiation of heat downwards from the ceiling is a most important consideration, looking at the House of Commons. There was a discussion as to the advantage of carrying the lights nearer the ceiling; it struck me that it would be a very bad thing for your object if you did so.

2434. Why?—Because of the downward radiation from the ceiling. I conceive, that if such a principle as has been the subject of discussion to-day were carried out, the heat of the ceiling, from those coves, for instance, would be so raised in temperature by the continual radiation of the gas lights upon them that they would become powerful downward radiators of heat, and persons in the gallery would very sensibly feel the effect upon their heads.

2435. Then you consider that the mode of lighting the House has a very material effect upon its ventilation?—It may have; that is a matter to be ascertained. When I saw it I thought it was as well arranged as it possibly could be in reference to ventilation. The chandeliers I thought were satisfactory; with the upward movement of the air, which is the correct one, there would be no interference by the mode of lighting.

2436. Can you account for the bad smells complained of in the House?—Yes, it is very easy to account for them, because, as I have before said, the air is allowed to come in contact with all sorts of things and all sorts of persons, the channels being thoroughfares, and the nature of the surfaces of those large passages being objectionable; and I saw, in what is called the Mixing Chamber, under the House of Commons, no less than six persons dusting.

2437. Sir *D. Norreys.*] During the sitting of the House?—No.

2438. Viscount *Palmerston.*] Dusting what?—Dusting all the surfaces of this chamber.

2439. Removing the dust?—Removing it, but of course much of it settled again.

2440. Mr. *Locke.*] Did I rightly understand you to say, that you would not use the present vaults for the purposes of conveying the air?—Not in their present state.

2441. Did I also understand you correctly to say, that you should not use the fan?—Certainly; I consider it quite superfluous.

2442. You would not use the warming apparatus now employed?—No, I should not.

2443. And you would not probably give access to the air into

into the House of Commons by means of the present apertures?—Not if you refer to the floor and the carpet; I certainly should not.

2444. I also understand you to say that you would not employ the present means of drawing the air through the House for the purposes of producing a current, namely, the furnace?—No, because it compels the air to descend.

2445. Then, in point of fact, there is no part of the present ventilation of the House of Commons which you would adopt?—Not if I were to be answerable for its being satisfactory.

2446. You think it altogether unsatisfactory and bad?—I am sorry to say that that is my honest opinion.

2447. Do you think that the draught arising from warm water would give you a sufficient power for ventilating the House of Commons, and all the accesses connected with it?—No doubt of it whatever.

2448. During all seasons?—All seasons.

2449. Then I apprehend, that if the system recommended by you were to be adopted for the ventilation of the House of Commons, a considerable alteration would be necessary to be made in the present mode?—The alteration would be material, because the principle would be so decidedly different, but not, I think, difficult to carry out; it would be totally different in principle; it would not be the same thing either in principle or the application of the principle.

2450. *Chairman.*] Have you not at Colney Hatch ventilated very nearly as large a space as is contained in the Houses of Parliament?—It is a space of two and a half millions cubic feet.

2451. And to your belief that is perfectly successful?—Yes, I believe so. I presume, if it had not been, complaints would have been made; everybody is entitled to that; but I have every reason to believe that it is quite satisfactory.

2452. (To Mr. *Daukes.*) You are in the habit of seeing the visiting justices constantly, are you not?—I am.

2453. Have any complaints been made to you of the failure of the system introduced at that asylum?—Not at all; there has not been one instance, but just the reverse. The Commissioners of Lunacy went over it the other day and expressed themselves very much satisfied indeed at the ventilation.

2454. There are peculiar wards there for the reception of idiotic patients, which it is exceedingly difficult to ventilate, are there not?—There are. At the first introduction of those patients into those wards they merely adopted the simple system of a natural upward flow of air, without the artificial

means

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means of rarefying the air in the extracting shaft; upon applying the rarefier the rooms were then considered sufficiently ventilated.

2455. But not before?—Not before; since that time, since the application of the rarefier, there has been no complaint at all.

2456. Is your rarefier such as Mr. Price would recommend, namely, a coil of hot-water pipe, or is it a steam jet, or is it a furnace?—That is a furnace. (Mr. *Price.*) Not what I should recommend for the House of Commons. (Mr. *Daukes.*) The coil was suggested at Colney Hatch, but it was considered more expensive than they were justified in adopting.

2457. Mr. *Greene.*] (To Mr. *Price.*) You would apply the same system to ventilating the House of Commons that you would apply for ventilating the asylum to which you have adverted, or the places of worship which you have mentioned? —Places of worship I have never, in my own experience, been called upon to ventilate artificially; they are occupied for so short a time, and when they are warmed upon the ascending movement, the renewal of the air is considered sufficient; I should, however, employ that system if I were desired to employ any compulsory power; but with respect to the asylum which I have mentioned, that is warmed and ventilated in the way referred to.

2458. You adverted to certain peculiarities and difficulties in ventilating the House of Commons, differing from other buildings; will you have the goodness to state what are those peculiarities and difficulties?—I mentioned that a marked peculiarity was the small cubic space provided for each person; and that it is always a difficulty of a certain amount so to arrange the inlet apertures, that they shall not produce any personal inconvenience; that is in every case a matter of special consideration; it would be of the first importance in the House of Commons, because there are so few free spaces in the House; but I also expressed my opinion that a good and satisfactory arrangement could nevertheless be made.

2459. But the places to which you have particularly adverted, as having hitherto ventilated, are, generally speaking, places where there is not a perpetually varying number of persons within them?—That is the fact, but I do not see the difficulty in that which is ascribed to it. I have heard a great deal said upon that point; whether I am right or wrong, it has not the force with me that it appears to have with other persons. I think there is a simple way of meeting it.

2460. Are you aware that in the House of Commons there have

have frequently been 500 or 600 people at one time?—Yes.

2461. And that that number may be reduced to under 100 in the course of a very short space of time?—Yes.

2462. And that then again it increases?—Yes, I quite understand that.

2463. Are you prepared to meet all those variations of temperature which must be produced by the difference of numbers within the building?—I have no doubt I could do so.

2464. In what manner would you do it?—First, with respect both to the inlet of air and the outlet, I should propose making no alterations in the ingress or egress valves, during any one sitting of the House. Perhaps such a statement as that may be questioned, because it is so opposed to everything which has heretofore been done; but I speak advisedly nevertheless. I assume that it is very well known beforehand when an important debate is coming on; whether there will be 300, 400, 500, or 600 persons present. I should then fix the ventilation for the maximum number, and should not alter it all night.

2465. *Chairman.*] Are you aware that there is a certain hour of the night when, for some reason, the number generally thins very much?—Yes.

2466. That is an hour when the leading speakers in the House of Commons, and who may be present on those occasions, are not in the habit of addressing the House. How would you propose to keep up the temperature at those times?—I would begin and end with the same rate of ventilation.

2467. Mr. *Greene.*] My question applied to temperature as well as to ventilation?—As regards temperature, my mode of proceeding would be simply to control the warming power (through the perfect command which I have over the circulation of water in my apparatus) according to circumstances.

2468. *Chairman.*] Will you describe to the Committee, as accurately and plainly as you can, what your system of warming is?—Has the question reference to the construction of the apparatus?

2469. It has.—I will describe it, if you prefer it, or produce a drawing I have here, which, with far shorter observations, will make me better understood. (*The Witness produced a drawing*). Assuming this to represent the House of Commons, and this the apparatus for warming it, below, that is the furnace or fireplace, this is the boiler; this is a rising pipe which opens into this square vessel, technically called the expansion box, to admit the increased bulk which the water takes

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takes by being raised in temperature, and it also leaves a certain space for the escape of the air which is held by the water when cold, and set free when warm. The heated water that rises from the boiler flows along this feed pipe, which has the same number of flanges and apertures as there are flat vessels; there is a corresponding feed, or rather return pipe here, which in like manner is attached to the lower ends of the flat vessels, and brings back the cooled water to the boiler to be re-heated and re-circulated through the flat vessels or air warming surface. This supply cistern maintains the water line (which is of course above this feed pipe), and keeps the whole apparatus charged with water, cold water in the first instance, and of one temperature. The equilibrium is disturbed and motion imparted simply by the action of the fire; then the hottest part rises here, and the coolest returns to the boiler; it is like the circulation of the blood in the human system, it keeps flowing out and returning back in the same manner. The effect of this form and disposition of the warming surface is, that every one of these flat vessels answers the purpose of spreading out the hot water which is rapidly circulating through them into numerous and thin streams; the thickness of the sheets of water is an inch and a half, and the air spaces between these flat vessels are an inch and a half also; so that there is an alternation of thin and numerous streams of water with equally thin and equally numerous streams of air. The air from the outward atmosphere, falling by its own gravity down this flue, is then drawn, by the rarefaction produced by the warming vessels, into this chamber. Then the single current of cold air thus brought down is divided into 40, 50, or 1,000 streams, if there are so many flat vessels, and there is a thin stream of air, of an inch and a half thick and three feet square, touching at each side each pair of flat vessels; so that in fact each stream of air and each stream of water thus brought into close contact are each of only three quarters of an inch in thickness. As these surfaces are all arranged vertically, in order to favour and develop the natural upward tendency of the air, the air passes up between them with a freedom and a velocity that causes the cold air to abstract the caloric of the water very rapidly, and thus attempered fills this air-chamber. This perforated plate was introduced for diffusing the air; but from the principle which I mentioned just now, I found that this anticipated good effect was more than counteracted by the resistance which it gave to the current, and therefore I gave it up. This drawing, I should remark, is many years old. Then it is obvious that the air to be warmed comes in contact with

with hotter and hotter water, and the water as it cools flows back with a proportionate and accelerated velocity to the boiler, the source of heat. The air, on the other hand, rises continuously upward, and never returns. With reference to the question put to me, how I should propose to regulate the temperature in the application of this warming power, we will assume, for the sake of illustration, the temperature of the room has been raised to 65°, but that the sudden influx of a much larger number of persons has caused the temperature in the course of half an hour to rise 5° or 10°, say to 75°; that is found an inconvenient temperature, and a demand comes to reduce it 10°; these stop-cocks are then shut off, which stops the circulation directly, but without stopping the flow of fresh air; the air continuing to flow upon these surfaces, and the water having no power of return to the boiler to have its temperature restored, is reduced 10° or 20° in the course of 15 or 20 minutes.

2470. Sir *D. Norreys.*] You can cool, in fact, these plates?—Yes; in 15 or 20 minutes the air that was coming in at 80° is reduced to 65°, the temperature of the room. Suppose that the House has got down to 60°, then re-open these stop-cocks, and the former temperature of 65° is quickly restored without altering the ingress air-valves.

2471. The whole air which you wish to give to the room comes between those plates?—Yes, and can come only through those spaces.

2472. And is heated by those plates?—Yes.

2473. There is no mixing of air?—No; the communication is unbroken between the vertical shaft and the air-passages; it has no contact with anything; nothing tainted or impure can touch it till it is discharged into the House. With respect to the operation of the apparatus upon the hygrometric state of the air: as I have before remarked, that is not attempted till the air has attained its temperature in this chamber, or before it begins to flow towards the House; I do not mean to say that the operation of moistening the air would be literally as I will describe, but still this shows the nature of it: this pipe supplies open trays, that are ranged round the inside of the warm-air chamber, but there are covers for closing them when you do not want to vaporize. Suppose the interior of this chamber to be four brick walls; round these are a certain number of covered trays, when you do not want to vaporize the air those covers are down, but when you want to vaporize it you throw those covers open; then you expose the surface water, which we will say is at 170°, to vaporize and mix with the air that is at the temperature of 80°; the air absorbs the vapour,

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vapour, and then flows onward charged with its natural amount of moisture.

2474. *Chairman.*] How do you ascertain the fact of the balance of the air being destroyed, and the necessity of using that apparatus?—It depends upon this: we know that 27° of Fahrenheit additional temperature doubles the capacity of the air for moisture, and in very cold weather, and especially with easterly winds, there is an absolute dryness in the natural atmosphere, independently of any operation to increase its temperature; in such a natural condition of the atmosphere, the dew point being very low indeed, a certain amount of moisture must be imparted beyond that which is due to the air's increased capacity for moisture arising from increase of temperature; but those are the times, and I think almost the only times upon a system of low temperatures like those I have described, when you would want to impart moisture.

2475. Mr. *Locke.*] What means have you of regulating the quantity of moisture; have you any means of ascertaining it?—Yes, by the hygrometer.

2476. *Chairman.*] By a wet and dry bulb?—Yes; there is no difficulty in it.

2477. Sir *D. Norreys.*] How long would it take to cool down these series of plates, say from 100° to 70°?—It would be, of course, according to the temperature of the external air, but assuming that to be 30°, you might reduce them 30 in 20 minutes, and accomplish the object without any regulation of the ingress air valves.

2478. What horizontal area do you propose that these vessels should occupy for a building of the size of the House of Commons; through what area would the air pass, in fact?—For the reception of the warming vessels a chamber would be required about 14 or 15 feet long and 10 feet wide, and the total area of air-passages 50 square feet.

2479. That is about 140 feet for area of floor of warming chamber?—Yes.

2480. *Chairman.*] Supposing the cubical contents of the Houses of Parliament to be 4,000,000 feet, how many of those apparatuses would you require properly to warm it?—That is entirely a local question, because it might require 50, or it might be done with 10; it would depend upon the greater or less facilities that the structure itself might afford.

2481. Taking the Colney Hatch Asylum, how many are there in that building?—There are seven acting strictly upon the main building; there are two more which operate upon detached buildings. The cubical contents are two millions

and

and a half feet. If the Colney Hatch Asylum had been a square building instead of being in one continuous line, laterally extended, I could have accomplished it with a much less number of apparatuses. *H. C. Price, Esq.* 22 April 1852.

2482. Then you imagine that to ventilate the Houses of Parliament by your system would require in proportion a smaller number of those apparatuses?—I think so, but I cannot give an answer of much value unless I have all the facts before me.

2483. But of course the fact of a building being in a more condensed shape would argue that a smaller number would be required, would it not?—Quite so.

2484. You spoke of some thoroughfares under the House through which the air passed to the House; what did you mean by that?—I mean the passages which you are conducted through for the inspection of the arrangements made for warming and ventilating the Houses; when I went through them the channels through which the air passed were what I call long rooms, or long and large passages; and under the House of Lords and House of Commons there are large chambers that you can stand upright in, and walk about in freely.

2485. You do not mean that they were used by anybody except those who were employed in ventilating the House, I presume?—My point is, that those should be exclusive channels, and not to be entered by anybody except there is a special necessity.

Veneris, 23° *die Aprilis*, 1852.

MEMBERS PRESENT:

Lord Robert Grosvenor.
Lord John Manners.
Mr. Thomas Greene.
Mr. Henry Fitzroy.
Mr. Ricardo.
Sir Denham Norreys.
Mr. Bankes.
Mr. Henry Hope.
Mr. Locke.
Mr. Stephenson.
Viscount Palmerston.
Mr. Henry Drummond.
Mr. Deedes.

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

David Boswell Reid, Esq., M.D., further Examined:

D. B. Reid, Esq. M. D.
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2486. *Chairman.*] WHAT are those papers which you hold in your hand?—All the accounts I have received in reference to the works executed since the meeting of the Committee before the recess.

2487. Up to what period?—Generally up to the period mentioned.

2488. What period is that; is it up to Wednesday night last?—Some of them are to the 19th; others have added a supplementary account, including everything in progress; that is what the expense will be of things that have been in hand and ordered, though retarded by various circumstances; for example, the meter and governor so essential for measuring and for maintaining the equilibrium of the gas might have been up in their place, but an objection has been taken to the site, and until that is settled, of course these works will be retarded.

2489. Will you state the gross amount of the money expended?—The gross amount of these accounts received is 502 *l.* 10*s.* 2½ *d.*, to that must be added Mr. Edge's account, which was promised to day but has not yet come. I expect it to be here every minute.

2490. Mr. *Fitzroy.*] What is that account for?—The principal gas-work, the meter, the governor, the mains and burners.

2491. *Chairman.*] Can you state to the Committee nearly what

what Mr. Edge's account will be?—I presume, including everything, it will be about 500 *l.*

2492. Then the gross total is 1,000*l.*?—It is so of the accounts received, including the allowance for Mr. Edge's.

2493. Of accounts not received what do you imagine will be the amount?—If an order were given that nothing further from this moment should be done, I should think another 100*l.* would amply include everything.

2494. Of this 1,100*l.* how much relates to the ventilation and warming; can you specify the different amounts for ventilation in the first place, warming in the second place, and lighting in the third?—In round numbers, 700*l.* to the lighting and 400*l.* to the other arrangements.

2495. Mr. *Fitzroy.*] Have you had any communication with Mr. Edge as to the amount of his account?—I have. I received a letter from him. I saw him again and again yesterday, and also to day at 10 o'clock.

2496. And did he state the amount to be 500*l.*?—He did so in his letter; but I requested him to give a more specific account, shewing what was actually executed, and what was in progress for which he had received orders, and I expected to have had that at a quarter past 12 to day.

2497. *Chairman.*] Will you have the goodness to put in those accounts which you have in your hand, and to put in the other as soon as you receive it.

[*The Witness delivered in the same. Vide* Appendix.]

2498. Mr. *Fitzroy.*] Have you looked over the accounts so as to ascertain the quantity of work which is accounted for in those different items, and to be aware that there is nothing else forthcoming?—There is nothing further beyond the contingencies which I mention, and I have had approximations even to those, if they are wanted in detail; it is impossible to get the accounts adjusted in a moment, if you will allow me I will give a single specimen. We have so many carpenters from Mr. Grissell, who have been working on for years in my department, and they have been doing miscellaneous work; they were acquainted with the chambers, and they have been doing so much miscellaneous work connected with another account; and some of them have been transferred, as they were the best men to apply to the business executed under the authority of the Committee. So far as I have been able to proceed with that account, I have an estimate, which I should presume is very near, somewhere about 25*l.* 5*s.*, but it is not in such a precise position as to allow me to class it along with

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the other accounts, and therefore I consider that if there is any difference between the final accounts given in, and those I now mention, it can only be a pound or two.

2499. Can you be responsible that the total expenditure in respect of the ventilation and lighting, which has been now performed under your orders, shall not exceed 1,100*l.*—Most certainly; as responsible, I think, as any man can possibly be under the circumstances.

2500. *Chairman.*] Has that amount expended come generally within your estimate of the cost?—It has. Perhaps I may be allowed to mention that I have been in the habit for twenty years, of expending large sums, and, on probable estimates, made with as much rapidity as on the present occasion, and I can refer you to almost every instance where I have been within the sum, or a near approximation; as, for instance, in the House of Commons in 1836, where several thousand pounds were expended in three months, and at the Old Bailey, where 5,000*l.* were expended within five weeks.

2501. Mr. *Locke.*] I think the fittings of the lighting at this moment are but temporary?—Not altogether; some of them are temporary.

2502. Are they partially so?—They are so.

2503. Does the estimate which you have delivered in this morning, contemplate or include the cost of making those temporary arrangements permanent?—No; permit me to mention that the fair decoration of those hollow pyramids, so as to take away their excessively bare appearance at present, is a point always contemplated, and that is included in the remainder of the sum which I have mentioned.

2504. But the 1,100*l.* will not complete the arrangements which you have in view, even as regards the permanently lighting of the House, irrespective of the gas?—Most certainly; it would not put the hollow pyramids in any proper and fit condition, in connection with the rest of the decoration of the ceiling.

2505. *Chairman.*] Would your original estimate of 2,800*l.*, put the whole in a proper condition?—Certainly.

2506. Sir *D. Norreys.*] What portion of the expense of the side lights is included in that 500*l.* of Mr. Edge's account?—A little more than 50*l.*; 40*l.* for glass and 12*l.* for iron work; the extras connected with it in attendance, and labour, and gas, I imagine would not exceed 10*l.*

2507. What portion of the original estimate do you conceive includes the placing side lights all round the House, and the shed or gallery in which they are to be placed, with all the arrangements

arrangements requisite to carry out your original plan?—That was estimated at 800*l.*

2508. Then by the omission of the side lights, that expense would be avoided, deducting, of course, any other expense which might be necessary in order to give a substitute?—Certainly; a substitute is given for the illumination. Allow me to add, to finish the position of that question, that when it is said, "We do not require the back seat on either side to be illuminated;" when it is said, "We wish a shadow to the extent that now exists there," there would be no necessity for additional expenditure at all.

2509. That would be saved?—Yes, we could light the House without it; I do not say that that is the mode which I would recommend as the best of all, but still I am anxious to state the case as fully as possible, though it may be against the view I have advocated.

2510. Mr. *Fitzroy*.] What is the amount expended for the work done in the vaults?—The amount of work done in the vaults is 163*l.* 15*s.* 8*d.*

2511. Is that work completed now?—That work is nearly completed; it is all substantially done except the paring and smoothing, and giving a final hardened surface to the whole interior, which would probably be from 5*l.* to 10*l.*

2512. What result have you obtained upon that work?—No practical result as yet in respect to the House of Commons during the sittings of the House, because, from the state of the works above, namely, in the corridors of the House of Commons, and the failure of the arrangements connected with the drainage, this vault, cleared now from external drainage, has been overrun by drainage from the closets above; therefore we have had to shut it out. At the present moment the Committee could see, were they to inspect that vault, a stream of water running down from above; that stream of water arising from the entire destruction of the drainage at a particular point.

2513. Is that obviated by what you have done at all?—No; what I did was to obviate the ingress of water from below; this is a fresh irruption from above, occasioned by the failure of glazed earthenware pipes used as a substitute for lead pipes; and the workmen, in repairing these during the recess, have cut apertures above, and most carelessly.

2514. What practical result have you obtained from the expenditure of the 163*l.*?—The practical result that I have obtained is this: that there is a channel, which I consider essentially dry, with a channel on either side, by which fresh

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air may be obtained from the vaults and from the clock tower, and which channel only requires at present, in order to be used, to be defended from an aperture lately knocked through the crown of the arch under the House of Commons, and leakage from the principal floor.

2515. Lord *John Manners.*] For the 163*l.* have you secured the vaults from external corruption?—No, I do not consider that I have secured the vaults as a whole.

2516. *Chairman.*] Have you secured one channel?—I have secured the central channel, and I have built out the other two channels; so that I have two empty channels, one on either side, which defend the internal channel, and the floor of that internal channel has been laid with pavement and cement, and concrete below the pavement.

2517. Mr. *Locke.*] What was your original estimate for the thorough repairs of the vaults?—For the whole of the vaults it was put down at about 400*l.*, it being understood that the drainage, which was necessary outside, would be put in an effective condition.

2518. Then this 163*l.* is only a portion of that which you originally contemplated for 400*l.*?—It is; it is that portion which I was authorized to do.

2519. Have you any doubt that the 400*l.*, which you formerly mentioned as being necessary for the entire remedying of the defects of those vaults, will still be sufficient?—I do think so from the large portion of work done; the whole range of central vaults, from the clock tower absolutely to the central tower, has been done, and that including in the centre portion the widest vault we have. At the same time I must state, what I have always represented, that I think the general state of the drainage, and of these vaults, ought to engage most careful attention; I have since 1843 or 1844 pointed that out, and I can show in every successive year the vast injuries which have accrued to the building from this subject not being taken up.

2520. Mr. *Hope.*] You have mentioned the name of Mr. Edge; I believe Mr. Edge is a very eminent gas-fitter?—He is so; very largely engaged in gas-fitting.

2521. Does Mr. Edge work entirely under your directions, or does he make any suggestions of his own?—Mr. Edge acts entirely under my direction; I have employed him for nothing but to do that which I require him. Of course he has made suggestions, as every intelligent gas fitter might do from time to time; but these suggestions have not been carried into execution for me, though they were to a certain extent introduced

duced outside by way of illustration, under the directions of the sub-committee, at the west windows.

2522. Then Mr. Edge is not in himself in any degree responsible for the merits or for the demerits, if there should be any, of the system of lighting?—Not in the slightest, except for one small expenditure connected with the illumination of the windows mentioned, in which some upright burners were used temporarily such as I have never employed; but I have no doubt that these were only put up there to meet the necessities of an immediate comparison, which was made there for a short time in one of the external windows on the west side.

2523. Mr. *Ricardo.*] Does Mr. Edge give you an estimate of the cost of the work before you give the order for its execution?—He does. I have asked from all an estimate previously, and have gone over the details, but that estimate under the limited time was not a regular tender. I mentioned the different things that I would require, and Mr. Edge gave me a probable estimate, and I have reason to believe that that estimate was a fair one, from what I have seen executed in other works.

2524. He was not bound by that estimate?—Most certainly he was bound to me; I never employ any one who is not bound to me by his estimate.

2525. Has he exceeded it, or is that work within the estimate?—I can only say that I have this moment received the accounts from Mr. Edge, which have been put into my hands since I have been under examination.

2526. *Chairman.*] What is the amount, is it about what you stated?—£. 507; 457 *l.* 1 *s.* 8 *d.* is the amount of the account for works already done, including the meter and other things that are provided, and 50 *l.* is the estimated amount for works in progress; that statement is within 7 *l.* of what I mentioned.

2527. Mr. *Hope.*] Does that include the laying on of the Cannel coal gas?—Every thing.

2528. How far is the Cannel coal gas conducted?—From King-street, close by Great George-street; there is a main there, and it was brought from there to near Westminster-hall by the company; then his expenses commence about Westminster Hall.

2529. Then it is conducted into the neighbourhood of the lamps?—It is then conducted on the roof till it gets above all places where a leakage would be objectionable if it occurred, and then the pipes from it descend; the principle being

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adopted that was sanctioned by the Commissioners of Woods and Forests and the Treasury in 1844, according to my representations on that point.

2530. Was it absolutely necessary to have Cannel coal gas for the purposes of the experiment?—No, it was not; but the experiment would not have been tried with any satisfaction without that, because one of the great objects is to reduce the heat. Then, if we had had a more strongly heating gas we should have required stronger copper work, a different arrangement of the plaster work, and a different arrangement of the modelling work, and it would have altered every detail connected with the strength and heating and conducting power of the materials used.

2531. Have you made any estimate of the expenditure for lighting the House from the side?—I mentioned that the expenditure for that would be about 800 *l.* altogether.

2532. I refer to the expenditure for lighting per hour, or any fixed period?—That I could not give till I had proper burners burning regularly; unless I had the quantity of interception through the glass arranged, I could not test to what pitch I should be compelled to burn the gas outside. Allow me to mention that within the House, the expense of such lighting as was shown last night in its highest power comes to about 4 *s.* 6 *d.* per hour; with ample light, but less than was given; the average cost will be about 3 *s.* per hour.

2533. Sir *D. Norreys.*] The cost of the gas alone?—Yes.

2534. *Chairman.*] For the whole?—For the whole of the interior.

2535-6. Mr. *Hope.*] If it was lighted from the exterior according to the plan which you showed us yesterday, what would be the probable expense of that?—It would be only a guess at present, for as yet we have only tried it with burners flickering in the wind; I could make a guess, but I should never put it in any way but as a guess.

2537. Will you be good enough to make that guess?—I should imagine that it might be from three to six times as much as the lighting in the interior alone, according to the nature of the glass used, and the facilities given in the perforations of the piers for removing the products of combusion so as to have a steady flame.

2538. From three to six times as much would be about how much?—Say from 12 *s.* to a guinea per hour; but it is a point upon which I should say that, until absolutely the burner is put in a right position and burns steadily, and is examined through the glass upon the surface to be lighted, for that is a most

most important point, it is impossible to do anything but give a guess. *D. B. Reid*, Esq., M.D.

2539. I am quite aware of that; but I still think that you are able to give to the Committee some idea whether it would involve a large amount of expense?—Most certainly it would be a great increase of expense. Allow me to mention, with respect to the escapes of bad air between the principal floor and the ground floor and between the galleries, yesterday for an hour or two water, from some source or other, was actually falling down almost upon the Members' heads in one place in the division corridor; so that if I do not get the means of correcting these evils as they occur, I am obliged to cut off all the ordinary supplies of air, and let none in but by doors. 23 April 1852.

Alfred Meeson, Esq. called in; and Examined.

2540. *Chairman.*] ARE you a Civil Engineer?—Yes. *A. Meeson*, Esq.

2541. The ventilation of all this building, with the exception of that which is under Dr. Reid's superintendence, is in your charge?—It is.

2542. Is that part of the building which consists of the House of Peers and those portions immediately adjacent, now in a complete state as regards ventilation?—Very nearly so; there are some alterations that will have to be made hereafter, when the centre tower is finished, but which at present do not prevent it from working in nearly a complete state.

2543. The system then in its application is tolerably perfect, and may be taken as a fair sample in the House of Lords and the adjacent portions?—Yes.

2544. Can the same be said of the Committee-rooms, or if not of the whole of the Committee-rooms, of what portion?—The whole of the Committee-rooms are very nearly complete with regard to their supply, but with regard to the discharge they are not yet complete; the channels are not complete, nor the valves.

2545. Is the object of your system to obtain constantly what is termed a plenum?—It is so.

2546. You have an extracting power, I presume, to get rid of the vitiated air and the products of combustion, have you not?—We have.

2547. That power is a steam jet, is it not?—It is a steam jet in some instances, and in other instances it is a coil of pipes, and both in some.

2548. Is that coil of pipes heated with hot water or with steam?—With steam.

2549. Is

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2549. Is it your object to depend completely upon the plenum system?—It is so.

2550. Do you imagine that you attain that object?—I think we do; but I should explain that when I say we depend completely upon the plenum system, I do not mean to say that we do not use extracting power.

2551. What, I presume, you mean to say is, that the extracting power is never in such force as to commence what is termed a vacuum?—Exactly so; except in one instance where it is a vacuum ventilation, and that instance is the smoking room.

2552. Mr. *Stephenson.*] Is that a vacuum ventilation?—That is a vacuum ventilation.

2553. How long has it been so?—From its commencement; the reason of that is, that were it a plenum ventilation there might be a liability, if the plenum was in excess in that room and the adjacent corridor and staircases, that the smell of tobacco would get into the other parts of the building; therefore, whenever you open the door of the smoking room, you find that the air will go into it instead of out of it.

2554. *Chairman.*] It has been suggested by one of the previous witnesses that it is desirable that there should be self-regulating meters to measure every supply, and to fix the number of cubic feet that should pass along each supply; what is your opinion of that view?—I think it would not answer in such a building as this, liable as it is to so many fluctuations of persons and of temperature, in almost all its departments.

2555. Have you ever made an accurate measurement of the quantity of air which is made use of in the supply and discharge?—Yes; we have a little machine, a little anemometer, that tells us by simple inspection how much air at the moment you observe it is thrown into the building.

2556. What is the general amount of air that passes per minute through the House of Lords?—It depends upon circumstances; it is modified both according to temperature and according to the number of persons; we have the power of throwing as much as 20,000 cubic feet per minute through the House. The usual supply when the House is sitting, as it has been these last few nights, is about 8,000 cubic feet per minute; from 8,000 to 10,000.

2557. Your pipes are heated entirely by steam, are they not?—By steam, with the exception of the Journal-offices on the ground floor, which are heated by hot water.

2558. It has been supposed that the heat at which steam is

is generated, must cause the air to pass over iron heated to a higher point than is desirable for the maintenance of the air in a good condition; how do you suppose that your steam pipes act upon the air?—I do not imagine that they act in any instances on the air prejudicially, for the reason, that in the tempering chamber, where the air is first admitted in contact with the steam pipes, the temperature of those pipes is seldom so great but that you can bear your hand on them. We have the power of admitting any quantity of steam into the pipes, and producing any temperature we please in those pipes; they are distributed through a very large chamber; there is a rapid circulation of air around them, and that keeps the temperature of the pipes so low, that, as I say, you can bear your hand upon them generally.

2559. Mr. *Stephenson.*] What is the pressure of the steam in that case?—The pressure of the steam in the boiler is from three to five pounds, but it is wire-drawn into the pipes, so that we can produce what amount of heat we please in the pipes.

2560. *Chairman.*] Am I to understand from that that the pipes are only partially filled?—The pipes are filled with steam of a less density than in the boiler.

2561. It cannot, I presume, be less than 212 degrees, otherwise it would not be steam, would it?—Yes, it would be steam at less than 212 degrees in a vacuum.

2562. Mr. *Stephenson.*] It would be hot vapour, not steam?—It would be vapour.

2563. *Chairman.*] How do you contrive to give circulation to vapour which is not steam?—It condenses through these pipes, if I may so call it, into water more rapidly than it is supplied, or as rapidly as it is supplied, therefore it distributes itself instantly into a rarer vapour throughout the pipe.

2564. Have you ever made any experiments to see how soon you could reduce the temperature of your air in the tempering chamber?—I have found that we can reduce it several degrees in a few minutes.

2565. How many minutes?—Say ten minutes.

2566. How many degrees?—I cannot say exactly, I have no doubt we could reduce it 15 degrees in 10 minutes.

2567. Have you ascertained that by actual experiment?—I know it from experience, not from an actual experiment made for that purpose.

2568. What means have you of mixing the tempered air with the warmed air when this mixture is required?—The tempered air passes from the tempering chamber into a channel

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nel that conducts it, for instance, to these Committee-rooms; that channel has also a side chamber in which is the additional warming apparatus. The tempered air is permitted to pass from the first channel directly on into the second chamber, where the warming apparatus is, and may be passed through both at the same time; it then comes up into a chamber which is under the principal floor, and from thence passes through other ducts to the rooms that are to be supplied; so that for each of the Committee-rooms there are four channels of supply, two for tempered air, and two for the tempered air after it has been warmed, they unite in one chamber, and the air passing from that through flues to chambers under the floors up the buttresses to the ceiling of the room is there passed through a trelliced frame. In this passage, I believe, it becomes so thoroughly mixed that there is no need for any further mixing of it.

2569. You are now speaking of the Committee-rooms, are you not?—Yes.

2570. Will you inform the Committee whether there are any Committee-rooms where the discharge is at this moment in as perfect a state as you intend it to be?—I think not; I think the circumstance of the discharge not being yet complete would apply to the whole of the Committee-rooms, because it is not complete at the exit of the main air-channel into the shaft; therefore it would affect the whole of the Committee-rooms more or less. Independently of that, there are some of them which have no regulation whatever to the exit; but there is no valve yet fixed to the openings into the main channel, so that I cannot say that there is yet one Committee-room where it is completed.

2571. What do you say of the Library in either the House of Lords or Commons?—They are under the same circumstances precisely as the Committee-rooms.

2572. Do you know the rooms which are now occupied by the Committee clerks in this gallery?—Yes.

2573. Is there a steam-jet in that neighbourhood?—There is a steam-jet in the shaft that is immediately over the oriel in the Speaker's Court.

2574. For what purpose is that?—For extracting the air.

2575. Where from?—From the Committee-rooms and Libraries, and other rooms adjacent, and the corridors, the discharge from which enter into the shaft, and also for taking the smoke from the fire-places.

2576. Is it contemplated that that should be a permanent arrangement?—It is; to be used only occasionally.

2577. I believe

2577. I believe in the House of Lords you use a downward as well as an upward ingress of air, do you not?—Downward principally; upward subordinately.

2578. An experiment was tried there the other day when certain doors were shut; and it was then thought, from the experiment made, that the air which entered at the upper part of the House of Lords, instead of going down to those portions of the House which were used for the sitting of the members, immediately passed along the roof, and made its exit with the vitiated air out at the channels appropriated for that purpose; what is your impression as to that?—My impression, and, in fact, my knowledge is, that that is not the case.

2579. In what do you think the experiment was defective?—I think the experiment was not a proof of that at all, because the experiment consisted simply in shutting the outlet of the room whilst the inlet was open; and then perceiving that very little air passed through the inlet arrangements, the outlet doors were opened, and a large quantity of air immediately passed through the inlet doors; that would be naturally the case, but it does not at all follow that that air, passing immediately in at the inlet doors, came straight across from the inlet doors to the outlet doors at the ceiling. It is an experiment similar to hermetically sealing a box, into which you could throw no air at all during the time that it was sealed; as soon as you open the exit from the box you then suffer the air to go in, but it does not follow that when you make an outlet from that box the air goes directly to that outlet.

2580. Still, was not the escape very much increased by the shutting of those doors?—It was increased just in proportion to the quantity of air that was being forced through the House, because as soon as you opened the outlet doors it gave vent to the compressed air, if I may so term it, that was already in the House, and a certain portion went out, admitting an equal portion to pass into the House.

2581. From what source did it draw in then?—It went in from the doors that the experiment was made at, in the centre portion of the ceiling.

2582. Mr. *Stephenson.*] Was the centre portion of the ceiling the ingress?—The ingress.

2583. In the House of Lords?—Yes.

2584. *Chairman.*] Then your opinion is that it was not the air poured in which came immediately out, but you imagine it descended to the lower parts of the House, and forced up other air which was there, the House being in a state of plenum?—

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plenum?—Exactly so; I am convinced that is the case from experiment, because I have tried it with smoke, and I have tried it in different ways, and I know that when there is a difference of temperature between the ingoing air and that coming out of two or three degrees only, or two degrees, that air descends to the floor of the House. Another thing (if it had been tried during that experiment) that would prove entirely that the air which rushed from the ingress into the House when the exit doors were opened did not pass to the exit immediately, is the temperature of it; because, if you will observe the register of temperatures kept there of the ingress of air and the exit of air (and it was so during that experiment), there will be found to be seven or eight degrees certainly of difference. Now if the air passed immediately from the inlet to the side channels of discharge, the temperature would be the same as at the inlet; instead of that, if you had tried it at that instant, you would have found the air passing out to be six or seven, or perhaps as much as nine degrees higher than the air going into the House, which is a clear proof that the air which passed into the House did not go out direct at the side chambers.

2585. You say that we should have found it so; have you actually tried that experiment over again?—I have tried it many times; and I have tried it since that; I have made some express experiments.

2586. And do you give that to the Committee as the result of experiment?—I can give the Committee some experiments which I have made since. On April the 5th I made an experiment. The temperature of the air in the chamber below, where it entered the House as it came from the fan, was then 54°.

2587. Mr. *Stephenson*.] I thought the ingress was from the top?—It is; but it is forced to the top up channels; it passes from the fan under the house up vertical channels to the ceiling of the House, and it is supplied at the ceiling; it all comes from below.

2588. Did you try the temperature of the channel under the floor of the House?—No; the temperature of the channel through which the fan draws the air, is the first temperature of the air.

2589. At what part?—Near the fan below the House. The fan is in the channel near the tempering chamber; it throws a portion of the air into the chamber, and throws another portion on the other side of the fan, without passing into the tempering chamber, directly into the House of Peers.

2590. Sir

2590. Sir *D. Norreys.*] Does the fan draw from the tempering chamber?—No; it draws from the main air channel, and throws a portion from that channel into the House of Peers without passing through the large tempering chamber at all. The temperature which I gave of 54° would be as near the temperature of the external air as may be.

2591. Mr. *Stephenson.*] Where was that temperature taken?—In the first chamber of the House of Peers.

2592. Where is that situated?—That is situated under the House of Peers lobby.

2593. From that chamber the air passes along channels underneath the floor?—Yes.

2594. And then vertically up flues in the walls?—Yes.

2595. And then it returns horizontally again, down into the the House?—It does.

2596. What did you say was the temperature of the chamber which yields the air into those channels, 54 degrees?—Fifty-four degrees.

2597. What was the temperature of the air at the point when it leaves the channels in the ceiling of the House, and goes into the House itself?—Sixty degrees on one side of the House, and 60½ degrees on the other side.

2598. Of the flat ceiling?—No; there are two sets of flues which go up the walls of the House from two separate horizontal channels; so that there are two supplies which unite in one over the ceiling. If you take the average of those two, which will be the supply, it is 60 ¼ degrees.

2599. At the exit apertures, at what temperature was the air?—Sixty-eight degrees on one side of the House, and 69 degrees on the other.

2600. Had you an opportunity in that experiment of taking the temperature about the Peers' table?—I had.

2601. What was the temperature there?—The temperature at the bar was 66 degrees on the east side, and 65½ degrees on the west side.

2602. Mr. *Locke.*] That is at the level of the Peers' table?—Yes; at the table of the House it was 66½ degrees, at the throne end of the House it was 65½ degrees at both sides.

2603. Mr. *Stephenson.*] There is a gallery in the House of Peers, is there not?—There is.

2604. What was it in the gallery?—I have not made that observation; I did not observe it in the gallery on that day. I take it that that experiment will prove that the air entering the House, does not go directly to the side channels of discharge.

2605. Mr.

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2605. Mr. *Locke.*] Will you state, as shortly as you can, your reason for thinking so?—Because in the time of passage from the centre channel to the side, which is some ten feet, the quantity of air which was sent in, could not possibly be raised in temperature nine degrees, it must go down to the source of heat whence the temperature is raised, before it could be raised nine degrees.

2606. Is that the only reason you have for supposing so?—That is not the only reason that I have for supposing so, because I have had ocular demonstration, by means of smoke, that it is so.

2607. When the temperatures have been the same as these?—When they have been much less than these.

2608. What have been much less?—When the difference of temperature between the supply and discharge has been been much less; perhaps only two or three degrees.

2609. Is that favourable, do you think, to your view of the case?—Unfavourable; the less the difference of temperature, the more unfavourable.

2610. Sir *D. Norreys.*] Was the House very full when so great a difference of temperature was created by the air descending at eight degrees or nine degress?—Not very full.

2611. Mr. *Locke.*] Will you state any other reason why the air entering at 60½ degrees at the centre of the House, should descend to the table at 66 degrees, in preference to passing off to the side at 69 degrees?—Because at the temperature of 60 degrees it would be much heavier than the atmosphere of the House at 66½ degress; therefore the particles of colder air would descend by the action of their own gravity alone, till they came to some material which would raise them in temperature higher than the surrounding particles; they then would begin to take their turn and ascend.

2612. At what point do they begin to take their turn to to ascend?—I imagine from the very floor; they obtain their warmth from the floor. The chamber under the floor of the House at that time was 68 degrees; the chamber was higher in temperature than the House itself; we always kept it so, that is, higher in temperature when we want to warm, than the House itself. The consequence is, the floor being iron covered with lead, the whole floor of that House becomes a radiating surface more or less to the air that descends on it.

2613. Sir *Denham Norreys.*] Except the carpet; the floor is radiating minus the effect of the carpet?—Yes; still the carpet becomes the same temperature as the floor.

2614. Mr. *Locke.*] Do I rightly understand you to say that in

in your opinion the air, when it enters the House from the roof, descends to the floor of the House before it seeks for its exit?—It does.

2615. Sir *D. Norreys.*] You said that the temperature at the table was 65 degrees?—Yes.

2616. Speaking of the air at the table, it is not necessary to conceive that that should have descended to the floor before it became at 65 degrees. Do you presume that the air which you find at the table will have descended to the floor?—I imagine it will.

2617. Then it must have risen perpendicularly against the downward current of cold air?—No doubt it does. I can believe that particles of air will intermingle of different temperature, and gradually work their way down one among the other, till they come to the source of heat from whence they obtain their levity.

2618. Then on that hypothesis, the air at the table must be composed of particles, portions of which are at 60 degrees descending, and other portions of which ascending are at something above 65 degrees, so as to form a medium of 65 degrees?—Yes; I will admit that it must be so; I would explain that portions of these particles of air may and do, I have no doubt, receive from contact with other warm particles of the air a certain degree of temperature that would bring them up above 60 degrees; but the difference really between the particles at the table which descend, and the particles ascending, may not be from 60 degrees to 65 degrees, but it may be some difference somewhat smaller, they having obtained a portion of heat from the particles through which they have passed.

2619. Would not an easier solution of the fact be, that there might be a certain amount of radiation of heat from the bodies of the persons on each side, which spread and was caught and carried down by the descending current, so as to make a descending current at the table of 65 degrees?—No; I imagine not. In the first place, at the table, there are very few persons seated, therefore that would not be the case at the table, but at the sides of the House where more are seated, it would not hold good; the bodies of persons there would tend to raise the temperature of any particles of air coming in contact with them, and cause those particles to ascend. In fact, I do consider that this system is the most natural system. Supposing you took the ceiling of this room off altogether, and opened it to the air, you would not doubt that you would have air enough to breathe. I should imagine that the warmed

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particles of air which surround us, and our breath too, would ascend; the colder particles, if it were cold, would come down. If it were colder here than the external air, you would get no ventilation at all in such a case; but so long as you kept the lower part warmer than the incoming air, you would get a ventilation, and a natural ventilation.

2620. Mr. *Drummond.*] You call it a natural state, then, to have four walls and a floor, and no roof?—A natural state, as regards venilation.

2621. But are not the walls and the floor an artificial state?—Any building is an artificial erection. If you go into the atmosphere unsurrounded by any walls, still you have that natural ventilation; particles of air that come in contact with the earth, which is warmed by radiation by the heat of the sun, ascend, and fresh particles come down from above; and so natural ventilation is carried on in a field or anywhere else; of course, setting aside the effect of winds and those sort of things, which disturb all those processes more or less.

2622. But you cannot consider it a natural state of things to have an artificial floor, and four artificial walls, without a roof?—No; that is natural so far as the enclosure goes; the ventilation would be natural in such an enclosure as that.

2623. The room, in fact, which you have described, and which you call a natural condition of things, would be a well?—A well you would imagine to be something below the level of the earth; if by that you mean a well, I should say the circumstances would not be the same.

2624. Mr. *Locke.*] A chimney?—A chimney.

2625. Viscount *Palmerston.*] Are not winds a natural ventilation, in fact?—They tend, no doubt, to ventilate almost every place where they have access; but the natural ventilation goes on independently of winds.

2626. Are not winds generally horizontal?—No, I do not think they are generally horizontal; they take, more or less, a different direction, according to the surfaces with which they meet.

2627. They are seldom perpendicular?—They are seldom perpendicular, except in the case of down draughts in a chimney; but I should explain here that another proof that the particles of air do not go immediately to the sides of the ceiling, instead of going down to the floor, is this: that after they enter from the chamber through the ceiling of the House, the velocity with which they go is so excessively small, that they have perfect liberty to adopt their own natural gravity to bring them down the floor.

2628. Mr.

2628. Mr. *Stephenson*.] Have you tried the velocity of the air at the point of ingress?—At the point of ingress it is very small indeed, because it is divided over a large surface; and immediately below the ceiling of the House, I imagine the velocity of the particles of air is not more than four feet per minute.

2629. Is that assuming that you are throwing into the House 8,000 cubic feet per minute?—It is.

2630. What is the gross area of the apertures of ingress at the centre of the roof?—I should think about 150 feet; I can get that; I have not it with me.

2631. Supposing 8,000 cubic feet per minute to be thrown into the House through an aperture of say 150 square feet, it would give you something like 60 feet per minute?—Exactly so.

2632. That is not consistent with the velocity of the air which you have just assumed a little below the ceiling to be only four feet per minute?—If you will allow me to explain that, I think I can show you that it is not altogether incompatible. The aperture through which the air is supplied to the ceiling is not one aperture; it is divided through a great many perforations extending over a large surface of the ceiling. The air passing through these apertures descends into a space, the area of which is equal to about 2,000 feet. Therefore those particles, though they may pass through this number of apertures, that in the gross amount to 150 feet, will have room to expand themselves, and to lose their initial velocity by the larger space into which they immediately come. Therefore, by the time they have reached a short distance below the ceiling, it will be found that their velocity is not more, or very little more, than what I have stated.

2633. There is a discrepancy there which I want to call your attention to; if you assume that the air which is entering the House through a number of apertures whose aggregate area is 150 feet, requires a velocity to discharge 8,000 cubic feet per minute, it is 60 feet per minute; that is clear?—Yes.

2634. Then you assume, to get rid of that velocity, that the air which comes through a small portion of the ceiling immediately dilates, as it were, and expands itself into a larger area?—Yes.

2635. You say 2,000 feet?—Yes.

2636. Do not you think that that downward current, spreading out, materially interferes with the upward current at each side?—No, because besides that 2,000 feet which I take for the down current, there are 2,000 other feet in the

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House for the upward current also. I divide the area of the House; I take one-half.

2637. Mr. *Locke.*] What is the area of the House?—About 4,000 feet.

2638. Is the entire access or supply of air to the House of Lords obtained from the ceiling?—At times it is entirely; except on some occasions, when there is a local admission at the throne, some at the ends of the side framing, and there is the power of admitting some at the risers.

2639. Then, in point of fact, you have the machinery now for supplying the House of Lords with air from the ceiling, as well as from the floor, from the seats, and from the throne?—Yes.

2640. Do you also take it from the table?—Yes, there is a small portion in the centre of the table supplied.

2641. Are those other accesses invariably used with the access at the ceiling? They are not; they are seldom used.

2642. Can you state whether they were in use at the time the Committee had the opportunity of witnessing the experiment to which the noble Chairman has referred?—I think they were not in use.

2643. Were they in use on the 5th of April, when you made these experiments in reference to the temperatures?—They were not in use, except perhaps at the table; the access at the table is generally kept in use.

2644. Would you say invariably?—Invariably I should say.

2645. Then in point of fact, you never have this system perfectly in operation; that is, a supply from the roof solely?—Yes, we have it sometimes; perhaps I should not say invariably at the table. For instance, last night there was no supply, except from the roof altogether; and the night before and for some time past, every access has been closed, except from the roof.

2646. But you cannot tell me whether, on the occasion when these temperatures were obtained, the supply was entirely from the roof?—I think entirely, excepting at the table, which is so small a supply that it would not affect the experiment in any way whatever.

2647. What is the area of the aperture at the table?—It is about 18 inches square on the top of the table, covered with a finely perforated piece of zinc; the zinc is so finely perforated, that I should think that would reduce it to one-third or one-fourth, perhaps.

2648. Can you tell the Committee what is the area of the other

other openings which are in operation generally at the floor of the House, or in the seats of the House, and at the throne?—None at all.

2649. I thought you said that you had some accesses?—We have some, but they are not in constant use; they are only used occasionally.

2650. Will you state what they are in fact?—They consist in a series of flaps placed along the risers, which would admit of being opened some two or three inches to the risers; and at the back seats there are some hung on centres, that would admit of being opened to a larger extent.

2651. What is the relative proportion to the entire opening at the top; are they 100 feet or 50 feet?—If they were opened to the fullest extent, I dare say they would be 60 or 70 feet, or more; I am not certain.

2652. Would they be sufficiently large for the ventilation of the House of Lords, supposing the system of ventilation not by means of the roof, but by means of the floor, were adopted?—They would be too large if open to that extent.

2653. They would be sufficiently large for the purposes of ventilation, supposing that principle to be adopted?—I think so; if they were open to their full extent the House would not be endurable, I imagine, from the quantity of air.

2654. It would be too much?—It would be too much.

2655. You were asked with reference to the ventilation of these rooms, and stated that they were none of them yet perfected, in consequence of the want of some tower, into which, as I understood you, the ultimate ventilation is to proceed?—You misunderstood my answer to that question, I believe. There is the tower, but it is the want of the completion of the valves of exit from all these rooms, which is now in progress of being done.

2656. I understood you to say, that some of the rooms had all their valves and appliances, and that others had not the valves applied, but that in all of them the ventilation was imperfect, inasmuch as the arrangements in the ultimate exit, namely the tower, were not completed; is that so?—Exactly so; we have the tower, but the arrangements in the tower are not yet completed.

2657. What are the arrangements in the tower, which are not completed?—The arrangements are the enclosing of jets of steam, and completing the valve which leads from the channel into the tower itself, and the separating one portion of the tower from another, which has to be done yet by a partition.

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2658. But your jets are there?—They are.

2659. And are in operation?—And are in operation.

2660. What is it that prevents the completion, first of all, of that which encloses the jet?—Nothing but not forcing the work on, which has not been done.

2661. What is the work itself which requires to be done?—Carpenter's work and iron work.

2662. How long would it take to do it, supposing you had to do it now?—Not any great length of time.

2663. Could you do it in a week?—Yes.

2664. How many Committee-rooms are there which have not got their flues in connection with the ventilating shaft?—None of them.

2665. They are all in connection?—They are all in connection.

2666. What is it in the defective arrangements of the Committee-rooms that is incomplete, excepting that piece of work which you have now alluded to?—The valves to the discharges from the Committee-rooms.

2667. Some of the Committee-rooms want their valves into the main channel?—Yes.

2668. What are those valves?—Those valves consist of a door hung upon hinges or centres, to regulate the discharge from each Committee-room.

2669. They are pieces of wood, in fact?—Pieces of wood.

2670. How long would it take to do that work?—I imagine it would not take very long if it was pushed; if the whole strength of the carpenters' shop were put upon it, it might be done in a very short time.

2671. But some of the Committee-rooms have them?—Some of them have them. I have not examined into the progress of the work for these last few days, but I think now they are in a very forward state towards completion, the whole of them.

2672. Mr. *Stephenson.*] Will you have the goodness to explain exactly how, for instance, this room is ventilated; where the ingress is, and where the egress is, taking this as an example?—The ingress to this room is from the east side of the ceiling, over the windows; extending some two or three feet along the north and south sides; the egress is from the west side of the ceiling, extending also some few feet on the north and south sides eastward.

2673. Mr. *Locke.*] There are other accesses of air?—There are other accesses of air; around the skirtings there is a moulding, which is kept some short distance away from the plinth

plinth of that moulding, leaving a channel of about half an inch wide, through which a supply of air comes.

2674. About six inches from the floor?—Yes; at the top of the wall framing there is a provision made for a supply, which in some rooms is in work, and in others is not; in a great many of them it is not at work, being found unnecessary, and only the lower and the upper ones are used.

2675. That second one is about six feet from the level of of the floor?—Yes.

2676. Does that supply extend round the room entirely?—With the exception of doors and windows, and fire places.

2677. You say that that has been discontinued in some of the Committee-rooms, being found unnecessary for the purposes of ventilation?—Yes, I believe, in almost all of them, there is a small fillet of wood placed; in fact, I do not know whether it is not lining, so that it can be removed. I am not quite certain.

2678. Mr. *Greene.*] You say you believe that it is so. Is not the whole ventilation of these Committee-rooms under your charge?—Yes, it is; but the peculiar arrangement of such matters as that in particular Committee-rooms is more under the superintendent of the ventilation, who is in the building; Mr. Scott, the superintendent of the ventilation department.

2679. I understand you to be the superintendent, now, of the ventilation?—Under Sir Charles Barry; but there is another person, who is called the chief engineer, who takes the charge of working the boilers, and looking after the men, and observing the local temperatures, and registering them, who is, if I may so term it, under myself.

2680. Mr. *Locke.*] What is his name?—Scott.

2681. Mr. *Greene.*] Then Mr. Scott, in point of fact, has the charge of the ventilation through these rooms?—He has the power of making adjustments, and requirements from time to time, as he thinks necessary and fit, according to circumstances, having general directions from Sir Charles Barry.

2682. Mr. *Locke.*] Acting under your direction?—Yes.

2683. He, as well as you, is responsible to Sir Charles Barry for what he does?—Yes.

2684. Mr. *Greene.*] But he is more particularly responsible for this range of Committee rooms?—Not for these more particularly, but for the other parts of the building also; the details of ventilating are left to his charge, subject to reference to myself upon any matter on which he is at a loss or finds any difficulty.

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2685. Then for any minutiæ, or minor details respecting the ventilation of these apartments, we should best refer to Mr. Scott?—Yes; for instance, I could not now tell you the particular state of the valves of any one room; I could not pretend to do it.

2686. Mr. *Locke.*] Because they are in his charge?—Because they are in his charge.

2687. Mr. *Greene.*] The warming and ventilating of these rooms is rather upon a different principle from that which you apply to the Libraries, is it not?—It is so; it is only different in this way, that the Libraries have not the supply at the skirting.

2688. Is there not a material difference also in this respect, that in the Libraries you have a coil of pipes near the windows for the purpose of giving warmth to that part of the room?—So we have them here also.

2689. In your statement respecting your mode of warming and ventilating these rooms, I think you did not refer to the fact that there is a coil of pipes at the windows of these rooms also?—I did not; the question was not asked me, and I did not explain it, but it is so.

2690. Mr. *Locke.*] What is that for?—It is for giving additional warmth to the window side of the room in times of very severe easterly winds and north-easterly winds.

2691. By radiation?—By radiation.

2692. It has no influence upon the air?—No.

2693. Sir *D. Norreys.*] Do you mean to say that that is when your general heating apparatus is insufficient for the purpose of keeping the room at a certain temperature?—It is not so much that the general heating apparatus would be insufficient; perhaps we could get up the temperature of the room quite sufficiently with the general heating apparatus at this side of the room, but it is very difficult to counteract, unless by some local heat, the effects of cold from such large windows as these are.

2694. Mr. *Stephenson.*] I understand the arrangements in this room; we will now trace the operation beyond the room. The series of Committee-rooms, ranging from end to end of the building almost, I suppose have one channel throughout the whole length?—Are you speaking of discharge, or supply?

2695. The ingress; we will begin at the beginning?—They have one channel throughout the whole length in the vaults below; they have not one ingress channel above; each room is distinctly separated from another room by a fire-proof material all the way down to the vaults.

2696. Then in the vaults there is one common channel from

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from end to end of the building?—From end to end of the building.

2697. From the vaults vertical communication is made with the horizontal part of the ceiling in each committee-room?—In each committee-room.

2698. Therefore the air comes up from the floor through flues in the wall, and communicates with that?—Yes.

2699. With the moulding, in fact?—Yes.

2700. What size is the channel which you state as ranging from end to end of the building, forming, in fact, the vaults; I suppose they are large vaults?—It is a large channel.

2701. Ten feet square?—Not square; but it is 100 feet area.

2702. What is the size of the vertical channels which ascend through the walls separating the committee-rooms from each other?—The channels consist of four in number; they are about two feet square, I think, or somewhere thereabouts.

2703. That would be 16 square feet altogether?—Yes.

2704. Have you ever calculated approximately the area of the aperture of that moulding for the ingress of the air?—I have not.

2705. On the other side a similar arrangement, I suppose, is made for carrying the air down from the egress channel?—Not down; it passes out upwards into a channel that goes the whole length also of the river front over the corridor, and passes out through a tower, or louvre, as it is called, which is situated at the Speaker's house, and another at the Black Rod's house.

2706. Can you give me approximately the dimensions of that channel?—The dimensions of that channel are about 50 feet area.

2707. Therefore it is nearly four times as large as the ingress, the ingress being 16 feet?—Yes; but that channel serves the purpose of all the rooms.

2708. The ingress is 16 feet?—The ingress is 16 feet, if it were all used.

2709. How many Committee-rooms are there that this one channel serves?—Twelve.

2710. Therefore there are 192 feet of area for the ingress of the air; that is 12 times 16?—If it were all used, but I should tell you, as I think I have already said, that two of those flues out of the four are used for the warm air, and two for the tempered air; it does not follow that all four are used at the same time, though they might be.

2711. In

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2711. In summer weather, when you want cold air into the rooms, you would, I suppose, not use two for the warm air and two for the cold, but you would use all the four for the cold?—Yes.

2712. Then the circumstances which I am now endeavouring to get from you would exist?—Exactly.

2713. That is, that there would be 192 feet of available area for the admission of air, and there would be 50 square feet for the egress of the air?—Yes.

2714. Has that gallery above the corridor, the area of which is 50 feet, to accommodate the exit of any other air, excepting that of the committee-rooms?—The corridors.

2715. By what power is the air drawn along that gallery at present?—By a steam jet, and by its natural temperature; by the temperature which it acquires.

2716. Is the air forced into these rooms at all by a fan apparatus?—It is.

2717. How do you regulate the admission of air; how do you get to it between the vertical flues in the wall and the channel through which the air passes into the room?—We regulate it by valves situated under the floor at the top of those four up-cast supplies to the room.

2718. Then there are four valves, if I understand you correctly, at the bottom of those vertical flues in the vaults?—Yes.

2719. You regulate the admission at the commencement?—At the commencement.

2720. You do not adopt the plan of regulating the exit?—We do; but that, as I have just said, is not yet completed; we intend to do so when the valves are quite complete.

2721. I am supposing the condition of things as they exist, which is, that you at present only have the power of regulating the admission of air at the bottom of those vertical flues?—Yes.

2722. To prevent too much air coming in, you always shut those valves?—We close them when we have the requisite quantity.

2723. If you narrow the aperture, near to the apparatus for creating a plenum, does not that render the plenum almost inactive?—No, it is not near the apparatus.

2724. It is on the plenum side of the room which you wish to ventilate?—It is between the room and the plenum power, undoubtedly, as all regulations must be.

2725. Supposing you regulated the valves of the exit air, would the plenum then not always be upon the room, and the vacuum

vacuum in the gallery; would not the contrary effect take place to what now does take place, if you regulated the emission instead of the admission?—The openings from the corridor also would be regulated, as well as the rooms.

2726. Why are both necessary?—For this reason; when the jet or any extracting power is used to compensate, if I may so term it, for the smallness of the horizontal channel of discharge, that is to enable a sufficient quantity of air to pass out of the room when propelled by the plenum power, it is necessary to regulate the rooms, because one room, nearest to the extracting power, would perhaps obtain a larger discharge than a room further on; therefore it is quite necessary to regulate the discharge as well as the ingress.

2727. For the purpose of maintaining the plenum, which I understand to be your principle, is it not almost necessary, in order to carry out that view, that you should regulate the exit, and not the ingress of the air; do not you think that is plain?—That might be one way of doing it.

2728. Is not it the most palpable way?—I think not, because it is a necessity that we have valves at these points to regulate the supply of warm air and tempered air. If we regulated the exit only of the room, we should have no power whatever over the controul of the two kinds of air that are mixed for sending into the room.

2729. Therefore you consider with your plenum apparatus that the jet of steam at the tower is made use of to compensate for the smallness of the aperture going along the corridors, as compared with the aggregate area of the ingress channel?—Just so.

2730. Mr. *Greene.*] What is the total area for the ingress to this Committee-room at the ceiling, at the plinth, or at any other place?—I could tell you nearly. I have not measured the exact area in this particular room. I believe it is many times more than the areas of the flues leading to it.

2731. Mr. *Locke.*] What is the area of your ultimate exhausting shaft?—I should think 60 feet.

2732. And the flue here is 50?—Yes.

2733. So that, in point of fact, it is about 10 feet more in one than in the other?—Yes.

2734. Mr. *Greene.*] What is the precise size of the channels supplying this room?—Sixteen feet.

2735. How are those channels cleaned?—By a man going up them and into them, sweeping them; during every recess of Parliament they are carefully swept out and cleaned.

2736. They

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2736. They are all of them accessible to actual inspection? —Yes.

2737. Is there any portion of them which is inaccessible? —There are no portions that are inaccessible, excepting over the cornice supply, but that is made to take out to clean and sweep.

2738. And is it from time to time taken out and cleaned? —Yes.

2739. How often is that found necessary?—Once in the session.

2740. Sir *D. Norreys*.] You stated that the ingress of air into the House of Lords is at the rate of four feet per minute, about one foot from the ceiling?—Yes, dependent upon the quantity, of course.

2741. Can you state the velocity of the vitiated air where it passes from the ceiling upwards?—It would be about the same.

2742. Has that ever been a matter of experiment, or is it merely from the rate of travelling at which the air ought to go?—It is matter of observation from the time that it takes for smoke, for instance, to descend from the ceiling to the floor of the House; therefore it is a matter of observation.

2743. Have you ever tried the smoke, and traced its current from the ceiling downwards and thence upwards?—Yes.

2744. And it appears in the ascending and descending current to be about at that rate?—Yes; I should perhaps mention that the time before the smoke is perceived in the egress channels from the House of Peers, after it has entered the ingress, is from 12 to 15 minutes.

2745. Can that experiment be made so clearly as to be able to have the downward and the upward currents, or is it that the smoke circulates through the House of Lords in different directions, and at last finds its exit in the time stated?—No, it can be made clearly to show that it descends in the centre to the floor of the House, and that it ascends to the sides; the last remnants of the smoke go through the outside apertures.

2746. Supposing there were no artificial means to assist ventilation in the House of Lords, but that all the pure air were admitted from the ceiling, and the vitiated air allowed to escape, as it could, from the sides; and also, supposing an average attendance of persons in the House of Lords, would not the difference of temperature, which would take place from the radiation from the bodies of those below, create a downward current far greater than the velocity of two feet per minute?—I think not.

2747. Mr. *Greene.*] You state distinctly that the velocity of the ingress is four feet per minute?—Yes, with the given quantity of air which I named.

2748. How did you measure that?—I measured it by a calculation of the area allotted to the supply of air, dividing the supply by the area which it must occupy in the House.

2749. Mr. *Stephenson.*] The area after it became dispersed?—Yes.

2750. That area is an assumed area of 2,000 feet?—It is.

2751. You suppose therefore in making that calculation, that the House is divided into three slices, one of which is the downward slice of 2,000 feet area, the others being each of 1,000 feet area?—Yes.

2752. In that you will admit that there is a little arbitrary assumption?—Undoubtedly.

2753. Mr. *Greene.*] It is rather a speculative notion than from actual experiment?—Not so; because from the time that it takes for smoke to descend with that quantity of air from the ceiling to the floor, you will find that it will give you that by positive observation.

2754. Mr. *Hope.*] The floor of the House of Lords is iron, covered with lead?—Yes.

2755. Were you present when the roving commission of this Committee went round the House?—Yes.

2756. Do you recollect that there was a complaint made of the noise; that the Chancellor had heard a noise?—When we were on the ceiling it was so.

2757. Was not that so when we were below the House?—I think no complaint was made whilst we were below the House, according to my recollection; but no doubt you can hear any one speaking loudly below the House as well as above.

2758. Through the floor?—Through the floor.

2759. It does not prevent the sound from passing?—It does not.

2760. Mr. *Stephenson.*] I understand now the ceiling arrangements perfectly. Do you not admit air also into the House of Lords through the risers?—Not generally; there is the power.

2761. There is some?—None at this time of the year.

2762. Still you have the means?—We have the power of doing so.

2763. And you do occasionally, I suppose, in warm weather want to avail yourself of that power?—Yes, it has been used.

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2764. With good effect, do you think?—Yes.

2765. Is the whole of the floor of the House perforated, or a large portion of it?—No; it is covered with lead.

2766. Is not there a perforated floor beneath that?—Beneath the lead there is.

2767. Is there not some considerable portion of the floor also left uncovered with lead?—No.

2768. Therefore it is all stopped up?—It is all stopped up.

2769. Therefore, the whole exit takes place at the two sides of the ceiling?—At the two sides of the ceiling, and a portion from the riser of the first step of the raised seats on either side of the House.

2770. Is that constantly in action at the riser of the first step?—I believe it is, to a very small extent; it is very small in itself altogether.

2771. The next riser to that you in summer occasionally use for the ingress of a portion of the air?—Yes; it may be so used.

2772. I understood you that it was used?—It has been so used.

2773. And with good effect you say?—Yes.

2774. Do you think that between the first riser and the second the cold coming in at 68 degrees under the second riser would not make its way as quickly as it could to the exit at the first riser, which is close by it, they being within two feet of each other?—They are further than that from each other; but between them there is a short valance.

2775. Do you think that you could so adjust the ventilation of that room, as really to get advantage from the cold air coming in through all the elevated risers without a large portion of it interfering with the exit, which you say is intended to operate in the first riser; do you think that they could be made to act independently?—I think it is very likely a portion of the air from the first riser might pass through the riser intended for discharge; but further than a portion of that of the first riser, I imagine none would pass whatever; it would become elevated in temperature, and would rise so as to be out of the reach of the action of the first riser.

2776. Mr. *Locke*.] Do I rightly understand you to be of opinion that it is desirable to have the means both in the floor of the House, and in the roof of the House, for the access of air and for the exit of air at the same time?—I think it is.

2777. Mr. *Stephenson*.] Do you believe it to be feasible to carry that out with effect?—I do.

2778. What advantage do you suppose arises from that subdivision,

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subdivision, if I may so call it, of ingress and egress, over the simple process of allowing a large volume of air to move into the House quietly and deliberately, without being forced through tortuous passages in this direction, and in the other direction?—I think there is no advantage whatever, provided you can attain that object, and the aim at the House of Peers is to attain that object, by letting a large quantity of air into the ceiling as freely as it will, to pass freely through the House and then go back again.

2779. Mr. *Locke.*] And you think that it is better to do that than to take it out at the floor of the House after it has come down the House?—Yes.

2780. Would not the effect of that mode of ventilation be that as the air came down into the House it would pass through all the Peers sitting on each side of the House, and ultimately find its way up again by the side?—Undoubtedly.

2781. And the air would positively be carried from one Peer to another, according almost to the inclination at which it would rise?—No, I think not; that would scarcely be the effect, for each Peer, as he gave out a certain portion of caloric, would raise the atmosphere round him, which would have the local effect of taking off from him the air that immediately surrounded him.

2782. But the benches are a little elevated?—They are.

2783. Do not you think it would be a simpler mode, supposing the access of air to be from the roof, to take it out at the floor, by which that double breathing, or double occupation of air, by its passing from one to the other, could be avoided?—I do not think it would.

2784. You think, therefore, that in ventilation it is better, if you put the air in at the ceiling, to let it come out again at the ceiling?—Yes.

Lunæ, 26° *die Aprilis*, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Henry Hope.
Viscount Palmerston.	Mr. Thomas Greene.
Sir Denham Norreys.	Mr. Henry Drummond.
Mr. Stephenson.	Mr. Henry Fitzroy.
Mr. Locke.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

Goldsworthy Gurney, Esq., called in; and further Examined.

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2785. *Chairman.*] WHEN last you were before the Committee, I think you gave us some evidence as to your views of the proper methods for ventilation; you explained the operations which you had carried on in the Court of Exchequer, and you also gave us some evidence in respect of what you had found existing in the House of Commons, according to the observations you had made up to that day?—Yes.

2786. Have you since made any examination into those parts of the building which are occupied by Members of the House of Commons, such as committee-rooms, refreshment rooms, and the library, which would enable you to speak now with some accuracy as to the method employed in warming and ventilating those rooms?—I can give a general answer to any questions, but I have not got sufficient data to enable me to give very accurate answers to questions regarding numbers and quantities; I have gone through them two or three times; but it is a very large building, and there are so many rooms to go through (I thought it right to make my observations under different circumstances), that I have scarcely completed them; during the recess there was no ventilation on, nor warming, consequently I could do nothing; since the recess I have been engaged on other important matters; I have done as much as I could; I am prepared to answer questions generally, but not particularly.

2787. Are you able to state what, in your opinion, is the effect of that system, whether it is successful or otherwise, whether it is such as you would recommend the continuance of

of; can you answer such questions as that?—Yes; those questions I can answer distinctly, to the best of my judgment and ability. I would answer this by saying that I think there are in the arrangements the foundation for everything which can be required, except for crowded committee-rooms on special occasions. The arrangements, with very little modifications, are sufficient for ordinary requirements. There is a good deal of artificial ventilation in many of the rooms which is not required; where there are two or three persons only sitting, and no more, I think there is no occasion for special provision; natural interchange of air would be sufficient. In the committee-rooms generally, with the number of persons at present in this room, the arrangements are sufficient, both for warming and for fresh air. There is, however, an evil in the whole of these rooms, arising from the great extent of glass surface, which should be removed. The cooling influence of the glass occasions a plate of cold air to fall, which is not prevented by the arrangement made against it. The glass cools the air in contact with it very rapidly, and it falls as a plate or sheet of cold air. Attempts have been made to warm that sheet of air from below the windows, but the warm air is overpowered by the falling sheet of cold, so that it does not effect its object. These windows are very high, and there is an unusual quantity of glass. The objection, I think, may be removed by a simple and inexpensive contrivance. I should not recommend double windows, first, because they would be very expensive, and would interfere with the architectural arrangement of the building; secondly, because, after all, double glass would only get rid of one-half the mischief. If a simple transparent blind, or curtain, which drew upwards instead of downwards, so as not to interrupt the light above the principal part of the window, was properly arranged, the stream of cold air falling from the glass, might be warmed *in situ* by the present warming apparatus. The intervening air then would be warmed, and the evil now produced by the falling cold sheet of air would be removed; this might be done too at a few shillings expense. My present observations and attention was turned to this subject in consequence of Sir Charles Barry, a day or two ago, when I was present, in his examination, stating that he thought it would be necessary, in order to get rid of this difficulty, "to put double windows into some of the rooms," which he appeared much to regret. On looking at the subject after I left the room it appeared to me that the remedy which I have suggested would remove the evil; and inasmuch as it could be tried at a very

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a very small cost, I would recommend its being done; I think it would remove this evil connected with all the committee-rooms and others.

2788. About how high would those curtains go?—I think a little more than half-way would be sufficient, even in the coldest weather; there is no occasion to draw them up so far as this in warm weather; a plain white curtain would be sufficient for the experiment, and even for practical purposes; I think the warmth air from a triple steam coil, or from those now fixed, would remove the evil. The other day in this room, when I was testing the amount and direction of the incoming and out-going air, I found that the cold glass of the window brought a current of cold air down at the rate of about a foot a second, from 60 to 80 feet a minute; this was a sensible and disagreeable fall; it ran along the floor.

2789. Are you able to say from the experiments you have made, whether that amount of air simply comes from the glass, or whether any part of it may be attributed to defective glazing or defective shutting of the portions which open?—The principal evil is from the cold glass; there is an incast through the windows; there is a leakage always found about windows, however well made; I do not think that that intake of air is of so much consequence as the cold sheet of air which falls from the cooling influence of the glass; the air that comes through the window leakage will go horizontally, or nearly so, into the room; but the air that I am speaking of is the cold sheet that falls from being cooled by the glass surface.

2790. Then you are not of opinion, that if greater attention were to be paid to the glazing and shutting, any very great remedy would be brought to the state of things which is now complained of?—I am not; in winter time particularly.

2791. Mr. *Hope*.] What provision would you make for enabling people to look out at the window if you blocked up the lower part of it?—You could not look out when the blind was drawn up; if this is an object, you might have a double glass frame to put up occasionally part of the way; the question of looking out never entered my head. If you put another glass inside instead of the curtain that I speak of, you might look through it, and the same effect would be produced by warming the air between the two casements as between the curtain and the window; without this warming between, glass alone would only remove one-half of the evil.

2792. Mr. *Drummond*.] You have made use two or three times of the expressions "plate of cold air" and "sheet of cold air" descending?—Yes.

2793. Therefore

2793. Therefore a room is heated or cooled in successive layers of air, not by the heat permeating through the layers?—I have used the term "sheet" and the term "plate" almost synonymously, to mean that vertical plate of air next in contact with the window; the descending particles of air call after them other particles, which fall in with the current; the whole increases as it it descends, and forms a large descending plate of air; when it touches the bottom it runs along the floor into the room.

2794. That sheet having come down is supplied by another sheet, which is equally cooled against the glass, and comes down, and so continually follow?—Certainly; that is an exact description of it.

2795. *Chairman.*] I believe that there is beneath these rooms a separate coil, which is not always, though generally, used in cold weather, for the purpose of rarefying the air and giving an additional upward current, and an additional warmth to the air which is supplied from below to these rooms?—There is.

2796. There is also, I believe, a coil of pipe immediately underneath the windows to counteract the effect of the cold sheet of air?—Yes; it is placed there with that view; but I do not think it effects the object.

2797. Are those pipes heated by steam?—Yes.

2798. Have you at all, in the course of your experiments, ascertained what the temperature of those inner pipes is?—I have not; the in-coming air, from what may be called the aorta, is passed through a chamber with vertical pipes standing in it; steam is made to pass into these vertical pipes, by which the air is tempered. I believe it is brought to the temperature of about 62° in this chamber.

2799. Mr. *Locke.*] I understood you to say that you considered the warming apparatus attached to these windows for the purpose of getting rid of the cold air, which is a contrivance of Sir Charles Barry, quite ineffective?—I think it is inefficient in very cold weather; if the temperature outside is below 46°, it is so; I think at a higher temperature outside, the warm air from the coil would rise against the falling one.

2800. Under those circumstances it would be, perhaps, effective?—I think so, but not in cold weather.

2801. Do you know whether Sir Charles Barry himself proposed that there should be double windows?—Yes; he proposed them in his evidence.

2802. Then what you propose to remedy the defect, instead of double windows, would be to put a screen against a large

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large portion of the window, by which persons on the inside of the room would be prevented from looking out?—It might be a transparent screen.

2803. You might make it of glass?—If you made it of glass you might see through it. Perhaps I may be allowed to say that I suggest the curtain more as a matter of experiment, to prove my view to be true; no doubt it would be more desirable to have double windows on some accounts; but unless you make the arrangement so as to pass warm air between those windows, namely, between the outer glass and the inner, you would never do away with the mischief. The temperature between the glasses would be the mean between the external and internal air; so that in frost, when the external air was, say 30°, and the internal air of the room 60°, the temperature between those two frames would be 45°; you then would have all the cold falling sheets still to guard against.

2804. *Chairman.*] Then, I presume, against that 45° the hot water coil below the window would probably be sufficient?—If the warm air from them was passed between them, but not otherwise; the warm air from the coil now comes immediately into the room, but if it was made to pass up between the two plates of glass, or between the curtain and the window, it would insulate the cold glass entirely.

2805. According to that answer, I understand from you that at present that provision is absolutely useless?—I think it is so in weather below 45°; the external temperature when I tried my experiment on this question was about 43°; then it was decidedly so; you can very easily have the experiment made, and judge for yourselves. You had better, perhaps, have an experiment made for the Committee, or any one to look at, because this is a more important question than at first appears; simple things are sometimes very important; the comforts of the whole run of windows in these committee-rooms and other parts of the House depend on it.

2806. Your great objection I understand to be, that in point of fact, the coil of pipe which is there does not obviate the coolness, for whereas the cold air falls straight down, the hot air goes into the room and takes a different direction, and the two do not mix immediately together?—Just so; the cold air is too heavy for the light; it overpowers it.

2807. Mr. *Stephenson.*] That is surely a mere question of temperature?—Clearly of the encased plate of air.

2808. You do not believe that under all circumstances that coil of hot pipe would fail to overcome the downward current of cold air?—No; when the difference of temperature

is

is slight, its extra weight would not overcome it, but in cold weather, when you want it most, it would not.

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2809. When you want it, you have the means of increasing the temperature of that coil, have you not?—Yes; you may bring the temperature of the coil up by high pressure steam to what you please, but not to overcome the fall of the down current.

2810. Mr. *Locke.*] Supposing the external air was as you state, at 45° or 42°, to what, in your opinion, would it be necessary to have the air inside heated in order to counteract the effect of the external air?—I do not think you could do it at all under the existing arrangements, because air is so easily moved, that a very slight disturbing cause would change its direction; air can get away sideways so easily from the pipes into the room, that there is hardly an expression you can use to show what the amount of that resistance really is. Cold air now acts upon the warm to drive it down; if the warm air be made to pass between the two windows, or between the curtain and the window, it would rise; but open, as at present, it comes immediately away into the room.

2811. Do you think that the present system of arrangement would be effective provided there were a double window?—Not unless the warm air was passed between the two portions of glass; I have seen so many cases of it that I speak positively on the point, from actual observation and experience.

2812. Mr. *Hope.*] Do you think that it would be possible, by blocking up the whole of the lower window above the two lower panes, and also the four upper panes of the upper window, with wood or slate, or stone, to meet the difficulty entirely, leaving the two lower panes of the lower window, and a portion of the upper window?—I do not think that allowing the under panes to be open would materially interfere; I think you might then look through them, if that is the object of the question.

2813. My object is to provide for a sufficiency of light?—I think that the upper portion of the window would give light enough; it is a question of surface; you would open a very small surface for the purpose of looking through; its reduction of column would not be sufficient to interfere with the respective weight of the others.

2814. Mr. *Locke.*] Do you think that the inconvenience which is felt in the room arises principally from the difference of temperature between the internal and external air, or from the pressure of air arising from the wind?—From the difference of temperature.

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2815. Then you think that more is owing to the effect of the difference of temperature than to the effect of the wind?—I think so; unless the wind blows strongly from the east, I do not think it of much consequence.

2816. Do you know whether, when it is most severely complained of, it is in times when the wind is blowing from the east?—It would be then very cold weather and you would have both causes, under those circumstances, operating together; but the great disturbing cause is the cold sheet of air that falls from the cold glass; the air that leaks through the window I do not think is of much importance; it would produce a disturbance in the air of the room horizontally, but would not produce that sheet of cold air of which we are speaking.

2817. Mr. *Drummond.*] Although there may be too much glass in the room for the temperature, do you think that there is too much glass for the light required in such a large room as this?—I do not; when you consider the source from which light enters a room, and consider the value of the direction from which it comes, you will find that a foot of glass above, for admitting light, is worth five feet below, for all practical purposes. At this moment, if you blocked up a large portion below, you would not see much difference in the effect of light in the room, but if you stopped it up at the top you would.

2818. Have you ever been in those countries where they trust chiefly to double windows to warm their rooms, such as St. Petersburgh, and Moscow, and Dresden?—I have seen rooms of that description, not abroad; the result of my observation and experiments are, that you just get rid of one-half the evil with double windows, and no more; but when you pass warm air between double windows you get rid of the whole; you effectually get rid of it.

2819. *Chairman.*] Have you ever known any instance where hot air has been passed between double glazing?—Yes.

2820. Where?—In my own house, and other places.

2821. By what means?—By warm air coming through a pipe and passing in between the glass frames.

2822. Where does it go to when it has got between?—Into the room.

2823. Is there an egress for the air at the top of the window?—Yes, a small one.

2824. Into the room?—From the top of the internal portion; there is a small opening below the warm air pipes, up between the glass; the extra quantity going up comes out above.

2825. Mr.

2825. Mr. *Locke.*] In point of fact, you convert it into a mixing chamber?—Just so; you have a portion of warm air and a portion of cold; the air is cooled by the atmosphere without, through the glass; if you have warm air between the two frames of glass you have a plate of warm air insulating the external air entirely. I may further remark, that the principle has been introduced into some hot-houses with great advantage.

2826. *Chairman.*] You were just now describing your impression of the manner in which the warm-tempered air passed into the committee-rooms and other rooms belonging to the House of Commons; will you proceed with your description; you had got, I believe, so far as to say that after being brought by the fan from the sources of supply into the tempering room where the upright iron pipes are, it passed forward somewhere; will you continue the description from the point where you left off?—The air is passed into the tempering chamber, where vertical pipes are placed filled with steam; I think that there are four sets, or compartments; the steam can be made to enter into the four altogether, or in different portions of these pipes at will; so that the whole may be warmed, or a part only. The air in this chamber I believe is tempered to about 60°; it is also moistened there; it then passes through various conduit channels to the different rooms; the trunk channel leading to the committee-rooms has an express opening from it into each committee-room; at the bottom of this channel there is a special apparatus (of coil pipes), by which the air then may be raised from 60° to a higher temperature if required for the room.

2827. (To Mr. *Meeson.*) What is the diameter of the pipes in the tempering room, and at the bottom of the committee-rooms?—Four inches each.—(Mr. *Gurney.*) So that the air, if it requires to be warmed above the ruling temperature, is brought up specially for the room. I would observe that in the first chamber the pipes are vertical; that is a far better arrangement than placing them horizontally, as in the second; the air, the moment it becomes warm, strikes against the side of the vertical pipe, and escapes sideways by conviction before it has time to arrive at a high temperature.

2828. It has a species of centrifugal motion?—It escapes easily under the laws of conviction; there is nothing to arrest or prevent it; but in the horizontal pipe air forms an eddy above, and remains for a short time in a sluggish state, almost a state of rest, and thus becomes overheated. The objection therefore to the special coil is, that it is horizontal; I think the less they are used the better, on that account.

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2829. Passing onward from those separate means of warming the committee-rooms, are you of opinion that there is sufficient ingress from that point, and that the current of air comes equally into the room, and passes through the room in such manner as not to destroy what you have termed the feather balance?—All the inlets and outlets are under regulation, so that the quantity admitted may be governed by them to a given quantity; this may be done by the man in attendance.

2830. Are you sufficiently acquainted with the openings for the ingress, and also the apertures for the egress of the air, to induce you to believe that it can be managed satisfactorily?—I have seen the openings in the general passage; I have not measured them; I have taken it for granted that my information has been correct, that they are of a given area the whole length; I conceive them to be adequate for all ordinary purposes.

2831. Have your observations been such as to lead you to believe that the information given you is correct in producing the desired effect?—I have no reason to doubt it. In support of it, I may observe that I have measured the quantity of air coming into this room by filling it with gunpowder smoke; the time it required to escape corroborated the information I received. In that experiment there was sufficient evidence of there being ventilation enough for all ordinary purposes; but I do not think enough for a very crowded room.

2832. Are you then of opinion that there are not sufficient means for that purpose, or that the means which are now in operation are not sufficient for that purpose?—How far they can be made so must depend upon the forces brought to bear; the motive power or plus force is finished; the extracting force at present is not finished; if the extracting force be made very powerful there is no doubt a very much larger quantity of air could be drawn through this room than at present.

2833. Would the air be drawn from the source expected, or from all sorts of sources, if a strong vacuum power were put on?—It would be drawn from the west side of this room; the vitiated air would be drawn from the west side; for every foot of air that was so drawn out, a foot of air would come in on the east side to supply its place; you would have the room in a state of minus pressure; the room is supplied below as well as through the west cornice; the two forces acting together would increase the quantity very much.

2834. Do you think that there are sufficient means for the ingress of air to render the application of a strong extracting power desirable, or if it were so applied, that it would not cause

cause any disagreeable feelings to the Members in the committee-rooms?—I am afraid it would; I think the supply coming in rapidly and passing out rapidly would entail the consequences of secondary currents, which would be inconvenient; therefore, for crowded state of a room requiring extra ventilation, I should prefer allowing it to come in at the upper part of the windows, and be drawn out by a more powerful escapage, or by opening a larger connexion with the extracting shaft.

2835. This, I presume, is not the system that you would have recommended?—The system that I should have recommended would have been to extract from below; I have given reasons for it in previous examinations; but as I find the arrangement made, I should not now attempt to alter it; without altering very considerably the arrangements of the House it could not be done. I should provide for the case of emergency of a crowded apartment, by having the power of letting in air from the windows from a high level, so arranged as to throw it upwards, not to bring it down directly upon the head, but to mix generally in the room.

2836. Supposing this portion of the ventilation were to be placed in your hands, would you retain the iron coils which you have described, heated by steam in the manner which has been spoken to by those competent to give evidence upon the subject?—I should, the aortical ones, in the tempering, for warming the incoming air; with respect to the extracting power of the shaft, if heated by a coil, it would be sufficient for the ordinary purposes for which rooms of this kind are required; but certainly I should increase the power and use the jet in case it was wanted, to produce a larger amount of outcast, in cases of emergency.

2837. The object of my question was to ascertain from you whether you think that the present system, which you, in your former evidence, termed a somewhat complicated system, ought to be retained, or whether you think it would be more advisable to substitute the more simple system, which you have described as the system you recommend in the Court of Exchequer?—I think it is far more desirable to ventilate by the single action, according to the system adopted in the Court of Exchequer; but it is one that cannot now be introduced here under the conditions in which I find the building.

2838. The channels being there made such as we have seen, and such as you have described, and as have been described to us by others, you do not think that would suit the system of which you are the author, which you have applied, and models

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of some portions of the machinery of which you have displayed to this Committee?—It might be done, but it would be attended with considerable expense and inconvenience, such as would hardly be worth the change. These rooms do not require that special ventilation which other more crowded parts of the building do; such as the lobbies; "the House" itself, for instance; these are under different conditions. I am speaking of these rooms under ordinary circumstances, and when they are crowded; for the latter case some provision should be made.

2839. But taking into consideration the probability that some of them will be, at many times, such as in Election Committees, and other Committees of great public importance, so crowded, supposing this Committee asked your opinion as to what you would recommend to The House for general adoption, are you decidedly of opinion that they should remain content with the present system, or are you of opinion that some other system should be adopted in lieu of it?—I am of opinion that some express system should be adopted; if means were at hand for opening these windows in the ordinary way in which church windows are opened, so that fresh air should be admitted upwards, and mixed with the air of the room, and at the same time an escape prepared by larger openings, it might be sufficient; making large openings above the doors for this purpose, leading to these corridor windows, would pass a large quantity of air. I think this command is simple, and one which would be found, in practice, effectual. In support of this opinion I would refer you to the evidence of Mr. Clark, from York. In cases of emergency windows are opened in those courts to a greater or less extent; and that in all cases fresh air is only admitted from high level windows. He says he opens those windows just as they want air, without any inconvenience being felt. These facilities are simple, and at hand; in this case I see no objection to a similar simple means of the kind being adopted here, rather than pull the place to pieces; it could be used, or not, as circumstances required.

2840. Then I understand you to say that the simple remedy which you propose is to open the doors and the windows?—To open the upper part of the windows, and allow the air to escape over the door, or through some larger channels made above in the ceiling. There must be two openings for ventilation, and it is important that those openings should be at different levels; you may ventilate through that window by opening the upper part of the window, and opening the under

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part of the same; you will always find a current of air setting in at one opening, and going out at the other; if the air outside is colder than the air inside, it will come in at the bottom; but if in summer it is hotter outside than in the room, it will go out at the bottom, and come in at the top; if you have only one entrance, it must be sufficiently large for two currents to pass each other, one to come in, the other to go out; it is very difficult to get air in and out through the same opening; if small openings be made at the bottom of the windows, and at the top, it is probable they would pass sufficient.

2841. Supposing the case to arise which you have described, of a very crowded committee-room, on a very interesting subject, and that the people in that room felt themselves inconvenienced by the temperature, and that they should then proceed to open the door and the window, what sort of sensation would those people have near the door?—They would feel comparatively fresh.

2842. Mr. *Greene.*] With a strong east wind setting in?—Then they would not require the window to be opened at all; you are now supposing an extreme case, of the room to be overcrowded and overheated; it would be better to carry the vitiated air off above the heads than through open doors; I do not wish the impression to go forth that I recommend it to go through the doors; I mention that it can go through the doors as one way of doing it in case of emergency; I propose that fresh air should be admitted at the upper part of the window, and allowed to go out at some opening on the other side where it might escape with facility.

2843. Supposing you made the outlet on the west side of this room very strong indeed, and then introduced your air from the cornice on the east side, might there not be a very strong draught carried across the ceiling?—There might be, but I think it would be wholly accidental; the disturbance of air is so easy under those circumstances that I do not think it would; I think that what are called the retrograde currents falling into the wake of the in-coming air would divert it in other directions out of the direct course which you suppose, from side to side.

2844. Still there would be the liability of a stronger draught from the direction in which you brought the air by the wind blowing the draught on the opposite side across the ceiling?—If there were a want of control, the room would be at the mercy of the winds.

2845. What would be the description of control which you would

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would recommend?—Under proper regulation of valves it would not be so.

2846. What do you mean by proper regulation?—To be able to regulate the areas of the passages at will, so as invariably to produce a given balance.

2847. How are the attendants to estimate that?—They can do it by observation from practice; but if they require an instrument, they could not have a better than the differential pressure gauge; it indicates the slightest preponderance; I think it would scarcely be necessary.

2848. Mr. *Hope*.] May we from your evidence draw the conclusion, that after having laid out 200,000 *l*. on ventilating the House, no better plan is to be devised than that of opening the windows?—You can devise plans, and you may change the system; the question before us, I take it, is one applicable to the present state of the building. I say, it is not worth while to interfere with the system as we find it; I would not, to alter the system of ventilation, go to a great expense, and upset the building; I would be content to introduce the means at hand which appear to me self-evident would get rid of those evils which temporarily obtain, and which may only occasionally be felt.

2849. Then am I to understand you to say absolutely, or merely with reference to the particular case of the House of Commons, that the best mode of ventilation which can be devised is by opening the windows?—I would rather have time to consider that question more maturely before I answer it; at present my notion is, that the evils of the committee-rooms might be removed by opening the windows and ceiling; it would only be required in hot weather, in summer.

2850. *Chairman*.] By opening the windows, but having a corresponding opening in the wall on the opposite side?—With the ingress of air, there must be an equivalent outlet given somewhere.

2851. Do you prefer that outlet about the same level on the opposite wall high above the heads of the people?—If it were at a different level it would be better; but if it could not be, you might have it at the same.

2852. I presume you wish it to be considerably above the heads of the people who are inhabiting the room?—Yes.

2853. That is a *sine quâ non*, I presume?—That the persons of the parties in the room should not be under the influence of a direct current is a *sine quâ non*.

2854. And that could only be attained in the manner which I have mentioned?—Yes.

2855. Mr. *Locke.*] But this suggestion of yours is only a sort of temporary expedient, upon those occasions when the room might be in a crowded state?—Yes.

2856. Taking the state of things here to be such as it is, supposing the arrangements are not sufficiently perfect for ventilation at those times when there is the largest number of persons in the room, what permanent course would you recommend the House of Commons to adopt in reference to it?—That is a question which I have not considered sufficiently to answer; whatever it be, it must suit the condition of the building; you might put a steam jet in the chimney; this would draw an immense quantity of air through the room; you might place a cylinder in this chimney, and by putting a little steam jet in it, about the size of this pencil which I hold in my hand, it would pass 5,000 or 6,000 feet of air per minute from the room up the cylinder.

2857. Mr. *Stephenson.*] That would be a great deal too much, would it not?—It might be for the occasion; it does not follow that you must draw that quantity; you might draw little or much, at will.

2858. Mr. *Locke.*] There are other modes, then, than the one which you suggest, of opening the windows, by which the ventilation of these rooms may be made perfect, even at those times when they are excessively crowded?—Certainly. I have suggested these means as being the readiest, the most simple, and the least expensive.

2859. Do you know what the exit passages connected with these rooms are in area?—I do not exactly.

2860. Then you do not know whether the velocity could be increased?—It might; and it would matter little what the rate of velocity through those channels was, because the current would be entirely out of the room, and could not be felt. When I say I can pass 6,000 feet of air per minute through a certain sized cylinder, I would mention that that cylinder would be out of the room; it need not be more than nine inches in diameter; this experiment has been done over and over again. You must take my opinion for what you think it is worth; I state the fact, that through a 9-inch cylinder, placed in that chimney, if it were a matter of necessity, you could place a small steam jet, which would draw from 6,000 to 7,000 feet of air per minute through this room; and, if properly made, without any noise being heard.

2861. I understand you to be in favour, then, of a simpler mode of ventilation, drawing from the roof and taking your exhaustion from the floor?—As a principle, certainly.

2862. In

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2862. In that respect you differ, then, from Mr. Price, who takes exactly the converse mode of effecting the ventilation?—If he prefers the converse system, I should decidedly.

2863. And you do not agree with Sir Charles Barry, who takes his air from the roof, and also takes his exit from the roof?—I should prefer its being drawn from a low level.

2864. I understand you to say that you prefer drawing your air downwards from the roof, and having your exits from the floor, because a different mode would involve a great many alterations in the present system?—In these committee-rooms; my answers should be taken entirely in connexion with these committee-rooms. Here we have a building already made, under certain conditions.

2865. Do you suppose that you could feed these committee-rooms entirely from the ceiling, or would you take the means at present given?—I would take the means as I at present find them. There is an admission above and below, and at the side, to a large amount; but I should prefer extracting from below.

2866. In this case you would take your exit from the ceiling?—I would, under existing circumstances. The libraries are under the same regulation as these rooms; the libraries are comfortable, with the exception of the cold windows; there is nothing about the libraries to object to; they are thinly used; never crowded; a committee-room is often over-crowded.

2867. *Chairman.*] Does the evidence which you have given apply to the refreshment-rooms as well as the library?—The refreshment-rooms I have investigated twice; there is an interference in the refreshment-rooms now acting which I wish further to look into before I give an opinion. There is an upcast from the overheated cooking-rooms below, which interferes with the air above; possibly there may be an express provision necessary for these rooms, to remove the effluvia from the cooking. In the smoking-room there seems to be very effective ventilation. If the refreshment-rooms have an express shaft, which I believe they have, there would be no difficulty in increasing the ventilation by proper means, to occasion a more powerful up-cast.

2868. Did you hear Mr. Meeson's evidence with regard to the smoking-room?—I did not.

2869. Are you aware that that is dealt with solely by the extracting power?—Yes; there is an extracting shaft expressly for that room.

2870. Do you think that that might be also applied to the refreshment-

refreshment-room and the kitchen if necessary?—I think so; the refreshment-room has an express outlet now; the power in it may be increased. If the coil is found not sufficient, it may be increased by the jet.

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2871. You state that you think, with the exception of the cold air coming down from the windows, generally speaking the ventilation in the libraries and in the committee-rooms is satisfactory?—I think that it is equal to the ordinary requirements of those rooms for select committees, not for public committees.

2872. But you are of opinion that the effect of the cooling operation of the glass ought to be in some manner counteracted?—I am.

2873. That until that be the case, they cannot be considered as properly warmed and ventilated?—No; particularly in the first stage of the Session, in February, March, and April; in warm weather you will find no inconvenience from the glass.

2874. Then no warming is wanted?—No.

2875. What do you think of the quality of the air, especially in the library?—The quality of the air, wherever it is objectionable, is from the horizontal pipes; I have a great horror of horizontal pipes from experience, for the reasons which I have previously given; but I have not had sufficient opportunities to say that the air is worse there than in other rooms, or worse in one committee-room than in another.

2876. Have you given as much attention to these rooms, and to the libraries, as you have to the House of Commons?—I have not; I have not had time to do so.

2877. Have you given sufficient attention to them to express an opinion upon the subject as to the quality of the air?—Not a positive opinion; I can give only a qualified opinion as far as I have at present investigated.

2878. What have your sensations been?—My sensations have been generally agreeable in the libraries, with the exception of the cold sheet of air falling from the windows.

2879. In walking through the lobbies and large halls and corridors, have your smell and taste of the air, if I may use those expressions, been such as to satisfy you that they are well ventilated?—If I may coin a term, I would say that the air is "caustic;" it partly arises from the particles of caustic lime and earthly matter floating about, and partly from the horizontal pipes which are to warm the air in the Cloisters and Westminster Hall; the system of warming there is different from that in the other part; I think a good deal

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arises from that cause; there is a peculiar sensation produced on the mucous membrane, which I should term caustic, something like that from caustic potass; I have no better term for it.

2880. Do you mean by that in reference to smell or taste?—Partially to both.

2881. Do you consider that air to be unwholesome?—I do not know how far health may be affected by it; the purer the air for health the better. If there are portions mixed with lime, burnt air would be injurious; if the air is overheated it is no doubt unhealthy, by its great affinity for water taking it too rapidly from the lungs.

2882. Have you ever smelt the kamptulicon which is laid down in the passage?—When it was first laid down I did.

2883. Is that organ of your sense delicate?—Ordinarily so.

2884. To what do you attribute the greater defect of the air in the House of Commons, compared with that which you have breathed in the library, committee-rooms, and lobbies?—I attribute it to its being partially overheated, and partially to impurities being drawn into the House from sources which are contaminated, and were never contemplated to pass air inwards. The air in the libraries is not so deteriorated, because there the plus action is in excess.

2885. Whereas, you mean to say that the vacuum is rather in excess in the House of Commons?—In the House of Commons it is so; in the libraries it is rather the other way.

2886. Have you been in the House of Lords?—Yes.

2887. Have you made any observations there?—I have gone over the whole of the arrangements for supplying it with air, and for warming, but I have not taken that particlar notice of it yet which I have of the other parts, because I did not feel that I was called upon to do so; I know the general arrangement in the House of Lords.

2888. Can you give any opinion as to the way in which that House is ventilated?—The House is ventilated by two forces.

2889. As to the effect, I mean?—The effect is, that when the pneumatic balance is preserved it is comfortable; but when the pneumatic balance is disturbed, then I understand occasionally a draught of air is felt.

2890. Have you felt draughts there?—I have.

2891. You have felt draughts in the House of Lords; have you breathed desiccated air there?—I have not.

2892. And you attribute the difference, as I understand you, partly to the different means of warming the air, one being

being by means of a horizontal pipe, and the other a vertical; partly to the different sources from which the air is extracted, and partially to the greater overheating in the case of the House of Commons, compared with the House of Lords?—Just so; partly to the difference that in the one case there are horizontal pipes and in the other vertical ones, and partly in consequence of there being a partial vacuum in the one case, by which air is drawn in from uncontemplated sources; in the other the balance is very nearly preserved.

2893. I observe that in your second Report to the House of Commons you state that the temperature varied very much in different portions of the House when you tried it with your thermometer; also that the break of balance showed that the proper hygrometric conditions of the atmosphere were destroyed; that is so, is it not?—It is.

2894. Since the alteration in lighting, have you made any experiments?—I have not.

2895. Mr. *Stephenson.*] When you made your experiments in the House of Commons with your differential barometer, did you find the air in the House in a rarefied state, or in a condensed state?—Rarefied.

2896. Therefore you attributed that condition of the air to the vacuum draught upon it from the shaft, where the furnace was?—I did.

2897. I take it for granted, that as a consequence you thought that the apertures of ingress were deficient?—Certainly.

2898. If the carpet were removed from the floor—I will not say that that is the most comfortable condition for the House to be in—but in order to get at your view, I will suppose the carpet to be removed, and all obstruction, all limit in fact to the ingress removed, then by having an aperture in the ceiling, which you would regulate in size, would the House, under those circumstances, ever be in a rarefied state?—It would not; I presume the communication with the floor to be perfectly free; it must not be throttled below.

2899. I assume that it is all open; that it is very much larger than the exit aperture; then it would always be in the condition of a feather balance?—Yes.

2900. Therefore, if I understand you correctly, in treating the House, you would never put a limit on the aperture by which the air comes into the House?—There is a limit to all things; you must guard against external interference. It does not follow that it is necessary to remove the whole of the carpet from the floor of the House of Commons to restore

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the break of balance; the break of balance may be restored through a much smaller area than that, but not through the present amount of area.

2901. Still you would, I apprehend, regulate the ingress of the air to the House by enlarging or reducing the exit aperture?—I would so arrange the intake as compared to the outcast that there should be no inconvenient break of balance between the House and the external atmosphere; that the air of the House should be only a feather break of balance.

2902. It is inappreciably small, I admit, but still it answers the expression plenum; there is a slight pressure of air in the House?—If you draw from above there will be a slight intake; the feather will draw inwards; if you ventilate by plus pressure, then the feather will go outwards.

2903. In order to explain my meaning, which you hardly seem to catch, I will take this room: you know that there is a valve by which the air is admitted into the room from the great chamber underneath?—Yes.

2904. And there is another valve at the exit into a large gallery, which has 50 feet area?—Yes.

2905. Mr. Meeson told us that a great many of the exit apertures were not fitted with valves; that one or two of them were, but that generally speaking that part of the ventilation of the committee-rooms had not been completed; did you understand that?—I did not hear all his evidence, but I can understand your description.

2906. Of what use can you conceive those two valves are?—One to regulate the quantity of escapage, and the other, under the circumstances in which the ventilation is carried on here, to regulate the quantity of ingress. I object to those two forces, and two regulations, and have done so in all my examination; I have been making a point of this constantly; practically you ought to do with one.

2907. Mr. *Locke*.] Which two forces?—The pushing and the pulling, if I may so call it. I think I now catch Mr. Stephenson's meaning; if the air is strangulated, or what is technichally called "throttled" in the exit, and there is at the same time free ingress, you cannot destroy the balance so as to be perceptible.

2908. Then the room would be in a state of vacuum?—No.

2909. If you open the exit aperture, and make it larger than the inlet, then, if the air is drawn away, the room will be in a state of vacuum?—Certainly.

2910. In ventilating these rooms the same as in the House

of

of Commons, would you use the egress or the ingress valve, or would you use both?—You must use both, as we find the arrangements; I should depend principally upon regulating the escapage valve; I should allow the other to be perfectly open.

2911. Do you attach much importance to the ingress valve?—If the air courses are properly made, so that air can come in freely, you do not require it at all.

2912. Therefore these committee-rooms possess the valve which you think least useful, and they do not possess the valve which you think most useful?—They are to possess both; the exit valve is not finished.

2913. (To Mr. *Meeson*.) You stated the other day that the exit valves were not fitted to a great many of these rooms?—To some of them; I do not know how many.—(Mr. *Gurney*.) I should certainly, with the view of preserving the balance, regulate the extraction; I should allow the intake always to be as free as possible.

2914–15. Then in point of fact, you would arrive at that state of the air in the House by regulating the exit, and allowing the air to come in as it might?—Yes, if it could come in freely.

2916. Do you think you would arrive in that state of things very nearly to a plenum, the feather balance being in point of fact a state of things in order to arrive at a state of plenum from that of exhaustion?—Yes.

2917. It is a point at which you approach the plenum system?—It is a point in that direction; you want to establish a "feather balance" between the air externally and the air internally.

2918. And you think the best mode of doing that is by keeping your control over the exhausted air, and allowing plenty of access of air into the room?—Allowing it to enter freely, but not to produce a sensible exhaustion.

2919. You seem, as I understand you, to perfer using the downward current instead of the upward one, as applied to the difficulty connected with the arrangements of these rooms; are there any difficulties connected with the arrangements of the House of Commons that induce you to come to that conclusion, or do you prefer the downward draught because you think it absolutely better than the other?—In the House of Commons there are facilities for it; the change might be easily made; I prefer it, and propose it; but in these rooms their construction offers a practical objection; I do not think it is worth while to incur the great expense and inconvenience necessary to alter these rooms.

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2920. You referred to the impurities which are drawn into the House; would your system of reversing the drawing of the air get rid of those impurities?—Yes.

2921. By what means?—By allowing the air to come in so freely from above that there should be always a balance; this would prevent an intake from contaminated sources.

2922. Would it not come exactly from the same sources?—No.

2923. How do you propose to take the air if you do not use the same channels?—If the air is brought in from above you must take it from other channels provided for it; there are some through the roof; or you can connect the upper part of the House, above the ceiling, with the Clock Tower, from which fresh air may be obtained.

2924. Supposing you were going to ventilate the House of Commons, according to your suggestion, by the simple exhausting process with a downward draught, where would you place your heating apparatus?—If the air comes direct from the roof it should be placed in the incoming channel there; but if the air be taken from the Clock Tower, then in the passages coming from it.

2925. Then, in point of fact, it would involve a change in the present locality, at all events, of the warming chambers?—Yes; and I should advise a change in their construction.

2926. If in the other alternative you drew your air down the shaft which is now existing, and along past the heating-pipes, would not you have all the impurities and imperfections of the air which you have at present?—If the pipes were placed horizontally, a position which I conceive must inevitably produce an overheated state of the atmosphere, they would decompose a portion of organic matter.

2927. Do you know what would be the alteration necessary in order to change the present system of upward current, or mixed current, to the downward current which you are now suggesting?—Certainly; but I cannot say positively the amount of expense of it; I could ascertain exactly.

2928. Unless you draw the same impurities against which you have already given evidence, you must have entirely new accesses for your air?—The roof of the House at present under the panels is ample for supply; there would be no alteration required there; the air could come in freely. If you made a free access of air to the chamber above, you would have no difficulty admitting all the air which comes into the House from that source, and that source only; but if you strangle or throttle it, and it could not get through that way easily, it would

would come, as now, through the easiest channel it could, and in that case it might possibly come through a contaminated source as the most direct and easiest way. Of course these conditions must be looked to, and placed under proper regulation.

2929. You think that you could get sufficient air for the purposes of the House of Commons from the roof of the House, or some similar situation?—Yes.

2930. At a very inconsiderable expense?—Yes.

2931. Can you give us any idea of what would be the cost of changing the position of the warming apparatus. I wish to trace your own system to see what alterations we should have to make in the present system of ventilating the House?—The alteration of the warming apparatus would not be much above 100 *l.*; certainly under 200 *l.* You would then have to connect the air passage from below with some upcast shaft, steam jet, or other means of extraction; that expense would not be great; I cannot say exactly how much.

2932. You know where the present steam-boilers are?—Yes.

2933. Would you propose to retain those in their present situation?—Yes; I do not think it matters much where they are placed, because you would take your steam-pipe from them to your warming apparatus, or for the steam jet whenever it might be wanted, at a very trifling expense.

2934. In your expense of 200 *l.*, do you intend to change the position of the steam-boilers?—No.

2935. Then you would simply carry your steam by means of a pipe up to your warming apparatus, wherever it might be placed?—Just so; that is, as far as warming goes. As far as the extraction is concerned, it is equally simple. Since I have told you that you can pass 6,000 cubic feet of air a minute through a nine-inch pipe, you may suppose that the expense cannot be very great; it might be carried up through one of the towers. I have not gone into the question of expense so as to be able to give a very satisfactory answer.

2936. Do you know whether other parts of the House of Commons are ventilated from the fan and the vault, because, as I understand, you would make use of that as an exhausting shaft, an exhausting vault?—If I could find nothing better. You may connect the under part of the House with the present exhausting upcast shaft.

2937. Are you aware whether other parts of the House of Commons are now supplied with air from those vaults?—I think only the lobby.

2938. The corridors?—The division-room corridors, none else.

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else. There is an objection to the downward current, which I think it right to state, namely, the descent of vitiated air from the Strangers' Galleries; you sometimes have as many as 200 or 300 people in the galleries; the air, unless some provision was made, would come down from the galleries into the body of the House; to avoid this evil there must be an express escapage made for it from the floor of the Strangers' and Speaker's Gallery. There is no difficulty about it, practically. At the first blush you will see it is a seeming objection to the downward system of ventilation, namely, that the whole of the vitiated air of those galleries would fall over the rails down upon Members below; but this need not be; it can be removed by connecting the extraction below the floor of those galleries, as easily as below the House.

2939. I understand you to say, that you would adhere to the present system of ventilation in these rooms, partly because it was already done, and it would involve a great expense to make a change; do you adhere to the downward current relating to the ventilation of the House of Commons, simply because you fancy it would only cost 200*l.* to change the present system? Supposing it was to necessitate a larger expenditure to change that system, are you so much in favour of the downward current as to induce you to incur a large expense in order to employ it?—I would.

2940. *Chairman.*] Will you therefore state now to the Committee your reasons for preferring the downward draught, supplementary to what you stated upon the day you were previously examined?—I would refer on this subject to the evidence which I gave to a Committee of this House upon the Ventilation of the New Houses of Parliament in 1846; the answer which I then gave to that question I will partly read, if the Committee will allow me; it is a very long one; I will cite some parts of it only. The question was, as to what were the advantages of a downward system, as compared to an upward current, in ventilation.

2941. What is the date of that evidence?—May 26th, 1846; Question 1323. The points in this answer are chiefly as to the products of combustion being heavier, the inconvenience of dust rising from an upward current, and as to the most serious practical objection of all, the incoming jets of air. The answer goes on to state, that "this latter is one which cannot be got over;" it is inseparably connected with pneumatic laws of air entering from below for ventilation; and goes on to show that air, where it enters, must produce a series of disturbances highly objectionable to the feet and legs, if in sufficient quanti-

ties

ties for proper ventilation. Before that period these disturbances never had been contemplated; it was thought that a draught of air was "a draught," and nothing more, going straight ahead in a given direction; but on the investigation connected with the rationale of the steam jet, it was apparent that the secondary currents arising from the primary motion were of more importance than the first, as respecting this question; for instance, it was manifest the air first passed in a given direction drew after it air that fell in its wake, which formed a series of currents of more consequence than the first. These would all take place near the floor, or near the source of the air entering, wherever it might be; if the entry of air were through the floor these series of currents would all happen in that locality, and therefore they would fall upon the person, and be very inconvenient. It was on this account that I recommend principally the downward system.

2942. Mr. *Locke.*] Are there any other reasons?—Yes; there are the emanations from the skin and sebacic glands.

2943. *Chairman.*] The exhalation from the human body?—That is one reason, but not alluded to in the answer before me; the experiments which I have made since this period all go to confirm that my views were, not only on this account, but as connected with other interferences correct, which at that time were not thought of.

2944. Must that upward current be a current coming from the floor, or does it apply equally to any upward current, such for instance as that produced from the risers of the steps, or other portions at the side?—They would all be inconvenient if the incoming air impinged directly and closely on the person; and on this account it is that the streams of incoming air should be at a distance, and so far away as to be broken up before they would impinge on the person. This is the reason expressly given in my evidence; the experiments which have been made since are with carbonic acid and other exhalations. From experiments which have been made since that, it appears that carbonic acid in excess does really fall under ordinary conditions; that it is not theoretically but practically so, from experiments made by me, and repeated by others, it may be seen; for instance, in your sleeping-room, where the atmosphere is very still, you may detect different quantities of carbonic acid at different levels. Fresh lime water will do it; if fresh lime-water be placed in a basin, on the floor, on going to bed, you will find in the morning that there will be a slight pellicle on the surface, showing the formation of carbonate of lime on the water; the water sometimes will have a milky

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milky appearance; this depends a good deal upon the stillness of the atmosphere. In a basin placed midway between the floor and the ceiling it will be scarcely visible, and in a basin placed high up it will not be seen at all. These are indications of quantities which show that the falling of carbonic acid practically is not altogether visionary, but that it is in fact really so. That is an experiment which any of you may make, but if you should make it, you must take care that there are none of those incoming currents which I have spoken of to disturb the atmosphere of the sleeping room, for if so, you will fail in the experiment; shut up the fireplace. That the effluvium from the sebacic glands falls there can be no doubt, and may be detected by actual experiment, under ordinary circumstances; it can be seen by observing many natural phenomena; we all know the fact of a dog following his master; the dog follows him for miles in the country entirely by the falling of this effluvia, even in stormy weather. This in the dog is a natural, not a supernatural power; there is something which has fallen to a low level from the person; it is this which produces what is commonly called scent. With regard to the emanations more directly from the sebacic glands, we all know in hunting that the scent sometimes lies floating over a low line; that the dogs will run with their heads above ground; the jovial cry of "heads up and tails down," is familiar to you all. These physical properties are from a peculiar power which the dog has to detect the fallen emanations; we may not perceive it, but it is no less true that they do fall; the dog is in possession of a sense more acute than ours.

2945. Mr. *Stephenson.*] Organic emanations, in fact?—Yes; that they actually fall is not a matter of doubt, our sense will detect quantity. In the Court of Exchequer, when it is very crowded, you can smell, in the escapages below going to the jet, a smell like rats. There is no doubt of this effluvium coming downwards; it is never perceived unless the court is crowded; it is perceived below, but never above. This is the case in all the other courts when they are crowded. The little court is the worst, because it is generally more crowded than the others. The emanations are all drawn down, and you are able to detect them as they pass out. There are a variety of other exhalations to be considered. The breath leaves the lungs at about 92°; blood-heat is 98°, but at six inches off from the mouth the temperature of expiration goes down to 74°; at a foot off it is very nearly down to 60°; in cold weather, from 64° to 65°, when the atmosphere is at the mean

mean temperature. Now, a reduction of temperature so sudden as that, is not due to what was formerly conceived, namely, expansion, but it is due to the laws connected with the steam-jet; in short, the breath escapes as a jet, and mixes with and draws after it a large quantity of atmospheric air, so large in quantity as to reduce the temperature very considerably; at a foot off you will find the breath very nearly down to the ordinary temperature of the air which you are respiring. In frosty weather you can see the watery vapours form and make a little parabola; you can see the watery portions of the breath first form and then dissolve; the solution of the watery vapour is another cause of cooling; the actual weight of the carbonic acid in the breath is about 1½ times heavier than the atmosphere; if the weight of the atmosphere is 1,000 then carbonic acid is 1,527; you require a temperature above 300° to make it equal in weight with the atmosphere at 60°. That is a temperature which never happens with the breath, except in the case of Dr. Fordyce. Carbonic acid expired from the lungs will fall in a still atmosphere, though not if the atmosphere is disturbed; therefore it offers no opposing force. The downward system of ventilation favours the immediate escape of carbonic acid and the sebacic formations; they are both heavier, and both naturally tend to go immediately out in escapage, if drawn from below. The skin, as well as the lungs, gives out carbonic acid; it lies at a low level. The nitrogen which leaves in combination with the breath is very nearly of the same weight as the atmosphere, so that it does not interfere with the escape, whether it goes up or down; all physiological facts, connected with the subject, are in favour of the downward system of ventilation.

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2946. Your conclusion from all that is, that the general excretions from the human body and the lungs would, if left to themselves, with the ordinary temperature, fall instead of rise?—In a perfectly still atmosphere they will all fall; with disturbance they would move about.

2947. Mr. *Stephenson.*] But you do not apprehend that there would be any difficulty in making them ascend?—No, by no means; I only say that it would be desirable to draw them away as soon as you can, and downwards is the easiest; all emanations are unfit for re-respiration, and 'tis better to draw them away before they can pass the mouth to be breathed again.

2948. You treat the carbonic oxide or carbonic acid, as it comes from the mouth, as if it were really a mass of carbonic acid thrown into the atmosphere, and as if, being specifically heavier than

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than the atmosphere, it would go down as a mass of carbonic acid gas; but you know that it comes out not in that shape; it comes out mixed with a large quantity of nitrogen, and with a large quantity of aqueous vapour, with which it is intimately mixed up; the vapour is specifically lighter than the atmosphere, and is mixed with particles of carbonic acid gas, which are specifically heavier than the atmosphere, but yet they are so mixed and commingled that you can hardly fairly treat the one as aqueous vapour alone, and the other as carbonic acid gas, therefore it is an intimate mixture of particles, which I will admit would, if left to themselves, unshackled as it were, take the course you mention; but when you find the temperature interfering with that course, when aqueous vapour interferes with it; and when another gas, namely, nitrogen, also interferes with it, you can hardly reason upon their falling down like lead into water; do you see what I mean?—Perfectly; your reasoning is correct; I have taken the elements separately. I first took carbonic acid, then I took nitrogen, which I said was about the same weight as the atmosphere, and as a matter of specific gravity did not interfere. Then as regards aqueous vapour, I was about to observe, that another law interfered, which entirely overrules all the laws of specific gravities.

2949. In the law of diffusion of gases there is no such thing as specific gravity amongst them?—When they are saturated there is a limit to the laws of diffusion; for instance, the law of diffusion of gases would act on carbonic acid in spite of specific gravities in the proportion of 1 in 1,000, and take it to the top of the highest mountains; yet a greater proportion would lie at the bottom of a well.

2950. It is only found in the bottom of a well where it emanates from the bottom of the well; if it was at the top of the well it certainly would not go down to the bottom?—I do not think so; I know it does not escape; there it lies if not disturbed. Mr. Stephenson's view is correct, taking it as a whole; my evidence goes to support it; I am taking the elements of expiration separately.

2951. That is just what I think there is an objection to; I quite admit your reasoning when you speak of carbonic acid alone, or when you speak of aqueous vapour alone, or anything else alone, but I do not think when you have a mixture, such as the air is that comes from the mouth, you can deal with them as separate bodies?—When you take them as an "*omnium gatherum*," a whole mixed together, you must take the mean; you will find the preponderance as a whole in favour of their falling. I have stated that the carbonic acid is heavier;

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heavier; I have stated that nitrogen, another escapage, is about the same weight as the atmosphere; but with water we have other laws; when it forms vapour, that is small particles floating in the atmosphere, there is no law of diffusion interfering, but the law of solution comes into action. There is a strong affinity between air and water; that affinity is so strong, that the atmosphere will dissolve it under very extraordinary circumstances. One I may call to your recollection, which you all have, more or less, observed, namely, that air will dissolve water when in the form of ice; it takes it from snow; it takes it from hail; if you wet your pocket-handkerchief, let it be frozen, and when so frozen, hang it out on a frosty day in the shade, when the temperature is below 32°, still it will dry; the water, in the form of ice, is still drawn by the law of solution from the handkerchief, and dissolved in the atmosphere. Nothing, in a popular view, can show more strikingly the strong affinity which there is between water and air; in breathing, in obedience to this law, within a very short space of time, all the aqueous vapour that leaves the lungs is dissolved in the atmosphere; this has nothing whatever to do with the laws of diffusion of gases; watery vapour may be put out of the question; as connected with ventilation, we have nothing to reckon upon but the mean weight between the carbonic acid and nitrogen.

2952. *Chairman.*] I understand from what you state that in point of fact the mixture of the air acts chemically upon the breath, and dissolves it into its separate chemical elements?—Mechanically.

2953. In point of fact, you consider that the aqueous vapour is speedily abstracted from the other component parts of the expiration?—It is almost instantly dissolved in the atmosphere.

2954. Therefore, in point of fact, in the matter of ventilation you have to deal with the carbonic acid gas, the nitrogen, the azote, and the other component parts?—Yes; I do not calculate much upon them; I think the fall of the sebacic excretions is more important than the gases or vapours expirated from the lungs.

2955. The proportion of aqueous vapour in the breath is nearly 80 per cent., is it not?—I do not recollect; I cannot answer the question off-hand.

2956. Mr. *Drummond.*] If these exhalations all have a tendency to fall, how do you account for the fact that in a crowded theatre the effluvium and the heat are both much more overpowering in the upper gallery, the higher you go, than in the pit?—The higher you go, the higher you find the

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the temperature, because hot air assumes the highest level; the overpowering feeling is one from temperature, not from any particular gas; where people are together there are disturbances going on which causes a mechanical mixture to take place of the whole, namely, the expired gases and the air of the room. I may add, not only in theatres but in all rooms there is a cause of disturbance always going on, from the temperature of the air of a room and the temperature of the wall scarcely ever being alike; if you make accurate experiments by tracing some very delicately visible body, such as the motes in the sunbeam, or by throwing a strong beam of light on them through a room, you will find there is always an ascending and descending current near the wall; if the wall is at a lower temperature than the room, there is a descending current next it which is very sensible; if the wall is warmer, there is an ascending current next it, so that these currents interfere to mix the air; the oppression which you allude to is a matter of temperature.

2957. Then, in point of fact, in theatres this heavy carbonic acid gas is carried upwards?—It is partially; if you analysed the air of the theatre by the lime-water test, you would find larger quantities of carbonic acid below than above; yet it mixes generally with the atmosphere, by mechanical disturbance.

2958. Viscount *Palmerston.*] Do not you conceive that the heat given out by the bodies of a large number of persons sitting closely together, near the floor, must act upon the carbonic acid which has fallen by its weight, and restore to it a temperature sufficient to make it rise?—It requires a temperature above 300°; I am now supposing you are acting on pure carbonic acid.

2959. The question refers to expiration?—If you take the whole as a body, temperature is not sufficient to make it rise of itself, unless it were a very cold room.

2960. Mr. *Drummond.*] In the case which you supposed of a sleeping room, would not the carbonic acid make its escape through the cracks of the floor, and under the door?—I have stated a condition; the room must be close.

2961. Mr. *Locke.*] Taking one of the theatres, with a large supply of carbonic acid, and that the temperature would not raise it sufficiently high to take it out of the roof, how is it carried out?—Part of it is not carried out at all.

2962. Do you believe that it never is carried out?—It is partially overcharged at night; the excess all goes out in the day time.

2963. Do

2963. Do you suppose that it is carried out during the night, when the people are there?—Only partially in some theatres; most of the theatres are ventilated; in the Haymarket Theatre there is a large upcast through the roof, and fresh air comes in unpleasantly, I am told, to the legs in the pit; this carries it up.

2964. Mr. *Greene.*] Do you consider, practically, in a crowded theatre, the upper part and the lower part as being in the most unhealthy state of atmosphere?—The upper part is the hottest, and the lower part is the most unhealthy. In the Lyceum Theatre the temperature, on one occasion, was 84° above the level of the boxes, 70° in the middle, and at the bottom, I think, about 60°.

2965. In which position do you conceive that a person would find the greatest difficulty in breathing?—The difficulty of breathing would be in the rare atmosphere above.

2966. Mr. *Locke.*] With reference to the downward current, have you considered how the lighting of the House of Commons would affect that peculiar system to which you have referred?—Experiments were made in the Old House with that view; there were a great number of experiments made in 1838, 1839, and 1840. One of the points which I had in view, was that of being able to produce a ventilation by the descending movement, and at the same time to light under the different systems which were then proposed. I have here a large number of opinions in the Blue Books; these experiments were all more particularly directed to that object, namely, that the lighting should not interfere with the downward system of ventilation.

2967. I will take the case of the present House of Commons; are you aware whether the mode which you propose would interfere with the lighting of the present House of Commons?—I have not examined the alteration since the Easter recess; it would not, if there was an express provision, a channel, made for the escapage of the products of combustion out of the building; I do not see why there should be any difficulty; if there is it could be easily remedied.

2968. But you do not know how that is?—I believe the arrangement is the same as was used in the experiments of 1839. There was an experiment exactly like it made. In the first experiment the light was placed above the ceiling in concave white earthenware pans; here on the table is the pan and the burner which were used; this is the burner which I hold in my hand, and here is the earthenware cone which was placed over it. If the present plan be the same, there can

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can be no objection to a downward movement. These experiments were all made with a view to downward ventilation. Sir David Brewster, Professor Faraday, Dr. Lardner, Dr. Birkbeck, Professor Wheatstone, Sir George Cayley, and Dr. Ure were all examined on this subject, and you will find their opinions given on these points in the Blue Books.

2969. *Chairman.*] In what year?—The Committee sat in 1839.

2970. Mr. *Locke.*] What was the result?—The burners were placed above the roof of the House, and the light was thrown down into the body of the House by reflection, which lighted it. At the instance of Sir Frederick Trench, who took a great deal of interest in the subject at that time, and, I observe, has just written and published upon the subject, two of the burners were brought below the ceiling for the purpose of lighting under the galleries, and some parts of the roof, which was in shade; the principal light for the business of the House was brought from above.

2971. Viscount *Palmerston.*] If the theory which you have stated as to the natural tendency of downward ventilation is correct, how do you account for the fact that in a room densely crowded, and much heated by the number of persons in it, and in which the air is greatly vitiated by breathing and exhalations, much greater and more instantaneous relief is afforded by opening the top of a window than by opening the bottom of a window?—The air from the top comes in more freely, from its weight, and falls upon all within; if it be admitted at the bottom, it only comes in across to persons on one side of the room. With respect to carbonic acid, the mechanical disturbance going on in most rooms prevents those laws of gravity which we have been investigating from taking place, except to a certain extent. If there was not a provision of disturbance established by nature, we should find all the dogs in the streets of London dying from carbonic acid; laws of disturbance interfere so as to produce that change of mixture in the atmosphere wisely intended, and prevents it accumulating in any inconvenient excess. The same laws obtain in a room where you are confined within walls, but not to the same extent.

2972. If all the bad air is in the lower part of the room, surely opening a window at the bottom, which is always some feet above the level of the floor, and not far from the level of the mouth, ought to afford greater relief than opening a window at the top of the room where the air is better, and where the entrance of good air would not displace, and could not

displace

displace the heavier air below, which, according to your theory, is the bad air?—In regard to the opening of a window other laws obtain; the ingress of fresh air into a room involves the necessity of air going out; in any open window, two currents must take place; in the window opening, you will find air going out at top, and coming in at the bottom.

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2973. Then would the lighter air coming in at the top force up to that level and out of that window the heavier air which was going towards the bottom of the room?—The air of the room in those cases is generally warmer than the air without, consequently if you open the window high up, the weight of the outer air will come more readily in, fall down, and displace the foul air; warm air at the same time will by being lighter go out of itself at the upper part of the opening; it would not operate so easily at a lower level, because the column would be less.

2974. But you have just stated that it is necessary to raise the carbonic acid gas to the temperature of 300° to make it of the same specific gravity as atmospheric air, and that the human body cannot do that, therefore no number of human bodies in the room would warm the carbonic acid gas in the lower part of the room to such a degree of temperature as would make it rise by its specific gravity so as to give way to the cooler air which was coming from the upper part of the window?—If you can suppose a great number of persons packed together, and obliged to sit perfectly quiet, supposing that the air of the room is also in a quiescent state, then it would be so; those are conditions which seldom occur; when they do, carbonic acid falls in large quantities at the bottom of a room. Carbonic acid accumulates in the gallery of a coal-mine, where there is not much disturbance, and that little in a horizontal direction; there is no upward and downward disturbance; you find the carbonic acid there in the lowest level as nearly as possible. You are aware of the Grotto del Cano in Italy, where a dog dies as soon as he goes in, but not if you carry him in your arms; in all the mines you will find carbonic acid lying at the lowest level, more or less.

2975. You think that if the people in a crowded room were either sitting or standing still, the relief afforded by opening the upper part of the sash window would not be so great as the relief afforded by opening the lower part?—The question of effect in opening the window at a high or low level depends entirely upon the difference of temperature between the room and the external air; if the room is hotter than the external air there will be a greater disposition for the warm air to go out

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out at a high level. If an inch of air goes out, an inch of fresh will come in; the quantity from without, at a lower temperature, will fall in with greater facility from a high level than a low one, and so increase the quantity passing in a given time through an opening of a given size.

2976. I think you have stated that, in order to render carbonic acid equally buoyant with atmospheric air of any temperature, that carbonic acid must be raised to the heat of 300° Fahrenheit?—Yes.

2977. No crowded assembly of persons could raise the air in contact with their bodies to that temperature, because the human body is at a far lower temperature?—In no condition of a crowded assembly have you the carbonic acid in a pure state; you have it in a state of mixture. If you had not to deal with the separate elements then it would be so. My answers to the questions have been with reference to carbonic acid alone, taken as a chemical element; but we are now supposing it to be, under ordinary conditions, mixed with other matters.

2978. Our whole investigation here turns not upon carbonic acid gas as a simple chemical element, but upon the exhalation of the human body?—Certainly. With respect to carbonic acid, I will recall one fact to your Lordship, which I think possibly may tend to get us out of our difficulty, namely, that of the Black Hole of Calcutta; those persons standing at the lower level died first, from the greater accumulation of carbonic acid.

2979. Mr. *Locke.*] What do you mean by the lower level?—Near the floor.

2980. Mr. *Greene.*] But that was the most densely crowded part of the Black Hole?—I think not. You have taken an extreme case, which never occurred; I have taken a case which really occurred; your case I conceive never to happen under ordinary circumstances; if so, you must suppose that you are to be in a room perfectly shut up, like the Black Hole of Calcutta, where carbonic acid gas would accumulate in large quantities, and be found in larger quantities near the door, as compared to the upper part.

2981. Mr. *Locke.*] Were there two storeys of people in the Black Hole of Calcutta?—No, there were two levels; some got on the benches higher than the others.

2982. Some of them were trodden down, do you mean?—No; if you read the account of it you will find that those at the lower level died first from suffocation.

2983. Had not they an additional pressure upon them, arising from persons standing upon them?—No.

2984. Viscount

2984. Viscount *Palmerston.*] Am I to understand, from one of your late answers, that you consider the exhalations of a crowded room not to be pure carbonic acid, but to be carbonic acid so mixed that the temperature of the human body will raise it to a degree of buoyancy, as compared with the outward air, which will enable the outward air entering from the top of a window to force that carbonic acid gas up to the level of the top of the window, and out of the room?—The heat of the human body, assisted by the laws of mechanical disturbance. Supposing we are uninfluenced by any external interference, I am perfectly right in my evidence with regard to the position of carbonic acid. The fate of those shut up under hatches in the Irish steamer is a case in point. Those on the floor of the cabin died.

2985. But my question assumes no mechanical disturbance of the air of the room; I am supposing the room to be filled to a great excess by persons, either standing still, listening to a speech, or sitting without any movement, and I assume that in that case the oppressive sensations of the persons in the room would be relieved more quickly and more completely by opening the top of the window than by opening the bottom of the window; I then ask you to tell me why that would be so?—The fresh air coming in being colder than the air of the room, falls readily from its weight, and more rapidly displaces the warm air that is in the apartment.

2986. If the air in the lower part of the room were by its physical character heavier than the air on the outside, it is impossible that the air coming in from the outside could displace the heavier elements below; it would be like oil displacing water; it is not in the nature of things that it should be so?—If you are right, no escape could take place.

2987. And no relief would therefore be afforded to the persons in that room by opening the top of the window?—I do not say so; because the laws of disturbance by weight will obtain. If there is a difference of temperature between the external and internal air, the laws of disturbance, from specific weight, must and will take place. I have stated instances of carbonic acid being practically found, not only in mines but in wells; it is known very well that in wells it is found at the bottom, though the top of the wells may be perfectly open.

2988. You have stated, that in order to enable atmospheric air to displace carbonic acid gas, the difference of temperature must be that between, say 60° on the part of the atmospheric air and 300° on the part of the carbonic acid gas. Now as no crowd of common bodies could raise the air in the lower part

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of the room to the temperature of 300°, how do you account for the fact that the entrance of the air from the outside, through the opening at the upper part of the window, could drive out of the room that heavier atmosphere of carbonic acid gas at the lower part of the room?—By mechanical disturbance, arising from different temperature; and mixing by the movement of persons.

2989. But I am assuming that there is no mechanical disturbance, inasmuch as the persons in the room I am assuming to be practically quiescent?—Then, I think, they would all die.

2990. You think they would receive no relief, therefore?—None whatever. I think the well is a case in point; if a man was to go down into it he would die.

2991. Sir *D. Norreys.*] In your last report you have stated that in the galleries the thermometer stood against the wall at 70°, that when the thermometer was held away from the wall and shaded off from the chandeliers it rose to 73°; is there not some mistake in that statement; is not the contrary of that the fact?—No; the report is correct. The thermometer against the wall was influenced by the temperature of the wall.

2992. Was it not the fact that the night the experiment was ascertained of holding the thermometer in the gallery behind the seats, the thermometer stood at 68° or 69°, and that holding it on the seat it stood at 70°, and holding it a yard above the seat it stood at about 73°?—I have this note as to the observation in the gallery, "22 March 1852, 10 o'clock. Under seat, 69°; over the seat, 71°; three feet up, but off the panel, 73°."

2993. Is not that statement inconsistent with the statement which I have just read from your report?—No; I repeated the experiment over and over again afterwards on the succeeding nights; I found the thermometer was affected by the temperature of the wall; therefore to get the mean temperature of the atmosphere of the House, I took it off from the wall.

2994. Is it not as easy to attribute the increased temperature, when the thermometer was held above the seat, to the effect of the radiation from the heat of the gas?—I shaded off the thermometer, as I have stated, from the chandelier.

2995. From the statement which you have made, does it not appear that the thermometer exposed to the light stood at 73°, and that when placed below on the level of the gallery, and protected from the light, it sank to 68° or 69°?—At the floor it was 69°, over the seat it was 71°.

2996. When

2996. When exposed to the light?—Yes.

2997. But not exposed to that light when at 69°?—It was only 71° over the seat when exposed to the light, but when three feet up, still exposed to the light, it rose to 73°, and remained so when shaded off.

2998. Then it was more immediately exposed to radiation from the light?—No, it was not.

2999. You have stated that the air came into the House at 62°, and that it was found in another portion of the House at 73°?—Yes.

3000. Is there anything in the circumstance of the number of persons present which, alone, could raise air coming into the House at the temperature of 62° to 63°?—I have found air in a badly ventilated and crowded theatre at 84° in the galleries.

3001. You conceive then that the number of members who may have been in the House at the particular time may have sufficiently explained the difference between the entering air at 62°, and the air in the upper part of the gallery at 73°?—Yes.

3002. If that fact be ascertained from the register to be the constant fact irrespective of the number of individuals who might be in the House at the time, would you still adhere to that explanation of the fact?—I should not be guided by the register on the wall; I have given 73° degrees in my report as the mean temperature of the air of the House at this level. The temperature of this room is supposed to be indicated by a thermometer which is imbedded in the woodwork; it is no measure of the temperature of the room; it is more the temperature of the wood, which is a bad conductor, and takes time to warm and cool. If you hang a thermometer near a wall, generally in the morning it will be higher than the air of the room in winter; after an hour or two it will be lower.

3003. May I recall to your recollection that the thermometer by which these experiments were tried was not attached to the wall, but it had been lying on the seat, some way from the cushion, and that it was merely held up for a few minutes so as to raise it to the temperature of 73°?—In the experiment of 22d March the thermometer was taken from the wall; the recorded temperature that I have given in my report is the mean of several observations made with three thermometers; I have always found that the temperature of a thermometer against the wall is no measure of the temperature of the atmosphere of a room.

3004. As to the fact of the temperature of the air coming into

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into the House being 62° to 64°, is not that simply a question of management?—It is a question of management most assuredly. Perhaps I may be allowed to state a fact which I did not allude to in my report; on one occasion the temperature of the air coming in below the third chamber was 50°, after going up through three chambers it came into the House at 62°; there was no warming on at all; the warming apparatus was not at work; the temperature of 62° was given to it by the heat of the walls and the apparatus alone in the chambers. That fact shows it to be a matter of difficult management, under the present arrangement, to keep the temperature down.

3005. In your report you complain that the outdraught is so much greater than the indraught, as to cause the difficulties to which you have referred in the report. Might not that outdraught be very easily corrected by limiting the area of the furnace draught, which is simply a question of management?—Certainly. If you stopped up the outdraught altogether you would have no intake at all.

3006. The floor of the House being perforated throughout, the power of giving ingress to air is also to that extent unlimited?—Yes; so far as the floor is concerned, but not if it is stopped up.

3007. Is not this question of outdraught and indraught therefore a simple question of management, of greater or less skill of the person who is in charge of the ventilation?—Provided all the conditions of areas are such that you can give free ingress below; but if the conditions are such that you cannot possibly admit sufficient air below, I do not see how you can blame the person who has to manage it. The balance must be preserved in the chambers below as well as in the House, which is not possible now. I have reported the facts as I find them; the intake is not sufficient; the floor is covered with a pervious carpet, it is true, but the floor is closed to a great extent below.

3008. Inasmuch as in your previous answer you have stated that it is quite possible to regulate the outdraught so as not to act so strongly on an insufficient incoming of air, would not that be remedied by giving an easier access to the indraught of the air?—Certainly.

3009. So that to that extent the whole of your report resolves itself into a censure on the mode of management of means of ventilation at present in existence?—My report goes to the facts as I find them; I make no observation on the arrangement, or did I give an opinion; I place the conditions before

before the House; any Member can form his judgment upon them as well as I or you.

3010. Still, does not your report really resolve itself into this, that there is an incorrect management of the means at present in existence for the proper ventilation of the House?—My report goes to state the conditions of the House as I find them; if you ask me a question as to efficiency of the apparatus, or on the provision made, I shall be happy to answer it.

3011. With the present means of ventilating the House, could there not be such a management of them as to obviate those objections which you have made respecting the present state of the ventilation?—I have stated, in my first report, that the House could be placed in a better condition in a short time, and by a very inexpensive alteration. I have referred to it in my second report, and I repeat it now, that it may be so; a change must be made; ventilation cannot be perfect in its present condition. There is an existing condition about the House, under which it is impossible to ventilate it perfectly; the Committee have never suspected what it is; you have never asked me, or any one else, a question upon it; no witness has alluded to it; yet I tell you there is a condition of that House which renders it physically impossible to make it perfect.

3012. Have you any objection to state what that condition is?—I have no objection to state it to any person whom you will name, but I have an objection to state it in public Committee; it is out of no disrespect to the Committee. I have given free answers, and information on all subjects on which I have been called upon to do so. The condition to which I refer is a pneumatic one, that has been discovered by a long series of experiments in investigating the laws of aerial disturbances; which have cost me much time and expense. I shall be happy to explain myself to the Speaker, the Chairman, or First Commissioner of Works, or to the Speaker's brother, who also is a mathematician, and was, I believe, senior wrangler of his year; he would understand it at once.

3013. Am I going too far in asking whether it is chemical or mechanical?—I would rather not answer the question.

3014. Mr. *Locke*.] You mean by a condition, a defect?—I do not say so; the condition has never been suspected; no question has been put to me upon it, or to any of the witnesses, nor have they suspected it. I hope your Lordship will not consider my observations disrespectful to the Committee. Those feelings which I have mentioned, and the consideration towards my friends, who have gone with me in my experi-

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ments, are my motives. I hesitate, since communications and plans which I have made from time to time have been imperfectly carried out by others, and discredit has been thrown upon them and myself. In connexion with the subject immediately before us, I would refer to the ventilation and lighting of the New Houses. I have been examined from time to time; the process of lighting at the present moment is taken from my experiments of 1816, and my evidence of 1839; the whole principle was then shown; but I have not even now been consulted; and the system then proposed is now introduced by others. I have never been paid for any examination since 1842, or for my services in superintending the light since that time, in full expectation that it would be introduced into the New Houses, when I should be paid. The discovery I now allude to is therefore surely my own property. I complain of the lighting being carried out by other parties, after all the points having been gone into so extensively and carefully by me. Under the Report of the Committee of 1842 I had a right to expect it, for the report of that Committee advised it. With regard to my system of lighting being extended to the New Houses, I beg permission to say that I have gone on for the last 10 years quietly, and never pushed my claims or complained till now, in the full expectation that the system would be introduced into this House. I have been told that then all my claims should be settled. I should not trouble you on this matter but in justification of my present hesitation; and as an apology to the Committee.

3015. Sir *D. Norreys.*] If it shall appear from the registers of the thermometer that from the alterations which have been made during the recess, or from the alteration of the mode of lighting the House; the incoming air now enters the House at a temperature of about 66°, and that in the galleries the thermometer is not raised above 69° or 70°, would you be led by those facts, if they be facts, to consider that the material defects, which you have referred to in your report, must have been in some manner or other corrected?—No doubt; I would not take the indication of the thermometer without knowing the conditions under which it was acted on.

Martis, 27°. *die Aprilis*, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Locke.
Mr. Fitzroy.	Mr. Henry Hope.
Mr. J. L. Ricardo.	Viscount Palmerston.
Mr. Stephenson.	Sir Denham Norreys.
Mr. Thomas Greene.	Mr. Deedes.
Mr. Henry Drummond.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

Goldsworthy Gurney, Esq. called in; and further Examined.

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3016. *Chairman.*] I UNDERSTAND that you wish to state something in reference to the opinion which you gave as to curing the defects which now exist in the warming of the committee-rooms, in consequence of the cooling process of the large surface of window, where you recommended that a blind should be used; what is it that you wish to say?—As there might be some mistake in regard to my proposition, I wish to say that the object I had in proposing the blind was for the purpose of having a plate of warm air between the atmosphere of the room and the external air: and that whether it be a curtain or whether it be a glass it is of no consequence so far as the principle of the warm plate goes. It is the application of the warm plate of air between these surfaces that I wish distinctly to be understood to have recommended. The question arose whether we could see out through the blind or not on the river? I wish to observe that the suggestion of an honourable Member of this Committee has removed this objection; he suggests, if I understood him, that the space of the under pane of glass, as high as the eyes, should be permanent double glass—that it might be a permanent frame—to be used during the months of February, March, and April, and then be removed. In such case the blind would operate above, and there would be no obstruction in looking out at the window under those circumstances; this would save much expense, and effect the object. There is no doubt that the objection of not being able to see

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through is of some consequence, and could be removed by that modification.

3017. The Committee understand that you gave evidence to former Committees, both of the House of Lords and of the House of Commons, as to the method which you thought best to be employed for lighting the Houses of Parliament?—I made a great number of experiments under the directions of the House in 1838 and 1839; I was assisted by several persons of the highest standing in connexion with the subject. There is a full report of the experiments in the proceedings of a Committee which sat in 1839, and also in those of a Committee which sat in 1842; the evidence of these gentlemen was taken at considerable length. The parties to whom I refer principally are Sir David Brewster, Professor Faraday, Dr. Lardner, Dr. Birkbeck, Professor Wheatstone, Sir George Cayley, Bart., who was then a member of this House, and Dr. Ure. There were many other persons whose evidence was taken on the subject, but those are the most important. I would refer to that Report, and to the views of these gentlemen, as the best evidence to you on this question.

3018. The Committee understood that you rather considered that you had given some recommendation of a particular system of lighting to the House which you thought, from some engagement which was taken towards you, should be put into operation, and that you should receive some remuneration for it. There was some question which remained undecided between yourself and the Government in reference to a system which you then recommended?—Yes.

3019. The Committee wish you to understand that they do not consider it their duty to go into questions of that nature; all they desire is to know your opinion as to the present system of lighting the House of Commons, and as to any other system that you would think proper to recommend. Therefore, presuming that you understand that, I will ask you what your opinion is of the present method of lighting the House?—The principle is good; the present method of lighting the House is the same as that of the late House. In the late House of Commons I thought it best to place the light out of the House altogether; it was placed above the ceiling; 18 burners were placed above the panels in the ceiling, and the light passed through glass panels into the House. The wood panels were taken out, and glass panels put in their places. There were suspended in the House chandeliers with very extensive ground surface glass for the purpose of illuminating under the roof and under the galleries, so that the Speaker might

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might be able to catch the eye and see members under the galleries. The present mode of lighting (I presume by the present mode is meant that which last night was used when I was in the House) is exactly the same, except the drop light, in principle, as was introduced in the former House; I see no objection to this system; on the contrary, I conceive it is a very excellent mode of lighting the House; but I think some provision requires to be made for lighting under the galleries and under the roof.

3020. The objection which you have stated being the strong shade under the gallery?—Yes; the light also is rather too white. In our experiments we found that light a little coloured was far more agreeable than pure white. The Speaker wished to have an orange-coloured light on his reading papers, which certainly is more pleasing to the eye; and lights were placed in the roof, immediately over his head, expressly for his use; they were reflected upon his paper when he stood up to read; at first it was a deep orange; the orange light was removed, and subsequently reduced to a very faint gold or yellow coloured light; this was found the most pleasing, and was continued to the end.

3021. You have stated that the present method of lighting the House of Commons is the same as the method adopted for lighting the late House of Commons?—In principle, exactly.

3022. Is there not this difference, that whereas in the old House of Commons the light traversed glass before it came to the House, at the present moment the light is reflected from a white surface, and does not pass through glass to the House?—Yes, in the last House it came through glass panels. The white reflector which was first used for applying that principle, is now on the table before us. I thought possibly it might be useful to refer to it. Sir Frederick Trench, who has taken some interest and just written some papers on this subject, I thought might be present; he would recollect and would describe the effect produced by that experiment if he saw the apparatus; attached to it there were some amusing circumstances which he would have recollected. Glass was afterwards intercepted between the light and the body of the House by taking out the wood panels, and placing in glass ones; the glass panes were not plain, but a little figured; you could not see the naked lights.

3023. Would you prefer the light reflected, as it is now, from a white surface to the House, or would you prefer the system pursued in the late House, namely, that the light should pass unreflected through glass for the purposes for which

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which it is placed there?—I prefer to insulate the burners entirely from the House, as in the late House, and to reflect the light.

3024. Mr. *Stephenson.*] Was it from metal?—Latterly from metal; at first it was from white earthenware; it was tried from mirrors, silvered glass, gilded reflectors, burnished copper, then from zinc cones, which were painted a dead white; oxide of bismuth was used; and latterly it was from silver plate. We could get, not only more light from the burners, but it was more easily directed into situations where it was most required.

3025. Do not you think it better that the glass should be removed in respect of economy and the saving of power?—No; there is an advantage in the glass, which I wish to mention, and which these experiments went to show, namely, that it intercepted heat reflected from the reflectors; the heat was intercepted by the glass, which was one reason for its being placed there.

3026. For which of the two do you decide; for the light reflected through glass, or the light simply without passing by reflection through that or any other medium?—I should prefer its being reflected through glass, not only on account of its intercepting the rays of the heat, but on account of insulating the lights entirely from the House, and also on account of its facility in colouring the rays to soften them; by colouring the glass very slightly you get a tempered quality of light, which is more agreeable than a pure white light. If you colour the reflecting surfaces you diminish their reflecting power; the expense of light is materially increased; you are obliged to have a larger quantity of initial light to produce the same effect. It is better to deal with reflected rays by coloured media.

3027. Mr. *Hope.*] You propose to put a glass shade, I presume, under the light ranging with the ceiling?—It would be better to do so.

3028. Am I to understand that that glass shade is to be of coloured or figured glass, or what?—That is a matter of taste; if it was very slightly coloured yellow or orange, the light would be more agreeable. We found that in the experiments which were made.

3029. Do you think that by doing that you get rid of the exceedingly disagreeable, what I may call spotty effect of those white funnels?—Entirely.

3030. Do not you consider that those white funnels produce a remarkably disagreeable effect to anybody whose eye is at all sensitive

sensitive to colour?—That was the opinion of the majority of the Members who saw the experiments, particularly the late Sir Robert Peel; he preferred a softened coloured light; Sir Robert Peel it was who suggested that coloured water should be placed between two plain layers of glass, for the purpose of colouring the rays; the coloured water, he conceived, would have two useful properties: in the first place, it would cut off the direct rays of heat; would insulate the burner; and secondly it would produce a tempered light. That experiment was tried to a full House, and approved of.

3031. Did that experiment succeed?—Yes; it succeeded in principle; there was an objection, in practice, to the water being placed between the glass; for if the glass from any accident were broken, the water would have come down upon the heads of honourable Members.

3032. There must have been a good deal of loss of light, I suppose, by going through two glasses?—Not so much as might be supposed. When the glass itself was a little coloured, it answered the purpose.

3033. How do you propose to get rid of the objection of the shade under the galleries?—That was done by bringing the drop-light down sufficiently into the body of the House.

3034. Under present circumstances, how do you propose to get rid of that objection?—Sir David Brewster proposed to do it by refraction. Sir David proposed that under the edge or cornice of the galleries a refracting medium should be placed, which would change the angles of light, and send them under the gallery. We made several experiments on that subject, and we found it succeeded to a certain extent.

3035. Where would those refractors get their light from?—From above. A portion of the light falling perpendicularly would by these refractors be turned out of that direction and thrown under the gallery.

3036. *Chairman.*] Where do you place your refractor?—Immediately under the outer edge of the gallery.

3037. Mr. *Hope.*] Have you calculated the angles so as to enable you to say whether you could get a refraction from the roof through these refractors?—Yes; a reflected light from the roof falling upon the refractor would be sent under the gallery.

3038. Supposing the projection of the gallery should be so great as to intercept that light, how would the light get through the refractor?—The refractor was placed outside below the gallery. It answered, except in quantity, in the experiment:

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ment: it looked very well. I beg to refer to Sir David Brewster's evidence in 1839 upon this subject.

3039. Could you explain in words, without a reference to a drawing or a diagram, the position in which you would place your refractor?—The refractor in the experiment was a curtain of gauze prepared with starch, isinglass, or some semi-transparent medium. Sir David, I think, advised ground glass; any other material of that kind would do for turning the direction of the light at another angle.

3040. Will you tell us the exact point of the position in which this refractor would be?—Hanging immediately under the cornice of the gallery.

3041. Then the effect of this refractor would be, that the light coming diagonally from the ceiling would be refracted at another angle, and would impinge upon the lower surface of the gallery?—Under the gallery. I should be permitted to go on to say that after that experiment was made it was found more desirable to bring the light itself down into the body of the House for the purpose of lighting under the gallery.

3042. You are now speaking of the old House of Commons; the height of the present House of Commons would make it very much more difficult, would it not, to bring down the light?—The galleries I do not think project quite so far as in the old House; but the angle is very nearly the same; the angle from the present lights is cut off at the last benches, so it was in the old House.

3043. But the present House is much higher than the old House?—Yes; I think the straight rays of light fall somewhere about the same place, namely, on the feet of the Members who sit on the back benches.

3044. Sir *D. Norreys.*] In order to reflect light, would it not be necessary to have direct light coming from the point of light, and would not that involve the inconvenience of having direct light upon the eyes of the Members in the House, which the present tries to obviate?—Not at all.

3045. Would reflected light be refracted in sufficient quantity to illuminate the under part of the gallery?—Yes, to illuminate it, but not sufficiently; not so much as the other part of the House. The rays of light come down nearly perpendicular, and strike the refractor, however placed, which becomes what is called a dispersor.

3046. The light not being immediately over the refractor, and not being a direct but being a reflected light upon the refractor, must not two reflections, namely, one reflection and one

one refraction, take place, in order to give the illumination required?—Certainly.

3047. Would not a much larger amount of light be required in the source of light in order to produce the desired effect?—The amount of light that would be robbed by the refractor in quantity would be almost inappreciable; some light would be reflected back from the refractor into the House; the quantity of light that passed through would be lost to the body of the House, but it would be very trifling.

3048. Still the light which you would require for the refractor would not be direct light from the source of light, but from the reflecting surface with which you propose to surround the light?—Yes.

3049. *Chairman.*] Would there be sufficient light, at the present moment, to supply through that refraction adequate illumination under the gallery, or would it require a greater amount of light in the ceiling to produce the desired effect?—I think there would be light enough. I should go on further, in answer to your first question, to say that, in another experiment, a concealed light was placed behind the pillars, for the purpose of lighting under the gallery; those lights were not seen in the House, but they were objected to because we should have had to cut away some of the temporary fittings and to make pipes and communications for carrying away the products of those lights. The practicability was proved; but it was thought not worth while, in the old House, to do more.

3050. Are you able at present to say whether you would recommend this process of refraction, or would you recommend that the light should be brought lower in the House, for the purpose of preventing the shadow in the present House?—I would not bring them lower; I would conceal lights under the galleries.

3051. You are accustomed very much to look at these things; what do you recommend—what is your opinion?—I should prefer the local lighting.

3052. Mr. *Locke.*] Should you prefer the refraction to any other system, not only in reference to that system and the one suggested by the noble Lord in the chair, but should you prefer that system as being the best of all?—No, certainly not.

3053. Have you considered the subject of better illuminating that portion of the House of Commons under the present galleries?—Latterly I have. I have lost sight of this point for nearly the last 10 years; but I am now prepared to say, if you will allow me, that I will hand in a drawing, to show that

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that you can illuminate that portion of the House agreeably by concealed lights.

3054. Then, in point of fact, what you have been giving evidence upon now, as to the mode of refracted light, is not probably the course which you would recommend?—It is not. I give these experiments and their results as a matter of information to the Committee, with all their evils and with all their benefits.

3055. Have you considered the best means of illuminating the part of the House of Commons under the galleries?—I have.

3056. Are you prepared to state to this Committee what means you would propose for that purpose?—I am prepared to do so; and to make the necessary drawings and plans; not to-day; I will do it to-morrow.

3057. Then the Committee are not to take it for granted that although you have given evidence as to the power which there is of illuminating by refraction, that is the course which you would recommend them to adopt?—Certainly not; I do not think it the best course. I thought so at the time Sir David Brewster proposed it.

3058. Mr. *Greene.*] You stated that illumination by refraction had been tried in the old House, but was abandoned; what was the reason why it was abandoned?—It was thought better to bring the light down into the House in a drop, in which there was a very extensive surface of ground glass; it lighted under the roof and under the galleries at the same time.

3059. Mr. *Stephenson.*] Was it your opinion that it was better?—I always had an objection to that light being so low, but when fixed, it was never afterwards interfered with.

3060. Your mode of lighting the House was by removing the lights entirely out of the House?—Clearly.

3061. Are you aware that the present lights aid the ventilation of the House materially?—The ventilation is too important a condition to depend on lighting; they may assist it slightly when they are lit. No doubt the up current from the heat of those lamps assists it a little.

3062. Then you think the introduction of lights into the House objectionable rather than otherwise?—I do certainly. In answer to that question, I may say this consideration was the great objection to wax candles, which could not be placed out of the House.

3063. Sir *D. Norreys.*] Do you not mean rather that you object, not to the light being introduced into the House, but

but to the supply of air to the lights in the House being taken from the House itself, and not supplied independently?—I object principally to the lights being in the House, as they must necessarily fall more directly on the organs of vision; upon the retina. Sir David Brewster in his evidence shows clearly what the angle should be for business and comfort. You cannot put the lights very well into the House without getting the wrong side of that angle.

3064. Dr. Arnott recommended, in his evidence before this Committee, that the lights and the supply of fresh air to those lights should be completely cut off from the House by some transparent medium; do you agree with him in that recommendation?—I do not think it worth while to trouble ourselves about carrying out that part of the question. The quantity of air required for the light is but as a drop in the ocean; the vitiated products are far more important to be out of the House.

3065. Mr. *Stephenson.*] If I remember rightly, your first proposal to light the House of Commons was by oil and oxygen?—Yes; called the "Oxygen Bude Light."

3066. Was the House lighted for some time in that way?—Yes.

3067. For what length of time; was it a twelvemonth or two years?—I think it was not two years.

3068. It was a long time lighted in that way?—Yes; it is a long while ago.

3069. Was that Bude light above the ceiling of the House entirely?—It was.

3070. When was it abandoned?—I think it was in 1841 or 1842. I will give in the Report of a Committee upon it I hold in my hand; it is much better evidence than mine.

3071. Will you be good enough to say why it was abandoned?—It was abandoned on account partly of the expense of the oxygen, and partly on account of my discovery of being able to produce the same quantity and quality of light by a more simple process. The change was introduced, I think, in 1841, and the sense of the House taken upon it; it was thought more agreeable than the very strong sharp light from the oxygen. Upon that point you will find a Report from the Committee of 1842.

3072. You abandoned it therefore, and went back to common gas, did you not?—With a view to the better lighting of the new Houses, we went from step to step; the oil was first given up for naphthalized gas; its flame was used instead of that from oil; the oxygen being applied to the interior of it in the

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the same way. Naphthalized gas had many objections, and was given up; oxygen was finally discontinued, but the flame of gas retained, because we had discovered a perfect mode of combustion by a peculiar arrangement. This apparatus was examined in 1842, and is fully recorded in the Report of that Committee, on the evidence of various witnesses who were examined before them.

3073. Then the result was, that oil was first abandoned, and then the oxygen was abandoned, and you eventually came to common gas?—The oil flame was first abandoned; then gas flame and oxygen were used; then the oxygen was substituted by common atmospheric air, which was used instead.

3074. You mean the common gas was used?—Common gas was used last; that is the order.

3075. When you say that oil was abandoned, that then oxygen was abandoned, and that then atmospheric air was used, what do you mean by atmospheric air being used, because every gas light must make use of the atmospheric air for combustion?—The oxygen of the atmosphere. The rationale of combustion is, that you must have a combustible body and a supporter. If we use those terms, I think we shall more clearly understand each other; whether the supporter is pure oxygen, or whether it be oxygen mixed with nitrogen, as in atmospheric air, is a question of degree. In the first experiments oil was used as the combustible body to produce the flame; pure oxygen was used as the supporter, for the purpose of producing a brilliant illumination. The oil was found inconvenient, and gas was used instead of oil as the combustible body; pure oxygen was still used as the supporter. It was found, from our experiments which were made at that time, that it was possible to use diluted oxygen, namely, the atmosphere instead of pure oxygen, if applied under the same principle upon the ordinary gas, to effect what we wanted. I do not see the object of this cross-examination.

3076. Viscount *Palmerston*.] You mean introduced in the centre of the flame?—Yes; every change was made under the direction of the Commissioners of Woods and Forests and the Speaker; it may be well if you were to call one of the officers of Woods and Forests, if you think the experiment were made on my own responsibility, without consulting the proper authorities.

3077. Mr. *Stephenson*.] With respect to your opinion as to the advantage of transmitting the light through glass, or reflecting it from a white surface, you say you made your first experiment with an earthenware glazed surface?—Yes; it was

afterwards

afterwards painted a dead white; it is now in the room; we made a series of experiments afterwards.

3078. It was with a glazed pot, was it not?—Yes.

3079. Then it was with a glazed surface?—Yes.

3080. Then it was with a metallic surface?—No. Then it was with mirrors.

3081. That is metallic, surely?—Commonly called "looking glass:" a common mirror.

3082. It is a metallic surface?—A metallic surface is generally understood to mean burnished metal.

3083. After you had made experiments on these various surfaces, you eventually came to the conclusion that reflection from a metallic surface, and transmitting that light through glass into the House, was the best mode?—Yes, it is the best mode; this was my opinion, and also that of the majority of the persons who were consulted on the subject; and for reasons I have previously given, again and again, in answer to other questions, it was the best, because we had more command of the direction of the light, and it was more profitable. It may be recollected that at the time of the marriage of the Queen she went to Lord Lansdowne's house to a ball; on that occasion the lobby of Lord Lansdowne's house was lighted by reflection from the ceiling; that was the first experiment I saw made for domestic purposes. On going into Lord Lansdowne's, there was no naked light visible. I think it was in 1839 or 40. Some of the rooms in the late House of Commons were lighted the same way.

3083*. In a previous answer which you gave, you said that a particular system was preferred in reference to economy; that is a very important consideration in lighting the House; you mean that you got the greatest quantity of light with the least expenditure of money?—The greatest quantity of available light at the least expense.

3084. You know, I believe, that by reflection a large amount of light is lost from whatever surface it may take place?—No, I do not; I can give you the quantities lost from different surfaces exactly, if you wish it; from the surface of a mirror the loss is only one-ninth, from the surface of a polished reflector as used by the Trinity-house it is scarcely so much; when reflected, if in a true parabola there is no loss. Radiated light loses as the square of its distance, but not reflected light; this depends on the angle of reflection. On one occasion a light placed at Purfleet, 11 miles away from Blackwall, threw a visible shadow of a stick held against a white board at Blackwall. The result of the experiment is a

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proof that the loss by reflection could not be what it is generally supposed. This experiment was made by the Trinity-house.

3085. Sir *D. Norreys.*] What sort of light was that?—The lime light.

3086. Lime and oxygen?—Yes; an experiment was made afterwards, at my house at Bude, with the "Bude Light;" it was put in the focus of a true parabola a mile off, and we traced the profile of the late Mrs. Fry, who was stopping there at the time, upon a wall at that distance; it is there still. You could not get that power of light by radiation; by reflection in a parabola there is little loss.

3087. Mr. *Locke.*] I understood you to say, that there was no loss from reflection; is that a proof of it?—If the reflecting surface is imperfect, there may be great loss either by material or from angles; but if the reflecting surface is very good, there is no great loss. The loss in radiation of light arises from the fact that it has to illuminate a space increasing as the squares; but if reflected from a true parabola the rays pass in one direction parallel to each other; the loss through the atmosphere by floating particles of opaque bodies is the only source of loss in such case.

3088. Viscount *Palmerston.*] It is a loss by absorption, but you make that good by giving it a greater direction?—The whole of the rays are concentrated into parallel rays; the only obstruction then is the floating bodies in the atmosphere.

3089. There is loss by absorption in the reflecting medium?—Yes.

3090. But you make that good by combining the rays in a parallel direction, instead of their radiating from the surface?—Exactly.

3091. *Chairman.*] All which occasions additional expense, I presume; all the counteraction of the difficulty can only be done at additional expense of money?—Whatever loss of light is suffered from imperfect arrangements must be made up in quantity; therefore, in regard to lighting the House, if you can direct all the light from the original source by perfect reflectors the loss is very little, even at a distance, say outside the ceiling; but if you return it by an imperfect reflector the loss will be considerable.

3092. Mr. *Stephenson.*] By a rough surface you mean?—Yes; or by improper curves.

3093. What amount of light is lost by transmitted light, at each surface of glass that it passes through?—Not much; I have not the proportionable numbers here.

3094. It

3094. It is large, is it not?—Not a great deal; not a very sensible quantity.

3095. Therefore by the old method of lighting the House, by reflection from metallic surfaces, and transmitting that reflected light through glass, there was very little loss indeed of the light?—Very little.

3096. Taking light reflected from one surface as it is now, or light reflected first of all from a metallic surface, and then transmitted through two surfaces of glass, which of those two methods do you think would be the most economical?—The metallic surface would be the least expensive.

3097. Would it be an agreeable light to be seen in the House?—Not if it met the eye directly; it must be tempered and dispersed.

3098. Sir *D. Norreys.*] When you illustrated your position that there was no loss of light from reflection by the experiment at Purfleet, was not that experiment one of a convex reflector, placed behind the lime light, concentrating all the rays at the distance to which you refer?—It was put in the focus of a true parabola.

3099. The effect of that was to collect and concentrate all the rays of light at the distance at which you were placed?—The light was placed in the focus of the parabola, and all the rays were reflected parallel to each other.

3100. Do you conceive that that is at all in analogy with the reflection which would be required for a room like the House of Commons, where the object would be to diffuse the light as much as possible, instead of concentrating it?—Certainly; it shows that you may use reflection profitably. It is an experiment to show that the loss of light by reflection is not so much as is generally supposed; under proper management the loss will be only as the unprofitable divergence or imperfection of the reflector, but not on account of the reflecting surface.

3101. But in the one case diffusion being required, and in the other concentration, are the two cases in analogy?—Divergence, not diffusion, becomes a second question; this is done by the figure of the reflector; diffusion is one thing, and divergence another. Diffusion is a secondary action obtained after reflection by divergence.

3102. Would not the object of reflection as applied to lighting the House of Commons be diffusion rather than concentration on any particular point?—It would: it would be first a divergence, and then "dispersion" where it is required. You have the command of the direction of the light, as I have observed in a former answer, by the figure of your reflector.

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3103. Then your answer will scarcely convey a correct idea to the Committee that there is no light lost by reflection, as far as the lighting in a large room is concerned?—In the old House of Commons there was no sensible loss; the reflectors were curved in the late House of Commons, to meet its conditions; the light was sent where it was wanted, none was wasted, and consequently no sensible loss from the original quantity was experienced.

3104. *Chairman.*] By "curved," do you mean convex?—They were concave, of a figure suited to the purpose for which they were required.

3105. What figure?—Of different figures; so that there was no light thrown into situations where it was not wanted; they were of different curves, so as to distribute the light equally. In the corners of the House, being at a further distance, it required more concentration; there was more light thrown about the table of the House than in other places.

3106. Sir *D. Norreys.*] Then, in point of fact, the reflector of which you have spoken must have been a series of reflectors, each bearing upon a particular part of the House, but so arranged that the light thrown should be in no definite form?—They were; there was a general figure used, but the angles of reflection were occasionally changed by enlarging or concentrating the size of the focal light, namely, the burner; all light beyond the focus would be reflected at different angles.

3107. Still your answer, with respect to that experiment at Purfleet, would not apply correctly to light reflected from an opaque surface, the form of the reflecting surface being one calculated for diffusion rather than concentration of the rays of light?—It only goes to show that light may be by reflection sent to a great distance and used afterwards, either by refraction or by dispersion, without much loss.

3108. Taking it thus, would not a light exposed directly from the ceiling throw more actual light into the House than one surrounded by opaque reflecting surfaces and the general light reflected from a convex mirror?—No; there would be more light from the reflection, because all the light given by the burner would be sent in the right direction; by proper reflection you bring the whole light into the situation where it is required, and render it what is called profitable light; in the other case the light radiating in another direction is lost.

3109. Taking the light at present in the House of Commons, would a less amount of light give a greater amount of illumination if it were directly exposed under the convex

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cones which are immediately above?—If the reflecting surface was good the quantity of light sent into the House would be very nearly double what it now is. I have stated in a former answer, that this is a question of expense.

3110. So far as the white surface is concerned a greater amount of light is required, in order to produce the same amount of illumination from the white deadened surface at present used?—Precisely.

3111. *Chairman.*] Do you consider the system of reflection adopted in the old House a better and more economical one than that adopted at present in the new House?—I think it is.

3112. You consider, as I understand from previous answers, that it is a great economy of light?—Certainly.

3113. Mr. *Locke.*] Are you at all prepared to give the Committee any idea as to what you would recommend for lighting the House of Commons?—Yes; I am prepared, and will give plans to-morrow. I did not expect that that question would be put to me to-day; if I had, I should have been prepared for it now.

3114. Are you prepared to say that the present system of lighting the House of Commons is not the best?—I think it requires modification; I think it is the best system.

3115. Are you prepared to state what that addition is?—I am not prepared to show it to-day, because I have no drawings; but I shall be prepared to-morrow.

3116. Mr. *Hope.*] To revert to the roof of the House of Commons; I think that the lights, as they now are, are what is called flush with the lower surface of the panels?—They are a little below, so as to partly illuminate the roof.

3117. Have you turned your attention to the effect of the shades which are thrown by the beams and rafters of the roof?—Yes.

3118. Will you be prepared, when you come again, to state some method of avoiding the objection which exists to the deep shadows which are thrown by the present lighting on the roof?—I shall.

3119. Mr. *Drummond.*] They do not obstruct any light coming into the House?—No; they are the deep unpleasant-looking shadows of the mouldings.

3120. *Chairman.*] You will be prepared on Thursday to give us your matured opinion upon these subjects?—Yes.

3121. You have answered some questions relative to the alterations which took place in the lighting of the old House, and you stated, I think, that you made one alteration in consequence

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sequence of a vote of the House; was there any specific vote of the House taken to authorize you to make a change from the oxygen and oil to gas?—No special vote of the House; it was not required, for the subject, by a previous vote of the House, was placed in the hands of the Speaker; the Speaker had the power to make any alteration he pleased under this vote of the House; the Speaker was consulted on every occasion, and the authorities at the Office of Woods made the preparations.

John Leslie, Esq., called in; and Examined.

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3122. *Chairman.*] YOU, I believe, are a gentleman who have devoted considerable attention to the subject of warming and ventilation?—I have.

3123. You have been employed I think by the Government at various times in making inquiries into these subjects?—Yes, and in carrying out important works.

3124. You were, I believe, a Commissioner also to inquire into the state of the hand-loom weavers?—Yes.

3125. Which probably drew your attention very much to sanatory matters also?—Very much indeed. I was one of the hand-loom commissioners for three years, I think.

3126. You have not been satisfied by mere theory, but you have reduced your theories to practice, have you not?—Yes, to insure their being properly carried out.

3127. Do you consider that you have been successful in bringing forward some inventions for the purpose of improving ventilation?—I think I have.

3128. Is that especially in the combustion of gas?—And in the combustion of coal.

3129. The improvement in the combustion of coal, I presume, has been more for the economy of the article of fuel than for the improvement of ventilation?—Certainly.

3130. But with regard to gas, it has very materially assisted in improving ventilation?—It has been most important.

3131. Have you been professionally employed in carrying into operation some of your patented inventions?—Yes, myself and two of my sons are exclusively so occupied. We have one of the largest manufactories at the West-end of London, and many Members of both Houses of Parliament have all my patents in successful operation. Another large class has my patents for the economy of fuel, and a still larger class has my patents for the purification and economic combustion of gas.

3132. Have

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3132. Have you seen the method in which the Houses of Parliament are warmed and ventilated?—By the permission of this Committee I accompanied the Members when they viewed the various processes in operation for the supply of air, for warming and distributing it, and also the mode of lighting and ventilating both Houses of Parliament.

3133. Do you think that you are able to give an opinion with regard to their successful operation or otherwise?—I consider that drawing air down long open brickwork shafts, pulling it by means of powerful steam-engines along damp, dirty cellars and vaults, moistening it, causing it to pass over heated iron surfaces, tempering, moistening, and equalizing it, destroys all the original freshness and purity of the air, and forms a most deteriorated mechanical mixture, combining dust and other impurities, which, apart from other considerations to which I shall presently allude, produce an atmosphere most injurious to the health and comfort of those who are compelled to breathe it.

3134. Do you derive your impressions of the badness of the air from what you have tasted and smelt, or have you any means of analyzing it?—From actual observation

3135. Is it that you have seen the passages, or that you have breathed the air, or both?—Both.

3136. Then your opinion is, that the sources and channels of supply are defective?—Yes. I have not a doubt about what I have stated as to the air; the processes by which it is produced create an unhealthy atmosphere in the House of Commons; but there are other points. I have two great objections to state to this Committee as to the manner in which the air is forced into the House, and the manner by which the vitiated atmosphere is withdrawn from the House.

3137. Will you state these objections?—The theory is, that a given amount of air for each individual of very varying numbers, in a chamber of constant cubical content, can be artificially forced through small apertures, at varieties of temperature, so as to keep the thermometers placed in that cubical content within a small range, say from 60° to 65° Fahrenheit. I believe that on the first night after the Easter recess this thermometric evidence was obtained, that the thermometer in different places indicated this range between 60° and 65°, which I call the thermometric evidence; but the universal complaints on that evening in the House are in evidence before this Committee. In the Speaker's gallery, where I sat the whole of that evening with a thick great coat on, there was a constant sensation of chilliness

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chilliness of the atmosphere. Now, this is a point of the very highest importance in the consideration of the subjects occupying the attention of this Committee. The thermometers tell one tale, and the human body tells another. "You ought not to be cold," say the thermometers, "we are at 65°." "But I am cold and uncomfortable," replies the body. What, then, is the solution of this apparent anomaly? The human body is at a much higher temperature than the atmosphere of the room, and it is placed in immediate contact with the issuing velocities of the currents through the apertures, and is most painfully sensitive to these powerful blow-pipe influences. The Committee will please to observe that the thermometers for registration are not under these blow-pipe influences. For illustration of this point, if I take the atmosphere of any room, it matters not what its temperature may be, and compress it so as to obtain a current of that atmosphere, and I allow it to discharge upon the bulb of a thermometer, the mercury will instantly sink several degrees. It is the same air; it is taken at the same temperature, and by its velocity only it produces this effect.

3138. Mr. *Stephenson.*] On the thermometer?—On the thermometer. The Committee will further observe, that this velocity is increased as the number of Members increase, varying, I think it is in evidence, from 8,000 cubic feet to 20,000 cubic feet per minute.

3139. *Chairman.*] You state that the bodies are brought in immediate contact with these currents of air, or what you have termed blow-pipe influences; but these currents of air do not come in in every portion of the House where people sit, do they?—No, but in most of the portions; the floor is perforated, the risers of the seats are perforated.

3140. Do you consider that when, as you have stated, you felt that influence, you were very near some ingress of air?—I am perfectly satisfied of it; and in an early sitting of this Committee, one of the honourable Members of the Committee showed that the thermometers on the floor were at 68°, on the seat at the side 70°, and about three feet above it 73°, and I think that has been repeated in evidence.

3141. Are you of opinion that air, the temperature of which is not altered, if it strikes upon the bulb of the thermometer, will lower the mercury?—I am perfectly certain of it; it is a fact beyond all dispute.

3142. Mr. *Stephenson.*] Have you made the experiment?—Yes. If I thought I should not have been out of order I would have brought a little instrument down with me to show

it

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it in this room. This is a matter of fact; I know it as a fact, and can illustrate it in this room. What the deduction may be is quite another matter. The point is this, that I compress a quantity of air taken from this room on this table, and accordingly as I discharge that air, I either lower or increase the indications on the thermometer, according to the velocity; that is a point to which I wish to direct the attention of the Committee particularly; it is the velocity of these currents which I think is one of the great causes of the mischief. I would show it to-morrow, if the Committee please, that if I let the air out with great velocity I reduce the mercury immediately, and if I let it out gently I increase the mercury; it rises.

3143. If I understand you correctly, you intend to imply by your answer respecting the velocity of the air, that the velocity is such in the House, under the present system of ventilation, as really to affect the thermometer. Do you mean this to apply to currents of such velocity as exist in the House?—I mean to say that the velocity of those currents impinging on the human body causes that sensation of cold so much complained of. Now, as I could not show it on the human body except by the sensation, I show it in this way by direct experiment, where the air is not prepared, but where it is taken from the room in which we are sitting. The whole operation does not take half a minute; 40, or 50, or 60 strokes of a small syringe in a box will take enough of the atmosphere of this room to show what I mean. But it is not a question of thermometers, it is a question of the human body; and therefore, as I cannot demonstrate the fact upon the human body, I take the thermometers as the next best evidence.

3144. If you used a wet bulbed thermometer you would then bring the thermometer very much into the same condition as the human body; it is covered with moisture capable of evaporation, and depending upon the current of air over it for its rate of evaporation. You by that means ascertain, under very parallel circumstances, the effect upon the human body?—I do not place so much faith in hygrometers as to bring me to that conclusion.

3145. Every human body is a hygrometer; that is to say, it is covered with a thin film of fluid, ready to assume an elastic form, and consequently the greater the velocity of air passing over the body, the greater the amount of evaporation, and the greater the sensation of cold?—Yes.

3146. Mr. *Locke*.] I understand you that the question of these

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these experiments has been simply to show, that when there are strong currents of air in the House, as you believe that there are, having found them by your own experience, they give you a sensation of cold?—I have not the slightest doubt about that.

3147. *Chairman.*] What practical remedy do you propose for the evils which you have described?—Before I answer that question, I wish to say that the egress of the vitiated air is through the slots. Now I think this egress most objectionable; the ascending current strikes against the whole bottom of the panel, causing a general reverberation, producing eddies and currents, consequently permitting only a partial escape of the vitiated air; the remainder of which, by this reverberation, is caused to diffuse itself again and return into the general atmosphere of the room.

3148. Mr. *Locke.*] Does that refer to the House of Commons?—The House of Commons.

3149. You think it comes down again?—There is no doubt about it. I do not think it gets away, from the circumstances which I have endeavoured to explain.

3150. *Chairman.*] By slots, you mean longitudinal apertures of no great width?—Less than an inch. All round the edges of these panels there are little slots by which the air is to make its escape; but the ascending current must strike against the whole bottom of the panel.

3151. Mr. *Locke.*] Do you know that those apertures are less than an inch?—No; I can only state what I have heard in this Committee. I understand from Mr. Meeson that they are rather more than an inch.

3152. Would your reasoning be at all affected by their dimensions?—No; the particular fact of the reverberation would not.

3153. Whether they were larger or smaller slots, your reasoning would not be affected?—It would, to a certain extent; but it does not get rid of the objections which I make.

3154. *Chairman.*] What are the practical remedies which you propose to apply to these defects?—Reserving my opinion for the moment, that the Houses of Parliament, the committee-rooms, the halls and corridors could be much better warmed and ventilated separately, than by any one combined system; for the whole buildings I should adopt the plan I have already proposed to the Government for certain offices about which I have been consulted; and where fireplaces cannot be obtained, and which for the moment, for illustration, I will suppose

suppose to be the mass of these buildings, I should proceed thus: I would lead in from the highest and least objectionable sources a copious supply of fresh air through glazed earthenware pipes, of large diameter, the joints of which I would cause to be most perfectly secured. These earthenware pipes I should cause to traverse into and round and round a large heating chamber; the floor and walls of this heating chamber I should make of fire-brick materials, in the centre of which, and upon the fire-brick floor, I should erect one of my patent fire-brick grates, with an independent supply of air to support combustion, by means of which I could secure any desired temperature of the air, circulating through these hermetically jointed earthenware pipes, and the air from them could be led in similar pipes of smaller dimensions to the different points, rooms, or places requiring the supply. It will be obvious to the Committee that all impurities and contaminations in the transit of the air from the external source of supply to the rooms in which the air is to be delivered would by this simple process be avoided; and that all chances of accident from fire, or explosions of steam-boilers, would be at an end; and what I hold to be of very great importance, the air would nowhere be brought into contact with heated metal, that is, either iron or zinc, both of which I consider very objectionable.

3155. Will you inform the Committee whether that is a theory, or whether you have put it in operation anywhere?—I think I cannot say that I have put it in actual operation; I have made a sufficiently large experiment to ascertain the fact. I would not attempt to tell the Committee that I have done it, and refer to any place where it has been done; but I have obtained a heat from the floor of a room made on purpose for that plan, by a very small expenditure of coals, equal to 95 degrees.

3156. You stated that you reserved an opinion with regard to the mode of warming and ventilating this House by means of one apparatus only, indicating that your own opinion was, that several should be employed instead of one only; will you state what your notions are upon that subject?—I will speak first of this committee-room. I think the evidence given at the last sitting of the Committee by Mr. Meeson has given every Member so clear an account of the processes as to the supply of air, and the means in use to carry off the vitiated atmosphere, that I need not repeat them; but the results are unsatisfactory. The Committee will remember, that in an early sitting Sir Charles Barry thought that nothing short of double windows would remedy the defect.

Now,

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Now, I look at the atmosphere of this room, and I judge that it is in a very doubtful state; by the several days' experience which I have had of the combustion of coals in that fireplace, I think there is an enormous amount of coal used there; that one quarter of the quantity of coals, under the system that I should propose, would give a great deal more heat into the room than is given there. I should call the attention of the Committee to that particular point; and with such a defect in combustion it has all the languor, or certainly has had during the last week, of a fire burning in a room very ill supplied with air. I said that one quarter of the coals would be quite sufficient burnt upon my system. Now, I will endeavour to make the Committee understand what I should propose to do in this one room. I should take out that grate. I should lead in an entirely new and copious supply of air through the floor of the room. This air I should cause to circulate round the bottom and sides of the grate, and discharge itself into the room, either at the sides of the fireplace, or at the opposite end of the room, as might be found most convenient. I should have also a small supply of air brought in by the same channel, to support or accelerate the combustion in that grate when it was a very cold day, so as to have an independent supply of air for the fire burning, without drawing upon the general air that was in the room. The fire-brick grate I would make in a circular form, because it is most easily managed by increase or decrease of fuel, according to the alterations of external temperature which so frequently occur. The whole fuel necessary would not cost 4*d.* a day upon the average for this room. Now, I apprehend no difficulty about the panels, in removing the products of vitiated atmosphere above the panels. I cannot say what may be above this ceiling, or how the smoke flue may run, or how the vitiated atmosphere flue may run, but I should apprehend there could be no difficulty about it.

3157. Why?—Because there is, as I understand from the evidence of Mr. Meeson, a sufficiently large aperture to take away the vitiated products.

3158. You are now stating what you would do with this particular room. You have told us how you propose to get a supply of air to make your fire burn, and to supply the room with air. Are there to be two mouths to supply the room, or how is the supply to come into the room; is there to be one mouth to supply the room with warmed air, which is passed round the fire, and another to supply it with cold air; or is the sole supply to be tempered air, which is to come round the

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the back of the fire?—It would all come in at the same opening, which is under the floor; but the portion that was for warming the room would pass round the fireplace to be sufficiently warmed, and the portion that was reserved for the occasional acceleration and proper support of combustion would be contained in a chamber immediately before the fireplace.

3159. Then into the room itself would come only that air which had passed round the fireplace?—Certainly; probably at either side of the opposite side of the room, or at either side of the fireplace. I have done it in both ways.

3160. Whence do you propose to get your supply of external air?—I should take it from the outside of the wall.

3161. Would you propose to use any tractive power to get rid of your vitiated air?—Certainly not; the chimney itself would be quite sufficient, supposing it had none of these exhausting flues above it.

3162. You propose, as I understand you, to make the ceiling air-tight, to close up all the apertures of the ceiling?—I could get the vitiated air away by means of the smoke chimney, with that grate which I have described, after burning the fuel; or if there were no fuel at all in the fire, it would go away. Now, that I say from positive and absolute fact, that it has been so done in very many instances, and that without a supply of air; in one of my own offices I have had a large open aperture into the smoke flue, with a constant ascending current of vitiated atmosphere.

3163. Are the Committee to understand that in your description of what you would do to this room your egress for your vitiated air would be simply the chimney?—By the power of the chimney.

3164. By the power of the chimney, the space being the space occupied by the fireplace?—Yes, in connexion with that chimney up above.

3165. Mr. *Stephenson*.] Close to the ceiling?—Yes.

3166. *Chairman*.] Where do you put the opening for the passage to take away your vitiated air?—I said that I apprehended that there would be no difficulty above the panels of this room, not contemplating any great alteration, but a small expenditure.

3167. Is your escape for the vitiated air a hole in the chimney inside the room, or where is it?—Inside the room.

3168. Whereabouts?—As close to the ceiling as we could get it, all that cornice being open.

3169. Supposing that to be shut, it would be as near the top

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top of the room as possible?—If it were all left open, as now, we could get into the smoke flue above it.

3170. Supposing that not to exist, and this room to be like any other room, you would deal with it by a ventilator close under the cornice?—Yes; but much larger than an ordinary ventilator.

3171. What proportioned ventilator do you propose to put in?—I think it should be 15, 16, or 18 inches square.

3172. Is that one of your patent inventions?—No, I do not claim any invention for it.

3173. Is what you propose one of those balanced thermometers which generally go by the denomination of Dr. Arnott's ventilators?—No, it is much larger in its opening.

3174. How does it act?—It is always open; it is always acting; it is not balanced to shut with the current, because I secure from the arrangements which I have an ascending current.

3175. Mr. *Stephenson.*] In summer time, where the temperature of the external air is about say 70°, let us assume that the inside of the walls of this House is about the mean temperature of our climate, namely, 52°, do you still, under those circumstances, by your apparatus, maintain an ascending current of cold air by a descending current of warm air?—Avoiding all theories upon the subject, I point to the fact that it is so. I have always an ascending current.

3176. Then there may be some other circumstances in connexion with the experiment of which I am entirely ignorant. Still, as it appears in your evidence, it would only come to that which I just now suggested, that the column of cold air being balanced by the column of warm air, the cold air would ascend, being specifically heavier, and that the only force which you have in order to make it ascend is the column of lighter air?—I do not go into that part of the subject. I state the fact; that is a fact, seen by hundreds and thousands of persons—that it is so.

3177. There may be some circumstances in connexion with the particular position of the experiment which may alter it?—But it is in so many experiments in so many places.

3178. *Chairman.*] Will you have the goodness to inform the Committee where you have carried out this method of warming and ventilating?—I do not recollect just at this moment, but I will give in a list.

3179. Mr. *Hope.*] At the Travellers, is not it in operation?—I do not know whether it is in operation at the Travellers now, but it was most successfully in operation. The great complaint

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complaint at the Travellers was, that they would not allow any air to come into the room either from the bottom, or from the top, or from the windows, if possible, for a very long time; for a whole winter, I think. I cannot tell exactly, for I have not been there myself lately.

3180. *Chairman.*] You say that in winter and in summer, by some means or other, you cannot exactly explain how, there is always an ascending current?—Always.

3181. Viscount *Palmerston.*] Does the smoke never come out of the chimney, through the aperture, into the room?—Never; I refer you to a case which you will see in my own office, that there is not the slightest vestige of smoke, and it is only partially done upon that system.

3182. *Chairman.*] Your plan would be that of warming all the committee-rooms separately?—Separately.

3183. How would you propose to deal with the corridors or the House?—We will take the case, if you please, of what I should propose to do with the House. I should immediately shut off all the blow-pipe influences from the floor and sides of the House. How it is to be done I do not attempt to say; probably from a flooring below or a flooring in the room; I do not attempt to go into that; I merely give a general idea of what occurs to me to carry out what I think would improve the system. I should also shut off every sort of connexion as to descending currents of air, which I hold to be most dangerous to health; I should take example from all previous failures. Sir Christopher Wren failed, Dr. Desaguillers failed, Sir Humphrey Davy failed, all from having too small apertures for the vitiated atmosphere to escape; and I believe that one of the great causes of the present failures is what I have already alluded to, reverberation from the ascending current on the bottom of these panels. I should remove the whole of the centre framing and panels of the ceiling; and I must request the favour of the Committee to defer their opinion on this proposition until they hear it completed in answer to some questions that I believe are to be asked of me as it regards the lighting of the House, because I believe that the two are most intimately connected. I will now state the leading principles of the system which I would propose as it regards the chamber of the House of Commons itself: first, that the floor of the House should be constantly and uniformly warm; this I take to be the basis of all good ventilation.

3184. Sir *D. Norreys.*] What do you mean by "the floor"?—I mean the floor itself; that upon which you walk. I would shut off all influences of air entering from below; secondly,

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secondly, that the supply of air should be self-regulating; thirdly, that the removal of the vitiated atmosphere should pass quietly away, and with the least possible frictional interruption. As to the supply of air on the separate system of warming and ventilating the House, it would be similar to the proposition as to the committee-room which I have just detailed. The supply for the House I would bring down from the exterior of the roof in glazed earthenware pipes.

3185. When you say from the exterior, do you mean the external air?—Yes, as high as possible, to get the air as good as possible, and deliver it, after being warmed in the manner previously described, into the least objectionable part of the centre of the House. I calculate that four square feet of supply channels would be amply sufficient; two from the east side of the House, and two from the west side. That consequently would necessitate two fireplaces, one on either side of the House. The exit of the vitiated atmosphere would be through the large aperture in the ceiling conveyed away through a shaft, the moving power of which should be a small fire-brick open grate, costing for fuel about 6*d.* a day, and which power would remove more foul air from the body of the House, and there would be a consequent acceleration of supply of fresh air as you increased the height in that shaft. The Committee will bear in mind that this portion of the plan will be further developed, as I before alluded to, in my replies as to the lighting of the House. I propose open fireplaces in the House, so as to cause a current of warm air to pass all over the floor of the House.

3186. *Chairman.*] Then the success of your plan would entirely depend upon the possibility of putting fireplaces into the House?—Certainly. If it is impossible to do that, then that plan is at an end, namely, the individual system of warming it, and I then fall back upon the other mode of supplying fresh air, as previously detailed, through the large diameter of earthenware or fire-brick pipes.

3187. Viscount *Palmerston.*] By "the House" do you mean specifically the room in which the Members sit, or would you include the side lobbies in your term "the House"?—For this present purpose I refer to the House itself.

3188. *Chairman.*] You have stated that a portion of your recommendation would depend a good deal upon the lighting; will you have the goodness to state your views as to the combined lighting and ventilation which that answer infers?—I have seen both the original system of lighting and the system as altered during the recess. Now, I consider the alterations made

made during the recess to be of the most dangerous character. In point of fact, there are 16 gas furnaces in close contiguity with a wooden ceiling; these furnaces can be elevated or lowered, as detailed in evidence before this Committee, as an increase or decrease of light is required. The cone above each furnace is of copper, one of the best of the metals for conducting heat, and the bottom of the burner, or the intercepting medium, or, as it has been termed, the softener of the light, is of copper wire gauze, covered with plaster of Paris. Now, I think that the dangerous character of this light is only concealed from view of the House by this intercepting medium; that if that intercepting medium were removed, the House would not tolerate the light in that position for five minutes. The system of burning the gas there is the same as may be seen in any coal shed or butcher's shop about the metropolis.

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3189. Do you mean that it is dangerous because it is likely to set fire to the roof, or dangerous to the health of the Members?—I think the health of the Members is improved upon this system as it regards that, but I think there is danger from fire to the roof. Again, I consider it very expensive, because Dr. Reid stated to the Committee a day or two back that he had at present, from some objection on the part of Sir Charles Barry I believe, not been able to place a meter or governor to ascertain and regulate the quantity consumed, but he assumed that the cost per hour was 4*s*. 6*d*., and that it would require, to complete his system of lighting, lights all round the external windows, the expense of which he varied from 12*s*. to a guinea per hour.

3190. You have not yet stated your reasons for desiring to take away all the panels in the roof, and leaving it open, as combined with lighting; will you proceed to state those?—The information that I have obtained is, that if the whole of those panels were removed, and the framework removed, I should then have 55 feet in length by 16 feet in width.

3191. Of open space?—Of open space. I will suppose the leather part of the table at which I am now sitting to be the present framing and panelling all removed within an opening into the House. I should make myself better understood if I gave the principles upon which I think it is absolutely necessary, under the peculiar circumstances and requirements of the House of Commons, to have the light, if I detailed shortly the principles upon which I should carry out this plan. First, that there should not be the slightest risk of fire in the ceiling. I should not concentrate a great mass of gas in one particular burner. Secondly—and I deem this

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of very great importance to the Members—that there should not be the slightest chance of danger from any portion of the apparatus falling. Were such an accident to occur, it would, from the great height of the house, in all probability be fatal to any one upon whom it fell. Thirdly, that the whole system should be in operation in five minutes after the order was given for artificial light, without any of the gas-lights being burnt during the whole of the previous morning. Fourthly, that each light should be a fixed and secure light, and not supplied from a vertical sliding tube, which is the case now; I understand they are allowed to slide down.

3192. Mr. *Stephenson.*] Are you speaking of the chandeliers or the present lights?—The present lights.

3193. That is not so?—I saw them there. I can only state what I saw. Fifthly, that there should be no intercepting medium between the light as generated and the duty it has to perform to light the House. Sixthly, that the gas should be thoroughly purified, and freed from any chance of the compounds of sulphur and ammonia. Now, the removal of these compounds is extremely important; and if the Committee wish, I can put in a report of Dr. Lyon Playfair on the effect of these processes in connexion with my operations at the Post-office, which was transmitted to the Government some time back.

3194. *Chairman.*] Would that apply to gas from cannel coal?—Most decidedly; more so than from the other. It is of far more importance.

3195. Mr. *Stephenson.*] When did Dr. Lyon Playfair make that report?—I should think it is 12 months ago; not for this occasion, but for the Government, for the Post-office. (*The Witness delivered in the same*). One of the witnesses before this Committee stated, as it regarded the Liverpool Philharmonic Concert-room, which was lighted by means of a sun-burner over the orchestra, and a row of jets round the cornice, that it cost 2 *l.* 12 *s.* or between 10 *s.* and 11 *s.* per hour to light that one room. Now, the entire of the postal department of London, with several rooms of much larger superficial content than the House of Commons, the whole of the money-order offices, on a separate side of the street from St. Martin's-le-Grand, all the newspaper department, all the London district department, the foreign, the French, the East India, all the workshops, and all the offices, do not, in the depth of winter and during the greatest pressure of business, when all the lights are going, cost so much upon my system as that one room at Liverpool, and there

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there are about 100 rooms lighted; some of them have about 50 lights, some have 60 lights, and some have 30, and so on.

3196. Can you give the whole number of lights?—Since I have had the thing put into my charge, I have superseded about 800 lights. Probably the best illustration of the old system and the new is to be found in the newspaper department, the superficial contents of which are much larger than of the House of Commons. In that department there were 355 Argand burners, and now there are 90, and have been for four or five years, of these burners (*producing a burner*). *Vide* App.

3197. By Argand burners, do you mean oil lamps or gas lamps?—I mean Argand gas-burners. From the effects of the purification of the gas, and this mode of consuming it, at this moment we are carrying through entirely new services; my men have been at work for the last week or 10 days completing entirely new services throughout the Post-office, the effect of which will be to get another very large decrease in the consumption of gas. And I look upon it that, although the pecuniary saving is very great, it sinks into perfect insignificance compared with the improvement as to the health of the persons who have to work in the place; because the products of combustion being so much less, the general temperature of the room is thereby very much improved. I will hand in also, if the Committee will allow me, a Report from the chief officer by order of the Postmaster-general, early in the progress of this affair, four years ago probably; but it is still very much improving, and in the course of a fortnight or three weeks from this time I think the whole system will be complete. (*The Witness delivered in the Report*).

3198. *Chairman.*] What is your object in handing in that report?—It is merely to show the great sanitary consequences of an improved mode of consuming gas.

3199. Will you state how you propose that the House of Commons should be lighted, and the ventilation assisted, according to your ideas?—First of all, I think that the House cannot tolerate the lighting of gas-lights during the time the House is sitting; it is a great inconvenience. Secondly, I think suspending lights from the roof very dangerous, from accidents that may occur from such a height as 40 feet. Therefore, to avoid these objections, I take a gas supply all round the edge of this opening, with perfectly fixed and secure lights inside of that opening.

3200. At what distance from the roof?—It would be a very considerable distance, but it would not signify, for that purpose, if it was two feet. I imagine, that if I can form the

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chamber which is now called the roof, with a chamber of light, I have no difficulty whatever, from the angle at which this would be placed, in getting the light entirely under the galleries and all over the House. If I place my patent burners (I will not confine myself to an inch higher or lower) at a foot apart all round this opening, I shall then have from 130 to 134 burners all round this opening. I should apportion the purified cannel coal gas three cubic feet per hour to each burner, and the whole would not require any assistance of external lighting, but the House would be splendidly lighted for about half-a-crown an hour. Now, I am perfectly satisfied that there is not the slightest doubt of the fact.

3201. What is the distance from the roof at which you propose to place your lights?—One foot above the existing ceiling, so that as soon as the order was given for artificial light, the men could go and light those burners without interrupting the House at all, or without the chance of the least accident in the House from anything falling.

3202. What is your reason for supposing that that would light the House?—Because I have had experiments.

3203. Where?—At the Earl of Eglinton's. There is the very identical thing, with the difficulty which has been alluded to, and thought to be a very small one, of forcing the light through glass. Now, it is precisely to get rid of that difficulty that I remove those panels to get the light down without any intercepting medium between the light as generated, and the light as thrown down into the room.

3204. Have you taken the angles of the House, so as to be able to state that the Members sitting under the gallery would have the light thrown upon them?—Yes, I think I have done so sufficiently; but failing that for the moment, because I have not gone into the absolute and positive detail, the top row of panels on the sloping side would enable me to do it, by placing the lights in those.

3205. By the top row of panels do you mean taking out the panels there?—Taking out the panels.

3206. And placing additional lights, or merely the allowing the light from the burners which you have already stated you would place in particular directions to strike through those panels below?—Yes.

3207. Not by any extra light?—No extra light.

3208. No extra burners?—No, those burners would be quite sufficient to light the House.

3209. Mr. *Greene*.] You would simply take out the panels, and leave everything else in the roof as it is?—Not of necessity,

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necessity, because I believe that the place where the framing is, at the top of those sloping panels and the sloping part of the ceiling, is quite sufficient for the purpose to light underneath the gallery in a straight line, as well as all the body of the House; but failing that, if I have not the angle sufficiently, I fall back upon placing the lights in the top row of panels.

3210. Do you think that taking off the panels at the slope would of itself be sufficient, without touching the other part of the ceiling?—For the purposes of light, but not for the purposes of ventilation.

3211. Then you would place no obstruction of glass in those panels?—Most decidedly not; you would lose a great per-centage of light by the glass.

3212. Have you taken at all into your consideration, as it is a necessary part of the good construction of the House of Commons, what effect would be produced upon the hearing if you removed all these panels?—If you carried out the proposals which I have made as a whole, you would be speaking in the calmness of a summer day's atmosphere, because there is plenty of space then for the vitiated air quietly to ascend, whereas now you are speaking in gales of wind and gushes of air, so that I apprehend it would very much improve the hearing.

3213. You think there would be no loss of sound through those apertures which you propose to make in the ceiling?—I am quite confident there would be a great gain.

3214. *Chairman.*] What does your confidence arise from, the reasons which you have already stated?—The reasons I have already stated.

3215. No others?—No; because I apprehend that if you are speaking in a quiet, still atmosphere, you are much better heard than when the sound is driven about, and when there is a reverberation of the currents, there not being sufficient escape. From having read and examined carefully all the plans as detailed by Sir Christopher Wren, Sir Humphrey Davy, and Dr. Desaguillers, I am convinced that the failure has arisen, as I said in the early part of my evidence this morning, from not having sufficient escape for the vitiated air. I have a case in point, of a room larger than the House of Commons.

3216. Where?—The whole of the buildings of the Merchant Tailors' Company, including their hall. Now, they have only appropriated what will hardly be thought anything of here, 25*l.* for ventilation; but I have been enabled to get this

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great result, because I firmly believe that too much attention is paid to bringing the supply of air into the House, and a great deal too little to taking it out of the House. I believe Providence finds us the supply of air better than we can do it ourselves, if we will only remove the vitiated atmosphere. In this case to which I allude we have 52 gas-burners in a room of a great deal larger cubical content than the House of Commons; all round the ceiling of the room are very large apertures, I forget the exact amount, probably 3 feet by 18 inches, divided into parts: each of these has a communication with the room below. The roof is precisely the same as the roof of the House of Commons; consequently above the ceiling there is another roof. I built a large shaft, I think some six feet in diameter, and into that shaft I put one of these little fire-brick grates. It never costs more than from 3*d.* to 4*d.* a day for fuel, and the effect that I am going to detail to you was one very carefully taken upon the last occasion of a public dinner there. I told the Master of the Company that I was satisfied that if they would shut up all the windows for that occasion we should find an immense benefit by drawing off the vitiated atmosphere without allowing a supply of cold air to tumble in from the ceiling. I obtained his permission. From 5 o'clock to 10 o'clock, where I sat, there was a thermometer near me.

3217. How many people were in the room?—About 400.

3218. Upon what occasion?—It was the occasion of one of the court dinners, about six weeks back. The range of the thermometers in the five hours was from 55° to 61°, and the range in the roof of the vitiated atmosphere never exceeded 64°.

3219. How do you know?—Because I had a thermometer and a man there.

3220. Above?—I had a man there the whole time.

3221. I rather gather from what you have just stated, (perhaps you can explain it otherwise) that if you have a shaft and a tractive power to draw your vitiated air away, you may trust to Providence for your supply of fresh air?—No, I do not say that. I say there is a great deal too much care taken as it regards forcing air into the House rather than taking it away. If I recollect rightly, I have provided, in the proposition explaining my system, four square feet of shaft for the House of Commons, for the air to be brought down round those fireplaces.

3222. You have just described to us an experiment. What I am anxious to know is this: you have told us how you got your vitiated air away; it would be agreeable to the Committee

mittee to know where you got your supply of fresh air to take the place of the air which was drawn out by your brick fireplace in this shaft?—There was no provision in the place for supplying fresh air, nor taking it away, till I made this application.

3223. Upon that particular night in question was provision made for the supply of fresh air?—None.

3224. Viscount *Palmerston.*] Whence did it come?—I cannot tell at all.

3225. Mr. *Locke.*] Was your seat near the door?—It was at the lower end of the room.

3226. Were you within a moderate distance of the door?—I should think I was within twenty feet.

3227. Did you discover any draughts of air during the time you were at dinner?—Not at all, except at the time the door was opened.

3228. Did you find considerable draught when the door opened?—No, I did not find any inconvenience at all.

3229. Mr. *Stephenson.*] Did it not occur to you to reflect upon that experiment, and to ascertain how to account for the fresh air. If the vitiated air was continually going out it was a remarkable experiment, and we should have thought you would have been curious to know where the fresh air actually came from?—I apprehend it came from the doors, and the other parts of the room, the windows.

3230. *Chairman.*] You tell us that you begged leave to shut all the windows particularly?—Yes; upon all previous occasions it had been the custom to open the top parts of the windows, which I believe caused immense inconvenience to the parties present, and upon this occasion I was enabled for the first time to make them shut almost all the windows.

3231. Mr. *Locke.*] Can you give us an idea whence the air came on that occasion?—I will not attempt to say that.

3232. And you have no idea in your own mind upon it?—No. I know what I should do if I had my own way with it, namely, as I propose to do in the House of Commons, make a fireplace for the supply of air, but I could not do that. I was limited to a very small expenditure, and that very small expenditure I used for the purpose described. I venture to say one word as to the expense of lighting that large establishment. There are a very large number of burners throughout the different offices and places in that establishment.

3233. *Chairman.*] What did it cost that night?—It has not cost above 22*l.* for the whole year; the year will very shortly expire. About 22*l.* or 23*l.*

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3234. Mr. *Locke.*] Can you state the amount of gas consumed in the year?—That is, at 4*s.* a thousand.

3235. That is what the company pay for the gas?—Yes.

3236. Mr. *Stephenson.*] A hundred and ten thousand cubic feet?—Yes, not quite that, about 108,000; but the gas in all these cases that I have detailed, as it regards the Post-office and the Merchant Tailors' Company, is the common coal gas purified. The expense would be vastly less, and the products of combustion still less, if we had cannel coal, because the proportion of the light in the one and the other is very different, greatly in favour to the consumer of the cannel coal gas.

3237. *Chairman.*] Do you think that the alteration which you have described would interfere much with the architectural beauty of the present ceiling?—I imagine that it could be made extremely ornamental; fancying the transept in the Crystal Palace, fancying all those panels in the sloping side of the roof filled in with glass, I think you might get a great deal more daylight, as well as a descending amount of light from those burners which I have already described, through the glass, and the direct rays which were sent down to illuminate the House. The importance of my burner, perhaps, you will allow me shortly to detail. If I take three feet of cannel coal gas, properly purified, and passed through this burner, I can probably get the amount of light of from 16 to 20 wax candles; but if I change the mode of consuming it, by putting on a glass a little longer, I decrease the light, and increase the flow of gas. The more I elongate that glass, the less is the light, and the more the gas, because the ascending current is increased by the length of the chimney, and the gas being of lighter specific gravity than the atmospheric current which is passing through it, the atmospheric current takes the gas away unproductively for the purposes of light.

3238. Mr. *Drummond.*] Do you mean unconsumed?—I cannot say that quite. I use the term advisedly; it is not consumed productively for the purposes of light.

3239. Mr. *Locke.*] Partially consumed, probably?—I will not say that. I do not like to say that. I do not know how it is consumed; but I know that if I place a most sensitive photometer, and get the illumination with three feet of gas, and do not touch the supply; if I put a long chimney on to it, I immediately decrease the light, and increase the flow of gas.

3240. Mr. *Stephenson.*] You increase the temperature of the burner, and you diminish the light?—I say that with the length of the chimney I get a more rapid ascent of the atmospheric air, and that atmospheric air being of a greater specific gravity than

than the gas, probably in the relation of one to decimal 5, the gas is carried away by the length of the chimney unproductively for the purposes of light.

3241. Mr. *Drummond.*] Do you mean to say that if you were at the top of the chimney, to catch any part of that gas which had passed through the chimney, you would then find unconsumed hydrogen?—I will not say that; I will not say what it is, but it has been examined and witnessed by pretty nearly every philosopher on the Continent, for they came to see this extraordinary thing; it has been investigated; it has been lectured upon at the Royal Institution several times. And there is a most remarkable case of the union of these points of flame which just occurs to my mind, related by the Dean of Westminster, who was taking great interest in this matter prior to his lamented illness. That was at the Civil Engineers' Institution; he got me to make him several burners for illustration; he placed two candles on the table separately, but close together; he said, holding his hands together, and downwards, "I cannot see any dirt on my hands, but if you will unite the two flames of those candles into one flame I can see a great deal of dirt," showing the increase of light from the united flames. Now, the evidence as to the lighting of the Philharmonic Concert-room at Liverpool was, that they were all separate jets. In this instance you will observe that I divide it into 28 portions, but I get an atmospheric current around each of the 28 tubes, the oxygen from which produces that brilliancy of light which this burner produces. If the Members of the Committee will take the opportunity of reading the very careful investigation by Dr. Lyon Playfair on these points it will afford them valuable information. I may tell the Committee that those experiments which Dr. Playfair instituted occupied more than six weeks; therefore his report, although a very short one, probably is worth the consideration of the Committee.

3242. Mr. *Locke.*] Do you attribute the advantages of that burner entirely to the arrangement of the 28 tubes, by which means you get a more perfect combustion, by getting a better supply of oxygen for the support of the burner?—I do.

3243. Do you attribute anything to the length of the glass?—Very much. I have explained that.

3244. Do you consider the advantage of that burner to arise more particularly from the peculiar length and shape of the glass, or from the peculiar arrangement of the tubes of the burner?—From both.

3245. And you suppose that by that arrangement you have obtained,

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obtained, by the subdivision of a number of lights into 28, and by the peculiar nature and length of the glass, a state of combustion which is next to perfect?—I do not know anything that would beat it. I cannot put any limit upon science; to-morrow it may be discovered, but at present I know nothing at all that can approach it.

3246. You mean to say that the arrangement of those tubes is such that you get a more perfect combustion than by any other combination. Take the Argand burner, do you think that you get a better combustion than with that?—Most decidedly. I produce more light with a given quantity of gas.

3247. Therefore you would infer that you have a more perfect combination?—No doubt; and also, if I get a larger amount of light, I require a less quantity of gas, and consequently I have less of the products of combustion in the room.

3248. Mr. *Stephenson.*] You have spoken of the danger of fire in the present mode of lighting the House of Commons; have you been in the room since it was lighted in that way?—No, I have not.

3249. You have not ascertained what the temperature of the gas is escaping from those burners?—No; I should ascertain what the temperature of the gas was.

3250. Have you tried the experiment?—No.

3251. If you were told that it was about 230 or 240°, would you call it dangerous?—Yes, certainly. I do not mean to say in the first week, but it would be so with constant burning at the temperature of 230°, in a roof within, I should think, 12 inches of timber.

3252. Mr. *Locke.*] Does the question of the extraordinary heat there weigh very much with you as a reason against that mode of lighting?—Very much indeed.

3253. Do you see any mode by which that danger or difficulty could be got over?—Certainly I do, in the way in which I have shown it.

3254. But with the particular burner now employed. Taking the burner there used, and the temperature to be what has been stated by a Member of the Committee, can you suggest a mode by which any danger could be avoided?—No, I would not take the responsibility of suggesting any alteration of a thing which I considered to be radically erroneous.

3255. Do you know that it has been given in evidence here that in the burner at Liverpool the inner tube is sometimes just red hot, and still, by encasing it, it is made not injuriously hot?—I was sent down to Liverpool by the Government a

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short time ago, in connexion with applying this system of burning the Liverpool gas to the new Post-office at Liverpool. The party who built one of the large reading-rooms at Liverpool gave evidence as to the state of those tubes; he described them to be red hot. Now, the evidence of Mr. King, the other day, the witness from Liverpool, was, that it was a dull red heat, and that that tube was encased with outer tubes, and it was described to be a great addition to the ventilation of the room. All I can say is, that I should not like to take the responsibility of carrying a red hot tube, made red hot by an hour or two's combustion, and cause that heat to be continued for six or eight months day after day.

3256. You think that you could not prevent its communicating with the roof?—I think that the thing may be done infinitely better, much cheaper, and much more advantageously than in that way, because the chances of the falling of any portion of that apparatus are extremely great.

3257. We are not speaking of that danger now, but of the capability of doing it without the danger of fire; can you avoid the danger from fire?—I would not take the responsibility.

3258. You do not see any means which would satisfy your mind?—I do not see them. The case which I had to investigate was the ceiling of one Government office, and the floor of another Government office, and whether there was a possibility of applying such a system of lighting between the wooden ceiling, the rafters of one, and the wooden floor of the other.

3259. The case which I put to you was the present House of Commons. I asked you whether, in your opinion, by the present system of lighting, it was possible to make it safe?—My answer is, that I do not think it is.

3260. *Chairman.*] You never, as I understand, made any measurements of the area for the escape of air from the House of Commons?—I have only heard it in evidence here.

3261. Nothing else. You do not pretend to have made any measurement whatever?—Certainly not. I had no authority to do it.

3262. Of the area of escape of vitiated air in the House of Commons you have made no measurement?—I have heard ti here.

3263. But you have made personally no measurement?—No; I have heard that the united openings of these slots amount to something like 240 or 250 feet.

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3264. Viscount *Palmerston.*] You have heard it in Committee, in evidence?—I have.

3265. Mr. *Drummond.*] You were asked, with respect to the architectural arrangements, whether you thought your system would be detrimental or not, and you said you thought rather the reverse; are you an architect?—No.

3266. You never have studied architecture?—Never; but I stated also, that having in view the transept of the Crystal Palace, and forming that roof into a chamber of light, I thought, by having the glass panels instead of the wooden ones at the sides, you would get a vast deal more daylight into the House of Commons; and I could not conceive that that would be detrimental to the architectural effect.

Jovis, 29° die Aprilis, 1852.

MEMBERS PRESENT:

Lord Robert Grosvenor.	Mr. Stephenson.
Mr. Deedes.	Mr. Locke.
Mr. Hope.	Mr. Drummond.
Sir Denham Norreys.	Viscount Palmerston.
Mr. Greene.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

Goldsworthy Gurney, Esq.; further Examined.

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3267. WHAT have you in your hand?—It is a sketch showing the mode of illuminating the roof of the House of Commons, and under the galleries, so as to destroy the black shadows arising from the mouldings.

3268. Will you take that sketch in your hand, and state whether you propose to do that by an actual alteration of the roof, or by bringing the burners lower down, or in what way?—The mode of doing it is the same as was done in the old House for the same object; when the lights were placed above the ceiling, as they are now, the same objection was raised to the black shadows arising from the ornamental members

members and mouldings in the ceiling; to remove that objection some experiments were made, amongst the rest this arrangement was made, a diagram of which I have now in my hand; it succeeded perfectly in removing the shadows, and I know of no better; the naked light for illuminating the roof was so placed that it was not seen from the House; it was placed in a catoptric mask brought down from the ceiling; the light itself was not seen in the House; the radiation of the rays were made to fall against the ceiling, also by the reflector rays from the burner, which would have otherwise passed into the House, were reflected back against the ceiling, and destroyed these shadows; the light was very small; the whole apparatus was not larger than the size of an ordinary sugar basin; it was so small that nobody saw or knew it was in the House. A greater power of light was afterwards placed in this catoptric apparatus, to illuminate the ceiling so strongly, that it might light the House. The system was suggested by Mr. Warburton; he proposed to try to light the House from the ceiling alone, and those burners were augmented in size for the purpose; they brilliantly illuminated the whole of the roof of the late House of Commons. The sloping roof was glass; it was found that a large portion of light passed through it on the sides; but the light which came from the central panels of the House was very powerful; it was sufficient to warrant the opinion that the House might be well lighted by that means.

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3269. Will you state how far the light was brought below the roof?—The light was brought very nearly in a line with the part where the sloping roof terminated; about four or five feet below the ceiling.

3270. In point of fact, is there any difficulty whatever in managing the lighting so as to destroy those shadows, provided only you bring the light low enough, and that, in order to render the light agreeable to the Members, it is shaded in some way from their eyes?—None whatever.

3271. This is a process by which that can be effected?—That is the process by which it can be effected, and by which the roof can be lighted; it must be made larger than is shown in these drawings.

3272. Does this light deal with the question of the shadow under the ceiling?—It does not affect the ceiling under the galleries. Before I leave the arrangement for lighting the roof, I will state that I had the pleasure of meeting Mr. Hope yesterday in the House, to whom I explained this plan of lighting the roof; Mr. Hope proposed that the light might be

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be placed at the foot of the windows, to try the experiment, instead of being hung from the ceiling; this plan is more difficult to apply reflection to, and send the light to the distance in the proper direction and quantity; there is also rather a difficulty in carrying off the products of combustion; you could not have a large light sufficient to illuminate the whole space required between the windows, without interfering with the glass and mullions by excess of light; if the upcast light is placed along the foot of the windows, and simply used as a radiating light, this objection will be found; radiated light loses as the squares of its distance; it will produce too much light at the foot of the window, too much for the distance. By the means which I have proposed in this diagram, the light would be equally diffused all over the roof; if you reflect it from the windows, you would produce shadows the other side; besides, it would be difficult to throw it into places where it would be most required.

3273. You expect some reflection from the roof, which would give light lower down?—Yes, it would a little assist the body of the House; but it would not go under the galleries; my observations relate to the lighting of the roof only.

3274. Did the chandeliers (as you termed them in one part of your former evidence) in the old House, throw any light into the body of the House?—Yes; sufficient light under the galleries; and a larger portion was thrown upon the table of the House.

3275. But the principal light sent down on the House upon the floor and that neighbourhood was derived from the lights that were in the roof?—From lights in the roof above the ceiling.

3276. Sir *D. Norreys.*] Would you not have to alter the colour of the ceiling, in order to get a sufficiently reflective surface?—Yes, a little; experiments were made with varied coloured bodies for the purpose of ascertaining what was the most agreeable light; we found light of a lemon colour, or something between straw colour and orange, was the most agreeable; blue light was very cold; the nearer we came to red, the more we found that the light was agreeable and soft.

3277. Then, the present dingy colour which we see in the roof of the House must be done away, if that plan is put into operation?—Yes; if you light the whole central part of the ceiling, and have it ornamented, the portions that are ornamented might be made to reflect the proper quality of light.

3278. *Chairman.*]

3278. *Chairman.*] Looking both to the architectural beauty of the building, and the agreeableness of the light, would you have the same number of lights that there are in the roof now, or a greater number; would you have, for instance, one in each panel, instead of one in every fourth or fifth panel, as at present?—I would have more lights for two reasons; first, that it would be more agreeable in appearance; and, secondly, that you would make up in quantity of illuminated surface, what you now produce by intensity; the intensity is now too strong to be pleasing; if you made it up in quantity, the light on the ceiling would be more agreeable it would not be so offensive to the eye.

3279. With regard to expense, should you give the preference to a smaller number of large, or a greater number of small lights?—The amount of expense would be very nearly the same.

3280. It would only be the first cost of the burners?—Yes; there would be very little difference in the expense of the nightly consumption.

3281. With regard to the laws of light, do a few large burners, or a larger number of small burners, concentrate the greatest amount of light?—The proportionate quantity of light from large or small burners was given very accurately by Dr. Ure, in the Committee of 1839, but I do not recollect them.

3282. Have you anything like a distinct impression upon the subject?—My impression is, that the difference is not, practically, worth consideration.

3283. Sir *D. Norreys.*] Is your proposition that light should hang from each of the present pendants, of which there are now ten?—A small mask catoptric light from each, for the sake of meeting the conditions proposed.

3284. Do you consider that 10 lights would be amply sufficient for lighting the House by proper management of the colour of the ceiling?—I do, if properly made.

3285. *Chairman.*] With those lights, do you contemplate the extinction of the present lights, or the retention of them?—The question now applies to illuminating the roof.

3286. You would still preserve the lighting above the roof as it exists now?—Yes, the same principle.

3287. Mr. *Locke.*] Do you suppose you could, by using the roof as a reflector, get sufficient light to enable you to dispense with the lighting above the roof?—It would require assistance from above, to throw extra light on the table and floor,

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floor, otherwise you would have too much light in the galleries as compared to below.

3288. Sir *D. Norreys.*] Then your proposition is, to retain the present system of lighting, and, in addition, to add these pendent lights?—Yes; I have put them in pencil on the diagram, to explain what I mean.

3289. Mr. *Locke.*] How many of those lights would you propose to suspend?—I would suspend one from each of the pendants now in the roof; if you put a number, you need not have them so large; they might be very small; the quantity of light must be obtained, whether you have it in one large burner, or in a series of small ones.

3290. Sir *D. Norreys.*] Then if the experiment which is to be made this evening, of placing a small amount of light behind the fret-work of the galleries, succeeds in removing those shadows, your proposition of the drops would be unnecessary?—Yes; it does not matter in which way you get light on the roof.

3291. *Chairman.*] Would there, in point of fact, be any difficulty whatever in lowering the present lights a foot or thereabouts, so as entirely to obviate those shadows?—Yes, there would; it would not obviate the shadows unless it was brought down sufficiently low to throw the rays of light in a certain angle upwards; it would be inconvenient so far below the ceiling, on account of the difficulty of the reflection.

3292. If you were to lower the present lights, so as to obviate the shadows, I presume you could not get the same amount of reflection that exists at present?—You could not.

3293. Sir *D. Norreys.*] Will you state what objections strike you to lighting the roof according to a plan which has been suggested to the Committee, namely, by having a sufficiently strong light suspended from each of the pendants, of course in a manner which shall best accord with the general architecture of the House, the light being invisible from the body of the House, and being assisted by strong reflectors, which shall throw such amount of light on the ceiling that the ceiling itself shall act as a general reflector, and by those means, without any assisting light, give sufficient illumination for the whole House, without the present lights?—I see no objection. If I understand the question correctly, I should say the whole House may be lighted by the masked-light, by augmenting its quantity, and by concentrating the atmospheric Bude light in the focus of proper catoptric apparatus.

3294. You conceive it possible, by increasing the amount of

of light, to get a sufficient amount of illumination for the House generally, by making the ceiling a reflector?—I do.

3295. What inconveniences do you anticipate from such an arrangement?—You would have more light in the galleries than you have in the body of the House; you would have sufficient light in the body of the House for all practical purposes, but not for effect; you would have more light in the galleries than in the body of the house, which would have an appearance of want of diffusion. It was on this account that, in the experiments of 1839, we introduced the lights above the ceiling; these were concealed from the House; they threw an extra quantity of light upon the floor, and equalized it.

3296. Did not you say that you were induced to adopt that arrangement in consequence of the inclined portions of the ceiling of the old House being of glass, and therefore not acting sufficiently as a reflector?—We found an inconvenience from a large portion of the surface of the old House being of glass; but, with a view of correcting this inconvenience, we had white curtains made to draw up under the glass; on making a second experiment, when those blinds were up, we found light sufficient; the inconvenience just stated obtained, namely, that the galleries had too much light for the body of the House.

3297. Would not the inclination which a portion of the ceiling has, throw an agreeable light upon the faces of the Members on both sides of the House, and take off that strong shadow on the features which the light from the mere centre now produces?—Certainly.

3298. *Chairman.*] Provided the surface were of an agreeable reflecting colour?—Certainly.

3299. That must be a condition?—That is a condition, as a matter of taste; but we must not lose sight of the business condition of throwing upon the table and the floor of the House extra light from a concealed position above.

3300. Sir *D. Norreys.*] Might not such an arrangement be made with respect to the supply of fresh air and carrying off the combustion from the lights so suspended, as to prevent its interfering materially with the ventilation of the House?—Perfectly; in those experiments I have referred to, I had always that object particularly in view: the flues which I made to carry away the products of combustion from the light, were insulated by a nonconducting substance, by which any heat was prevented from passing to the outer pipe itself; no heat whatever came into the House; and every

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portion of air that was vitiated went away in the general upcast.

3301. The objection you have stated to this system of illumination is, that the gallery would be more illuminated than other parts of the House; having reference to the angles at which the light would be reflected, would not the gallery rather escape that amount of light that you referred to?—I think there are means of colouring the roof so as to throw the light more down the middle than sideways, you would then get rid of part of the difficulty; there are a number of deep mouldings lying at angles with the House which might be painted much lighter than the other parts; the light from them would be thrown directly into the body of the House instead of on the galleries.

3302. *Chairman.*] By colouring different portions of the sloping roof different colours?—Yes; the deep mouldings.

3303. What is there to prevent the present House being lighted perfectly well, exactly as the old House was lighted, by adding to the present light in the roof a couple of what you called chandeliers, which would light those portions of the roof which are now in shadow?—None; the pendents possibly might be offensive to Members in the House, if not properly arranged; no naked light must be allowed to pass directly from them to the eye. If the light was placed in a catoptric mask, there could be no objection.

3304. Was not the light in the old House fitted with a catoptric mask?—It was, to a certain extent; but not carried to the extent that I should now propose: we wanted light under the gallery.

3305. I presume a couple of lights, so brought down, would effect the same purpose which the plan that you have now proposed would effect, unless it is proposed to light the whole House from pendents?—Yes.

3306. Mr. *Locke.*] According to the plan you have now described, how many of the panels in the central part of the roof would you propose to illuminate?—The whole.

3307. Not only the 16 that are now illuminated, but every parcel in that portion of the roof?—Yes; one portion of the glass panel should be ornamented, in keeping with the rest of the House; but the portion of the panel through which the light came should be extensive, and the same in every panel.

3308. But your proposition is to alter every panel in that part of the roof, and to pass the light above it?—Yes; so as to diffuse the light over a larger extent of surface, and by that means

means get rid of its intensity; in other words, to make up in softened quantity what you lose by offensive intensity.

3309. What do you mean by diffusing the light over a greater extent?—If you have a certain quantity of light from one source, and you have the same quantity of light from another source which is double, you only require in the latter case half the intensity: the quantity would be the same in both cases. If, for instance, you had light sufficient to light the whole of the House from one panel, you must then necessarily have the whole quantity of light necessary concentrated in one burner, and the light from that panel would be very intense; but if the whole of that were broken up, and instead of that quantity of light being reflected through one panel it were diffused throughout the whole, it would be a mild, soft, agreeable light, and not offensive to the eye.

3310. In point of fact, it would be less intense?—Less intense; a canopy of white clouds is better than light direct from the sun.

3311. Do you propose to enlarge or diminish your lamps in each of those panels, as compared with those that are now erected?—Those that are now erected I have not looked at.

3312. Do you know what the size is?—This is the size burner—(*producing a burner*)—I think it is about this size; a ring of about three inches diameter fitted round with bat-wings or fish-tail burners.

3313. *Chairman.*] How many?—I do not know.

3314. Mr. *Locke.*] Are you speaking of the present light, or of what you propose?—The present light.

3315. What kind of light do you propose?—I should propose the atmospheric Bude light, with concentric burners, as used in the old House, because it is a focal light; from it we could obtain a far greater quantity of light from a less size burner; they would be easy of concealment, a larger quantity of light in a given space; which we should be enabled to place profitably, under the laws of reflection; able to send the rays with accuracy in certain directions.

3316. Will you designate the light by some name?—It was called the "Atmospheric Bude Focal Light."

3317. Is it a circular light?—A central light with concentric rings.

3318. What diameter?—It may be of any diameter.

3319. What would be the diameter of the light, that you would put in each panel?—About an inch and a half, the outer ring.

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3320. About what diameter of flame would that give you?—About two inches, the flame would not be produced by bat-wing burners; they cannot be made into a focal light; but by the plan of this arrangement, which I now hold in my hand. The atmospheric Bude light is produced by two sheets or cylinders of flame; both drawn into a chimney, placed immediately above them.

3321. Is that an horizontal flame?—It is a vertical flame; air is drawn in laterally and very powerfully, on the unburnt points of flame, by which means the murky appearance, which the ordinary combustion of gas gives, is made to produce a brilliant light; that murky appearance is converted into a bright white light; the combustion is made more perfect.

3322. Then all the panels of the roof being so illuminated, do you think it would be necessary also to suspend a light from each of the present pendents, in order to illuminate the roof?—Yes; a very small masked light from them would be the best means of illuminating the roof.

3323. Do you think that those two modes of lighting would be effectual, with reference to the perfect lighting of the House?—I think they would, except under the galleries.

3324. You think that there would still be a deficiency of light under the galleries?—Yes.

3325. Then how do you propose to remedy that defect?—I would place small masked lights concealed under the gallery, so as to illuminate under it, and to illuminate the Members who sit below, and also the back panels. It would be necessary to make it a masked light, because a naked light would be offensive to their eyes, and possibly seen from the House; a masked light, shedding its radiance over the whole of the panel-ceiling of the gallery, would not be seen; it would diffuse itself generally, and would be agreeable to the eyes. I find from examination of the construction, and from a sectional drawing, which I hold in my hand, there is no practical objection; there would be facilities for carrying away the products of combustion from those lights, without inconvenience or danger to the wood-work about. As the quantity of light required under the galleries is small, spring wax-lights might be used, properly placed and made for the purpose; they must be made to burn for twelve hours, and constructed to be fitted to the catoptric mask. We had them in the old House constructed for that purpose, with a large quantity of wax in proportion to their length; they were placed in a spring-socket, so that the flame was always at the same level, like the flame of a carriage-lamp. They used to burn

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12 or 14 hours; this length of time prevented the inconvenience of being obliged to change them during the sitting, and the inconvenience of persons coming to light them when the House was sitting. We tried an experiment, and found it successful: this arrangement was not carried out, because it was not wanted after preparations were made for bringing the pendants into the body of the House. On reconsidering the subject, and referring to my notes, I see there would be no objection to that mode of lighting under the galleries, whatever the mode of lighting above may be.

3326. Your third proposition for illuminating the gallery, is to put a light between the pillars, or behind the pillars, or in a line with the pillars, so as to reflect against the back of the gallery?--Against the ceiling below the front of the gallery; I conceive that to be the best mode.

3327. Do you conceive that, with those three modes, the lighting of the House of Commons would be perfect?—I think it would.

3328. Have you formed any notion of the expense of carrying out those three modes of lighting?—I have not done so; I think the expense would be very inconsiderable.

3329. What do you mean by "very inconsiderable"?—I am not prepared to answer the question exactly; I do not think the whole expense would be more than from 200 *l.* to 300 *l.*; there are facilities already fixed in the House.

3330. *Chairman.*] Have you ever considered the difference that might naturally be supposed to exist between the lighting of a room for pleasurable purposes of a social nature, and the lighting of a room simply for the transaction of business?—From the quantity of light in private rooms being so small, as compared to that required in the House, and from the situations of those lights, being enabled to be placed nearer the persons, the two can hardly be judged of in comparison. In the House of Commons, the lights must be placed at a considerable distance, and be at the same time sufficiently powerful to reach all the Members. In a private room you may have the light near to where a few persons generally sit.

3331. The meaning of the question was this; that in a room which is to be lighted for social purposes, the desire is, that every person in the room should be in the light and not in the shade, and that it should be agreeable to the eye, wherever the sight will naturally fall; whereas, in a house for the transaction of business, it would perhaps be a matter of indifference, whether certain portions of the room were in light or in shade?—Those are entirely matters of taste; you

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must have light enough for business purposes; effect is not so much looked to in business-rooms as profitable light for business purposes.

3332. Mr. *Greene*.] In your scheme for lighting the House, could you make openings through certain portions of the panels of the roof, and if so, have you at all directed your attention to what the effect of that would be upon the hearing?—If, in those openings a panel of glass were placed, it would make no difference; it would, if they were left open; producing reverberation of sound; sound, like light, is reflected back at given angles, and if allowed to cross, they very much disturb each other; if a panel of glass were dropped in the place of wood, it would remove this objection.

3333. You mean a plate of glass between the light and the House?—Yes; so as to insulate the lamp and sound, but not the light.

3334. So that in point of fact, there should be no more openings in the roof than there are at the present moment?—There would be none communicating with the House below; you must have openings above the roof for the purpose of carrying off the products of combustion, but not into the House.

3335. The ceiling of the House would be precisely the same as it is at the present moment, as far as regards openings?—Exactly.

3336. Mr. *Hope*.] Have you made any experiments as to the colour most suitable for the reflection of light?—The most powerful reflection is from white surfaces; the least powerful is from brown or black; you find them follow nearly in the order of colour from white to black; the whiter the surface, the more light is reflected.

3337. Is yellow good for reflection?—Not so good as white, but nearly so: it is not objectionable.

3338. Is red?—Red is very good for penetration, but not for reflection; red rays of light, after reflection, will penetrate a very considerably greater distance than any other colour.

3339. Should you recommend red as a reflecting surface?—No.

3340. What should you say as to gold?—Gold is practically good; experiments were made with gilded reflectors; the light was good, and produced a very agreeable tint upon the countenance; persons looked very well: particularly when it was deep gilding. The quantity of light reflected from a gilded surface in proportion to the quantity of light

that

that would be reflected from a white surface, was less; I measured it by a good photometer; I think the loss was in the ratio of one upon five, we lost about a fifth upon the gilded surface.

3341. So that you would not recommend gilding as a favourable surface for making a reflector?—Not as a matter of economy of light; but as a matter of effect, in many cases, it might be used with advantage.

3342. You mean that you get less light from it?—Yes; you get less light back from it than from a silver reflector.

3343. Would you recommend silver?—Yes; highly polished; such reflectors are used in all the lighthouses; the object is to reflect the light as effective and profitably as possible. It was found, from the experiments which I made at the Trinity House, that there is less light lost from silver reflectors properly burnished, and properly curved, than from any other surface; even from a mirror.

3344. *Chairman.*] You were understood to say that the red light is reflected a greater distance?—It penetrates further than any other light.

3345. How do you distinguish between penetration and reflection?—If you have a red light of a certain intensity and a white light of the same, and you place them side by side in a parabola, you will be able to see the red light nearly double the distance that you would see the white. The distance at which you can see it is the measure of their penetrating power.

3346. Mr. *Greene.*] You said that lighthouses always use silver for reflectors?—They do; because, if the reflector is coloured, it loses power; and if you use coloured glass after reflection, it obstructs the rays from passing. As you cannot get a red reflection without a very expensive sacrifice of the primary light, a white reflection is preferred; if you could have a red light *ab initio*, at a cheap rate, it would be far preferable to a white one, but you cannot obtain it in the present state of science. I made many experiments at the Trinity House with strontia, and other bodies, which produced intense red light.

3347. But the red light is carried to a greater distance?—It is; red light on one occasion was produced by reflection from red foil manufactured for the purpose. The light from it was too expensive to be used for practical purposes.

3348. Then, in point of fact, it is the expense alone which prevents the use of the red light in lighthouses?—It is.

3349. Mr. *Hope.*] You have told us that silver reflectors

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are the best reflectors; do you mean burnished silver?—I do.

3350. Did you ever try the experiment of reflecting from a silver surface not burnished?—I do not think I have; when the reflector gets dull, the power of reflection is very considerably reduced.

3351. Supposing you were able to silver panel wood in the same way that you would gild it, what do you imagine the effect of that would be?—If the panels were dead silvered, you would get a quantity of light from it greater than you get from rough white painted surfaces; ordinary white surfaces are a series of white points or facits; dead silvering would be much the same thing.

3352. So that you might apply a system of silvering, instead of gilding, which would answer your decorative purposes, and at the same time give you a very good reflected light?—Certainly.

3353. By a little mixture of light blue, the effect might be very pleasing?—Certainly, if introduced with taste.

3354. Mr. *Stephenson.*] With respect to the red light in lighthouses, does not all the light in a lighthouse pass from the flame to the reflector direct?—No.

3355. Then how do you collect the light?—Lighthouses of the first order are on the "dioptric" principle.

3356. In the silver reflector they have the light in the focus of the reflector?—Yes.

3357. Then the light recedes from the flame to the reflector, and it is then shown in a parallel flame through a green or blue medium of glass?—No.

3358. How do you obtain a red light in a lighthouse?—In the experiments that we made upon the subject, and which were afterwards made by Lieutenant Drummond, the red rays were obtained by placing a red medium between the light and the parabola; the common mode on railways, for instance, and other places, is to place a red or green medium between the reflector and the external atmosphere.

3359. Red is not got from the reflector; it is got by transmitting the light, after reflection, or previously to reflection, through a coloured medium of glass?—It is, in ordinary red lights.

3360. Mr. *Locke.*] By the system of lighting you have now proposed, I understand that you would require 64 lights in the panels, there being 64 panels in the flat part of the roof; you would have a light for each, and ten suspenders?—Yes.

3361. How many lights would you require under the two galleries?—The sum of the whole quantity required would be equal to about eight or ten wax candles; there are about a dozen openings, so there would be a dozen very small little pencils of light.

3362. How many lights would there be?—I think 12 on each side.

3363. That would be altogether 98 lights?—Yes, if you call those pencils "lights."

3364. They would be applicable for diffusing light?—Yes.

3365. Supposing those 98 lights were placed in one continuous line round the upper part of a screen, at the foot of the sloping roof, or round the house, would not that give the diffusion of light which you now propose?—No: the light would be radiated in all directions from definite points, not reflected; to effect diffusion, but radiated unprofitably. In the other system, the light would be first reflected, and then dispersed. If you were to place the naked lights round the House, there would be a difficulty in getting sufficient light radiated to the business parts of the House.

3366. You think there would be a difficulty in getting reflected light placed in the position you have suggested, namely, at the back of the screen, or at the foot of the sloping part of the roof?—If you were to place 90 lights along that sloping roof, there would be great difficulty in getting them reflected, in proper quantities, any distance; it would entail a practical difficulty not easily got over; diffusion would be very imperfect.

3367. And you think that without reflection it would not be possible to get a sufficient amount of light, so as perfectly to illuminate the House?—If you had an unlimited number of burners, you might get a body of light that would blaze across the House; I am speaking of lights that can be used under practical circumstances; it would be far too great at the part where these were fixed. The expense would be very great; it would increase as the squares of its distance from the table of the House.

3368. After full consideration of the subject, you are in favour of adopting the roof lights to a certain extent, and pendent lights, to a certain extent, and you would have a sufficient number of other lights for lighting the galleries?—Yes.

3369. You have given that opinion after fully considering the

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the subject of the best method of lighting the House of Commons?—I have given that opinion after full consideration and experience. I have practically been engaged in lighting the House of Commons, and well know its requirements.

3370. *Chairman.*] Do you consider that to effect the object, that would be the best and most economical mode of proceeding?—I know it is the most economical; I think it is the most agreeable; and I know it is the most practically manageable.

3371. Do you propose to light the pendent burners from the outside of the House?—No; to light them from above the ceiling; as was always done in the old House; there is no occasion for any one to go into the House at all.

3372. You have told us, in describing your mode of ventilating the Court of Exchequer, that you produced a down draught by means of a steam jet in a shaft in the wall, which drew the air through the bottom of the chamber?—In a chimney.

3373. That was by the tractive power of the jet?—It was.

3374. Can you give the Committee any idea of what the expense per hour or per day of the use of that jet is?—I think it is about 3*d.* to 4*d.* an hour; it consumes about half a bushel of coal per hour.

3375. Supposing the rate of ventilation of the House of Commons to be 5,000 cubic feet a minute, what would be the expenditure for high-pressure steam for a steam-jet to sustain that rate of ventilation?—It would be about 6*d.* an hour. They now draw 7,000 cubic feet through the three Courts at a less expense.

3376. Sir *Denham Norreys.*] You mean after the first expense?—Yes; I do not include the wear and tear of the boiler, nor time of the attendant; I am speaking simply of the expense of fuel. There is one observation, which I think right to make with regard to the jet; the noise of the jet in the present building, is objectionable, and ought not to be, because imperfectly applied; as applied in the Courts of Law, and other places under my direction, there is no noise from it. The noise of the jet which I observe here, arises from an imperfection in its construction; therefore I hope this point will not be considered as a practical objection to a simple and valuable principle, for effecting ventilation, in all cases where extra power is required.

John

John Phipps, Esq., called in; and Examined.

3377. *Chairman.*] YOU are an officer belonging to the Board of Works?—I am.

3378. Will you be so good as to inform the Committee what portion of the New Palace of Westminster is in charge of the Board of Works?—I have coloured a plan which will show the portions of the New Palace of Westminster that are in charge of the Department—(*producing the same*).

3379. You have handed in a plan to the Committee in various colours; will you state what those colours mean?—The red colour designates the portions of the House of Lords: the dark green, the House of Commons: the light green, the buildings not yet finished, comprising a portion of the Speaker's house, and a portion of the residences of the officers of the House of Commons which are not in the possession of the Department.

3380. Is the whole of the rest of the building in the charge of the Board of Works?—It is.

3381. The portion which is light-green is not yet entirely finished?—It is not.

3382. That is the reason why it is not in the charge of the Board of Works?—Yes.

3383. There is a portion marked yellow; what is that?—Those are the public approaches; they are in possession of the Office of Works.

3384. When you say that those portions of the building are in charge of the Office of Works, were they delivered over by the architect to the Office of Works in any formal method?—They were.

3385. In what method?—By a letter witten to the Chief Commissioner, from whom I received directions to attend and receive from Mr. Qualm, the Clerk of the Works of Sir Charles Barry, possession of the building.

3386. When you received possession, what did you proceed to do; did you proceed to appoint an officer to take charge of it?—We had an officer already appointed; the officer that had charge of the old Houses of Parliament is the officer that has charge of the present Houses.

3387. Does the Board of Works appoint officers to take care of the House?—No.

3388. Does the Board of Works pay all the accounts for any repairs that may take place?—Yes.

3389. Therefore it is the fabric that is in charge of the Board

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Board of Works, but not the cleansing?—A certain portion of the cleansing, such as the public approaches.

3390. But not the Houses of Lords and Commons, or the committee rooms, or any part excepting the public approaches?—We clean the carving in the House of Peers, committee rooms and the corridors, but not in the House of Commons.

3391. Do you consider that the ventilation, or the warming and lighting of the House, is under your control in any way?—The lighting of the House of Lords is under the control of the Board of Works.

3392. Do you mean to say that the Board of Works appoints a person who sees to the lighting?—Yes.

3393. Can any alteration in the lighting take place without the consent of the Board of Works?—No.

3394. As to the ventilation and warming, who has charge of that?—That is still in charge of Sir Charles Barry.

3395. Therefore, when the fabric was delivered up to the Board of Works, the Board of Works considered that it merely took the fabric, and the cleansing and lighting of those portions you have mentioned, but nothing else?—At that time, I believe not.

3396. You have stated that the warming and ventilation of the House of Lords remains in charge of the architect?—It does.

3397. In whose charge is the ventilation and warming of that part belonging to the House of Commons, which is marked green, which is finished?—The House of Commons is under the direction of Dr. Reid, the other portions under the architect.

3398. With the warming and ventilation of that part, the Board of Works has nothing to do?—Yes, but alterations and repairs required by Dr. Reid we attend to.

3399. But with regard to the direction and management of it they have nothing to do?—Nothing.

3400. Can you say whether or no it is accurately ascertained whether they have or have not?—It is.

3401. Do you think they have or have not?—I consider the direction of the warming and ventilation of the House of Commons to be exclusively with Dr. Reid.

3402. Is there any officer of your department who can give that information to the Committee?—It can be procured.

3403. Will you have the goodness to ascertain that at the office, and give the Committee information upon the subject?—I will do so.

3404. Is it not the fact, that of the part which is marked dark green, a portion is under Dr. Reid, and a portion is under the architect?—It is so.

3405. Who appoints the persons who are employed in the superintendence of the warming and ventilation?—For the House of Commons, by the Chief Commissioner, on the recommendation of Dr. Reid, and for the House of Peers and other portions of the building, by the architect.

3406. Who appoints the persons to look after the lighting?—The tradesman who was employed by Sir Charles Barry still continues to look after the lighting of the House of Peers, under the direction of the officer in charge of the building.

3407. By whom is he paid?—He would be paid by the Office of Works.

3408. Can any expense be incurred for any alteration in the system of warming or ventilation without the sanction of the Board of Works?—There cannot.

3409. Not in any portion of the building?—I should think not.

3410. Are all the bills referred to your office?—Since we have taken charge of the buildings, any repairs that may be done would be referred to and paid for by the office.

3411. For every purpose connected with it?—I think so.

3412. Are you able to say whether the bills for warming and ventilation are also paid by the Board of Works?—They are.

3413. Will you ascertain that at the office, and inform the Committee?—I will.

3414. Sir *D. Norreys.*] Suppose any alteration were intended to be made in any part of the building, either in that which is coloured red upon this plan, or in that which is coloured green, or in that which is coloured yellow, which might, through accident, entail danger upon the building, would the Board of Works be responsible for the result of that alteration?—For the whole of it, except the part at present marked light green, if done under the direction of the Board.

3415. Mr. *Locke.*] Has any alteration been made in the lighting and ventilation since the Board of Works took charge of these buildings, in respect of which authority has not been asked for by Sir Charles Barry or Dr. Reid of the Board?—No alteration has been made since possession has been given to the Office of Works in the House of Commons, except that in progress under the direction of the Committee,

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in whom the direction of the ventilation is at present temporarily vested.

3416. Is it the invariable practice for Sir Charles Barry to make application to the Board for leave to make any alteration that he may wish to make in the lighting or ventilation?—I believe it is.

3417. And you believe that no alteration has been made without an application being made, and authority given by the Board of Works?—Not for that portion under the charge of the office.

3418. *Chairman.*] Can you ascertain the fact yourself, or can you send another officer of the Board of Works who can give the Committee this information?—Yes. If any alteration is required to be made in any part of the building of which the office has the charge, application must be made to the Chief Commissioner, and it must have his authority before that alteration can be made.

3419. For any purpose connected with the fabric?—Yes.

3420. Practically, have alterations been made without such previous application?—No, not in that portion under the charge of the office.

3421. Mr. *Locke.*] Have any alterations been made at all?—Yes, there have been alterations made in the ventilating arrangements under Dr. Reid.

3422. Then there must have been applications made for permission to make alterations?—There have.

3423. Can you state how many applications have been made since the time when the building came into the hands of the Board of Works?—I cannot.

3424. Could you ascertain that at the Board of Works?—Yes.

3425. *Chairman.*] Will you furnish the Committee with a statement of the expense which has been incurred in alterations in warming, ventilating and lighting the House, or any other purpose, since the building has been delivered over to you, distinguishing any alterations which have been made without the consent of the Board having been previously obtained?—I will.

3426. Sir *D. Norreys.*] Certain alterations have been made in the ceiling of the House of Commons in respect to the lighting; were those alterations done by order of the Board of Works?—They were.

3427. Mr. *Drummond.*] Do you examine the accounts before they are paid?—The examining officers of the department do.

3428. Sir *D. Norreys.*] When those alterations were proposed to be made in the ceiling, did the Office of Works send for any competent person to ascertain the nature of the alterations, and to satisfy themselves that there would be no danger resulting from them to the House?—They did.

3429. *Chairman.*] Are you the special officer in whose charge the Houses of Parliament are?—I am.

3430. Mr. *Locke.*] Were all the parts of the buildings, when they were handed over by Sir Charles Barry to the Commissioners of Works, finished?—They were not.

3431. Under whose direction were the parts which were not finished?—Under the direction of Sir Charles Barry.

3432. How do you distinguish between the expenses governed or directed by Sir Charles Barry, and those undertaken by the Commissioners of Works?—The works executed under Sir Charles Barry are charged against his estimate for the New Houses of Parliament. The works or ordinary repairs executed under my direction are charged against the estimate in Class I., for ordinary repair of works to public buildings.

3433. Then, in point of fact, in certain portions of the building, Sir Charles Barry's men performing certain unfinished works, and your men connected with the repairs of those works, are working together in many cases?—Yes.

3434. Do you find that a convenient system?—We do not find it inconvenient.

3435. Do you think it is a desirable system?—I do not see that it can be particularly objectionable, for the work that we have to do is so very small.

3436. The chief part of the work that is now being done on those parts over which the Board of Works has the control, are being done under the direction of Sir Charles Barry?—Yes, in completing those parts not finished when the building was transferred to the office.

3437. Although, in point of fact, those parts of the buildings are under the Office of Works, probably nine-tenths of the works going on in the building are still under the direction of Sir Charles Barry?—Yes.

3438. So that, in point of fact, the handing over to the Board of Works is but a nominal handing over; it still remains where it was to that extent?—To that extent.

3439. *Chairman.*] How do you distinguish between the expenses which ought to be charged to the general estimate of the architect, and those which should be charged in your estimate, as coming under the direct superintendence of your Board?—

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Board?—The accounts for the works that I order are distinct from Sir Charles Barry's.

3440. How do you distinguish them?—Because I have a separate clerk of the works from Sir Charles Barry, and separate contractors.

3441. Is there anybody in your Board who is appointed to say what works come under your control, and what under the architect's control?—It is understood that what we take at present is the usual ordinary repairs required to such parts of the building as have been already completed by Sir Charles Barry.

3442. Mr. *Locke.*] Can you state the average amount of your expenditure per week for repairs?—I should think about 35 *l.* a week.

3443. Is that including or excluding the general superintendence?—That is excluding the general superintendence, that is without the Pay Clerk of the Works.

3444. With that exception, all the expenses of repairs would be included in 35 *l.* a week?—Yes, exclusive of the cost of gas; I mean ordinary repairs, such as sweeping and cleansing.

3445. I understand you to say that the expenses which you are now incurring at the Office of Works for the repairs of these buildings, excluding the providing gas and things of that kind, do not exceed 35 *l.* a week?—They do not.

3446. Mr. *Hope.*] Besides that 35 *l.*, how much does the Clerk of the Works receive?—The salary of the Clerk of the Works is 130 *l.* a year.

3447. *Chairman.*] Supposing a vast variety of alterations were to take place in the ventilating apparatus of the House of Commons, should you be made aware of it?—Yes.

3448. Supposing one steam-engine were to be changed for another, and a fan put in, or a steam-jet, do you believe that the Board of Works would be made acquainted with it?—I do.

3449. What makes you think so?—It is the duty of Sir Charles Barry and of Dr. Reid to make the Board acquainted with it; and if I saw anything of the kind going on in the building, I should consider it my duty to report it to the Board.

3450. You are in the habit of inspecting the House?—I am.

3451. Mr. *Locke.*] You have stated that Sir Charles Barry has still charge of a large extent of the building for the purpose of completing his works; supposing Sir Charles Barry

said,

said, "This ventilation is not complete, I am only completing that which I originally contemplated"?—I think it would be my duty, if I saw any alteration being made in the building, to report it to the Chief Commissioner.

3452. If you saw an alteration being made in a fan or in a flue, or in an air-channel, would that come under your supervision, and would charge be taken of it by your superintendent or clerk of the works, or by the clerk of the works of Sir Charles Barry?—Yes, by the Clerk of the Works to the Board, unless in the ventilation under the architect.

3453. Then that being so, how does it come under your cognizance at all?—As having charge of the building.

3454. But you have not charge of those unfinished parts of the work which Sir Charles Barry has in hand; how are you to discriminate, so long as his men are there doing work?—I do not see any difficulty, as the men are employed on the unfinished works.

3455. Sir *D. Norreys.*] Will you be good enough to state what alterations in the vaults took place during the recess?—The alterations in those vaults would be under the order of the Chief Commissioner.

3456. You, as an officer of the Chief Commissioner, are not aware what those alterations were?—I can speak only to the alterations which I superintended as an officer of the Board, which had reference to building the foundations for a steam engine, and other alterations. I have reason to believe alterations were made by Dr. Reid and by Sir Charles Barry, in connexion with Dr. Reid's ventilation.

3457. Mr. *Greene.*] Under whose control is the part of the building which is coloured light green upon the plan?—It is with Sir Charles Barry.

3458. Although it is under Sir Charles Barry's control, does not the Board of Works exercise some supervision over that portion of the building during its progress?—It does.

3459. Is that in your department of the Board of Works?—It would be in mine if that portion of the building had been delivered over by Sir Charles Barry.

3460. In whose department of the Board of Works is that?—The works in that portion are under Sir Charles Barry, acting under the direction of the Chief Commissioner.

3461. Is there a clerk of the works appointed to check the proceedings of Sir Charles Barry?—That portion of the works is superintended by the clerk of the works of Sir Charles Barry; the Clerk of the Works in charge of the building on behalf of the Board has of course a general

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supervision of the works in progress, but none which would justify him in interfering with works not under his direction.

3462. Have you any person on behalf of the Board of Works to superintend what is going on under Sir Charles Barry?—We have not.

3463. Mr. *Locke*.] In fact, the clerk of the works of the architect has really the superintendence of the work itself, as against the contractors on behalf of the Board of Works?—Yes.

3464. Mr. *Drummond*.] There is a paper before the Committee, containing a "Statement of the expenditure incurred and proposed to be incurred in respect of the site, and in erecting and completing the New Palace at Westminster;" but this paper is not signed by anybody; will you state by whom that is prepared in your office?—I presume the question refers to Paper No. 709, of the Session 1850. That paper was not prepared in the office.

3465. Why was not it signed?—I am not able to say.

3466. Sir *D. Norreys*.] What precautions have been taken above the ceiling of the House to prevent any danger of fire from the combustion that takes place so close to it?—As soon as the building was transferred to the Office of Works, firemen were appointed to various parts of the building, and each man has a beat to go every half hour, from 6 o'clock in the evening till 6 o'clock in the morning, and their time checked by tell-tale clocks. Firecocks are also placed on every man's beat. With respect to the ceiling of the House of Commons, there is a firecock, constantly charged, in the roof; and a fireman goes into the roof every half hour, and within two minutes from the time he sees a fire he could throw water to any part of the ceiling. Allow me to observe that I have but recently had the charge of the building, and, strictly speaking, the warming and ventilation is not under my charge; I do not consider myself at all responsible for that. As far as regards the ordinary repairs to the building, or the alterations that are made in certain parts, I am responsible for the execution of any order that may be given by the Board, and for advising them where I think it necessary that orders should be given.

3467. Then will you explain why you stated that you consider the entire fabric of the Houses of Parliament under the charge of the Board of Works?—I still consider the fabric under the charge of the Board of Works.

3468. Yet you admit that you are ignorant of the precautions which have been taken by Dr. Reid, or any other person who

who may have superintended the matter, against the possibility of fire, in reference to certain alterations in the lighting of the House?—I do not consider the warming and ventilation connected with the House of Commons, under my charge.

3469. But as far as the warming and ventilation may affect the safety of the House, do not you consider that that cause of danger is under your charge?—No.

3470. Mr. *Locke.*] Have the Board of Works any other superintendent of the Houses of Parliament than yourself?—There is a clerk of the works.

3471. The clerk of the works is under you?—Yes.

3472. Is there any other person besides you two, who has charge of the ventilation and warming and lighting, or anything connected with the Houses of Parliament?—Yes; I consider that I have no charge of the ventilation and lighting of the House of Commons or public approaches at present.

3473. There is no person in the department of the Board of Works who exercises authority over any changes which may take place in the ventilation and lighting?—Yes; no alterations can be made in the House of Lords, or any expences incurred for alterations in the ventilation of the House of Commons, without the order of the Chief Commissioner.

3474. You have not given any directions to your clerk of the works upon that subject?—Yes; he is not to make any alterations in the lighting or ventilation without the sanction of the Board.

3475. Sir *D. Norreys.*] With regard to the steam-engine that was erected at the House of Commons, and which was removed previously to the meeting of the Houses, was that done under your direction, or with the approbation of the Board of Works?—It was done under the direction of the Special Commissioners for superintending the completion of the building.

3476. Was the steam-engine erected under the approbation of the Board of Works?—It was not usual for the Special Commissioners to refer for the approval of the Board.

3477. Was the steam-engine itself erected under your direction?—I presume under the direction of Dr. Reid.

3478. By whose direction was the steam-engine removed?—By the direction of the Chief Commissioner, to whose charge the direction of the works had been subsequently transferred from the Special Commissioners.

3479. Was it by the direction of any officer of the Chief Commissioner?—It was by the direction of the Chief Commissioner himself.

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3480. Mr. *Greene.*] Are not the directions of the Chief Commissioner with regard to works executed here, sent through you?—Not sent by me, but executed under my directions.

3481. Sir *D. Norreys.*] What was the cause of the removal of that steam-engine?—Its situation was objected to.

3482. Can any officer of your department give the Committee that information?—It was found to be noisy.

David Boswell Reid, M. D., further Examined.

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3483. *Chairman.*] YOU explained to the Committee on a former occasion, and you have shown experimentally your present method of lighting the House of Commons, have you not?—To a certain extent.

3484. Upon a former occasion you also described your method of lighting the old House of Commons?—I did, to a certain extent only.

3485. You also stated that you would have sought to obtain greater diffusion by putting a small light in every pannel, rather than larger light in a smaller number of pannels?—I did; the plan submitted to the Commissioners contained a light in every pannel in the ceiling.

3486. And you still adhere to that opinion?—I adhere to the opinion so far, generally, that it is an object of infinite consequence to give a diffused mild light, instead of a concentrated light.

3487. You have heard the evidence of Mr. Gurney?—I have.

3488. He seems to agree with you in that opinion; you therefore, retaining the same opinion, concur with him as to the desirableness of diffusion of the light?—So far as he has expressed it to-day; his position is different from that which was shown by his works in the old House of Commons; I have a drawing here of the ventilation of the House of Commons—(*producing the same*).

3489. So far as regards the evidence he has given to-day upon that subject, you quite concur in it?—No, I cannot say I quite concur, because I do not know the details of many of the points that he was examined upon, or which were touched upon incidentally; with respect to the principle of diffusion of light, that is a principle that I advocated, and which was stopped first in the old House of Commons when Mr. Gurney's plans were introduced.

3490. How do you propose to obviate the difficulties which have been alluded to, in the course of to-day's proceedings, with

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with regard to shadows in the roof, and the want of a sufficient amount of light underneath the galleries. Do you propose to continue the side lighting which has been adopted in two of the windows in each side of the House, or do you prefer any other method?—I should certainly consider that the best method of doing it, namely, that contemplated when I commenced experiments on the roof; but not the least expensive; if the Committee will indulge me for a very few minutes in making some observations upon that point, I could show the progress of that question, and what has been already brought under consideration with respect to the House of Commons, and what has been stopped; and that in reality the difficulty may be met in many different ways; but the stoppage has always been caused by the different tastes of different parties, who had not the means of communication that the Committee of 1846 contemplated.

3491. The Committee are not desiring to have information with regard to the progress of the experimcnts upon the subject, but they desire to know whether you have altered your opinion at all as to the best mode, or the mode which best combines economy and utility, as expressed in the evidence you formerly gave, as to the propriety of having a side light, in addition to a roof light?—I have not altered my opinion as to the principle, nor as to the details, but the same difficulties exist.

3492. Supposing, therefore, the Committee should be of opinion, that side lighting, in consequence of the expense of the alterations which it would necessitate, is not a proper method, what other mode would you propose to substitute?—I should then fall back upon that mode which will be partially shown in the experiment to-night, and which will be seen in the papers I now lay before the Committee, containing the drawings that were made in 1846 and 1847, by Mr. Groves, who was for five years Sir Charles Barry's principal Clerk of the Works, with the view of obtaining the latest effect referred to; it consists essentially in making the arrangements immediately at the base of the window, where concealed lights would give the necessary illumination to the ceiling, and they would have also that amount of reflection that might be desirable below in the darkened portion of the gallery.

3493. All that the Committee desire now to have is your recommendation as to the best plan to be adopted now; supposing the outside lighting to be excluded; what is the plan that you would propose in order to obviate the shading of the roof and the strong shadow under the gallery?—That

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which is indicated by the diagram now laid before the Committee, which would assume any form in a decorative point of view, that might be considered most desirable, and harmonize with the present arrangements.

3494. Whereabouts would the light be placed according to the diagram you have just shown the Committee?—Immediately under the sill of the window, and below the rail at the top of the wood-work, where any appropriate decoration would conceal the burners required.

3495. Mr. *Stephenson.*] You proposed originally to sink all the lights into a channel cut in the wall, and obscured from the House, and yet so near the open fret-work, that, with the assistance of reflectors, the light would be thrown into the House nearly horizontally?—I did; or at any required angle, but with dead white reflectors; not metallic reflectors.

3496 *Chairman.*] Does that fret-work now exist in the House?.—No, it does not exist.

3497. Then how do you propose to carry that operation into effect now?—Exactly by the arrangement that will be seen to-night in the House in operation, which will show whether a proper effect can be produced by lights thrown through open wood work towards the gallery, and at the same time thrown up towards the ceiling. The light will by no means be sufficiently powerful to-night; it will only give a general illustration. When the local light shall be put out, to those observing the appearance under the gallery, then the difference of effect will in a moment be seen.

3498. Will the application of that light, as it is proposed to be placed to-night, be a fac-simile of the plan to be carried out throughout the whole extent of the side of the House?—Certainly; but it will be an imperfect fac-simile at present, with deficient power.

3499. Is that a matter which will require any considerable works, in the way of putting up new work, or the taking away of work already finished?—No; it would be exceedingly economical, for there exists at present a channel where the light can lie perfectly concealed, and the light of the burners would be observed only through portions of the present rail; so that very small means would be sufficient to diminish the intensity of visible light.

3500. How far underneath the bottom of the present window would that light be placed?—Immediately at the foot of the sill, and behind the rail, that is, where the stone-work terminates and the wood work appears.

3501. Upon

3501. Upon the plan you have put in, there are certain ornamental compartments underneath the gallery window; do they exist now?—They do not.

3502. What exists in their place?—A light rail, such as is observed on the top of the cases in this room; when this drawing which I have produced was made, I was anxious to secure the use of some lighting power at those particular parts, and in order that there might be a distinct record and diagram of it, I requested the assistance of Mr. Groves, which assistance I obtained from the Commissioners of Woods, that he might put it into some architectural shape, and that is the shape which he gave it.

3503. Do you believe that the addition of such lights as these would entirely cure the defects complained of?—I do believe so; I think, however, that the minute masked local light which has been shown to the Members of the Committee, behind each pillar, should also be tried, for I think it would be quite feasible; a very minute light of hydrogen, which in burning would produce only water, would be quite unobjectionable to illuminate a metallic surface to such a degree, that we could, with the least possible expenditure of trouble and labour, give the light requisite below.

3504. You mean behind the pillars which support the gallery?—Yes.

3505. Mr. *Stephenson*.] Would you have a separate gas apparatus for the generation of hydrogen?—Yes; the quantity required is so very small, it would have simply a slight local effect upon the countenances of the Members; there is a surface of gold leaf under the gallery at present.

3506. *Chairman*.] How many lights do you imagine it would be necessary to place under the sill of the window in order to produce the effect that you desire, namely, of obviating the shadows on the roof?—I should imagine that from three to six fish-tail jets might be sufficient in each window; at the same time, till the experiment is tried, it is so very difficult to calculate the effect, from a highly coloured ceiling, and from that deep colour of green on the floor, that it is impossible to resolve it satisfactorily except by experiment.

3507. It might add 120 burners to the jets?—It might, from 120 to 150.

3508. What would that add to the expense of the lighting?—It would add from a half of the expense upwards, according to the quantity of light required.

3509. By "half" do you mean that it would cost half as much again as the 4 *s.* 6 *d.* an hour?—Yes.

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3510. Say, perhaps, 7*s.* 6*d.* altogether?—It will be according to the intensity desired. Permit me to mention that the estimate which was given before, was a considerably outside estimate for great intensity of light, such as many in the House do not wish to have.

3511. The expense will be much less than, according to your first proposition, of getting a side-light from outside the House?—Certainly.

3512. I believe you do not acquiesce in Mr. Gurney's claim to be the inventor of the system of lighting now employed in the House of Commons?—If you allow me to state as frankly my own opinion, as he did his freely, I should simply state that I think Mr. Gurney came into the House of Commons under circumstances that stopped the application of that system which he now advocates. Mr. Gurney stated that I borrowed all that he did in 1839. I have here in my hand a burner—(*producing the same*)—used, from 1833, before 2,000 professional pupils, and between that time and 1840. It will appear from published Parliamentary documents, that when I succeeded in introducing gas into the House of Commons, the system was diffusion, and that Mr. Gurney was only admitted when Lord Duncannon agreed that he should try his oxygen and oil, after application to me.

3513. In short, you dissent entirely from Mr. Gurney's assertion, that you borrowed all your present system of lighting from him?—Most certainly; and I have proofs of the correctness of my statement in these documents; and I am ready to answer, to any extent, the assertions which he has made upon that subject.

3514. In what classes of buildings have your experiments and observations been made, in respect of warming and ventilating, and lighting?—They have been made in every class of building, public and private, from palaces to cottages. When I came here in 1840, after making experiments in St. Peterburg, Berlin, and Paris, I had begun a work on architecture; the first two illustrations were engraved by Sir William Johnstone, the late Provost of Edinburgh, from drawings made at St. Petersburg; and it was when engaged upon questions connected with the state of education in Europe, and the improvement of the sanitary condition of the people, that I was called up here; and that work has been stopped from that day to this period, in consequence of my excessive engagements at the Houses of Parliament.

3515. Have you any observations to offer in reference to the evidence of the witnesses whom you have heard examined before

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before this Committee?—Yes; I should say, that while the witnesses have illustrated many individual points to which they have paid much attention, I think I may state, that they do not appear to have entered into the detail of the House of Commons' ventilation, or to have made themselves acquainted with it, though every opportunity was given by me for this purpose.

3516. Have you ever had any special difficulties to contend with in the application of your plan in other works?—I have; I have had in the old House of Commons special difficulties to contend with. The ventilation there would have been stopped entirely on the report of Dr. Arnott in 1838; but the late Lord Besborough brought him and me face to face for five hours, when we cross-examined each other. Sir Francis Baring was present, and Sir Benjamin Stephenson, and other gentlemen; he then said he was quite satisfied. Allow me to mention another example: on board her Majesty's yacht the ventilation was stopped for about a year, and the yacht went to sea with the valves shut, in consequence of the difficulties connected with it. I represented the case, and the Earl of Haddington, Admiral Sir George Cockburn, and the Hon. Sidney Herbert, met me on board the yacht; they summoned the naval architect at the time, Sir William Symonds; we met face to face, and in a quarter of an hour the business was settled, which a whole year of previous communications had not accomplished. The only other example I shall give you is in respect of Liverpool. No person ever attacked me more than the builder there; the architect supported me; the committee there, seeing the difficulties of the case, agreed that we should appear face to face. We did so; all the difficulties vanished, and the plans are now successful which, it was said, would fail. In the Houses of Parliament all the difficulties have arisen from the reverse course being adopted. When the original plans were introduced, the architect and I sat at the same table, and were examined; but from the period of 1846 to this we have never been once sifted as to a single point on which we have differed.

3517. Have you any statement to make in reference to the difficulties you have experienced, from the mode in which business has been conducted, in the execution of works at the new House of Commons?—Certainly there are the greatest difficulties in getting a single thing done; for three months I have asked for locks to doors, and cannot get them; the currents blow the air in all directions when the doors are opened:

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for three months I have asked that a certain door be finished. At present it is rough and unfinished; through it the air blew upon Mr. Leslie, I suppose so sharply the other evening, that he had to put his great coat on; in short, only yesterday there was water falling down upon the Members in the division corridor from the closets above. There were also emanations on every side from places below. There is no such thing as getting from the clerk of the works matters which are absolutely necessary, though the Speaker said, on a recent occasion, that he would adjourn the House if the inconvenience could not be removed.

3518. Are those matters between you and the Board of Works?—They are between me and the parties who are directing what is doing at the present moment; I have submitted that there ought to be some person who should do what is necessary to check the evils which all notice; they are a source of perfect disgust, as well as annoyance to public business.

3519. Does not Mr. Fincham attend from the Board of Works for the purpose of facilitating your arrangements?—He does; but there are parts of the building that are not under Mr. Fincham's directions; Mr. Fincham has given every attention to every application I have made to him. I will mention this extraordinary case: the Speaker said he was extremely annoyed in the chair with the smell of gas; we stopped the gas at one place, I investigated it thoroughly, and at eleven o'clock at night I found, in a room below, a hole about a foot square, and gas escaping there; next morning Mr. Quarm was requested to give me the key, he is clerk to Sir Charles Barry; he refused it; Mr. Ashby, another clerk, could not get it; Mr. Fincham could not get it; so that the House was flooded with gas; I would not tolerate it for an instant if I had the control; but my interference is useless when no one will control such parties.

3520. Sir Charles Barry has stated that all your requisitions at the new House of Commons have been complied with, as far as it was in his power to comply with them; have you anything to state upon this point, after hearing his remarks?—There never was a more incorrect statement made by any man; there is a long list of points—(*producing a paper*)—on which I am ready to show the manner in which he has opposed me, upon some of which an expense of 5,000 *l.* or 7,000 *l.* has been unnecessarily incurred; I am quite ready to go into those details.

3521. You before stated that Sir Charles Barry had continued

tinued to refuse access to drawings, which he himself admits that he did?—I did.

3522. What difference do you consider exists between the ventilation of the House of Commons and that of the House of Lords?—There is a great difference, not merely in the ventilation, but in the means which are requisite, in consequence of the differences of structure: one of the answers of Sir Charles Barry implied that there was no essential difference between the one and the other, to make any difference in the ventilation. Now it so happens, that many things in the structure, certainly everything in the ceiling, was finished while I still was directing the ventilation of the House of Peers, in 1846. One of the first points then arranged was, that there should be no direct door immediately behind the Throne, which is analogous to the Speaker's seat. Now, I can bring Member upon Member, if you will allow me, to prove that they complain of the effects of the flapping of the doors, and the numberless currents in and out: therefore the House of Commons is utterly different from the House of Peers in that respect. I refer to the fanning movement that is given to the air, which will play 20 feet into the House, sometimes throwing the air round the Speaker, upon one side, and sometimes upon the other. Secondly, at the bar, there is exactly the same difficulty in the House of Commons as at the Speaker's end of the House; but in the House of Peers that is entirely prevented. If any Honourable Member will compare the difference of the two doors, he will see that the access is totally different. In the House of Peers there is a door laterally upon either side, whereas in the House of Commons there is an opening from end to end, when the door, behind the Speaker's chair, and the doors at the entrance are opened.

3523. Are there any other differences besides those?—There are: in the next place the galleries are totally altered, The galleries in the House of Commons were, at first, only of the same breadth nearly as those in the House of Peers. But the new projection, and the additional seat given in the lateral galleries, not only affects the ventilation, it also affects the lighting, and it affects, very particularly, the amount of any descent from the ceiling, while it narrows the general cavity of the House, making the body below to approach to a sunk well compared with the large expanse above; such a thing does not exist in the House of Peers. Then, again, you have parties to attend to who are sitting at very different levels in the House of Commons, from what you have in the House of Peers.

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Peers. Look, for instance, at the Strangers' Gallery, the Ladies' Gallery, and the Reporters' Gallery: there are no seats above the House of Peers at the Throne end,, such as you find at the Speaker's end. Therefore you are subjected to numerous oscillations and movements from local aggravations and crowding in the House of Commons, which do not exist in the House of Peers. Again, from the higher level of the present ceiling of the House of Peers, compared with the House of Commons, the descent of air has greater difficulty, but it has less interruption at the sides. Lastly, the corridors on either side of the House of Peers are much smaller than those in the House of Commons, and are never used in the same manner, while, at the same time, there are no upper corridors or retiring rooms at the House of Peers, such as have been added to the House of Commons.

3524. Have you turned your attention to the question of fresh air entering one part of the ceiling and passing to another portion?—I have examined that very particularly for many years past. It will be seen, in a moment, that some of the witnesses who have been examined, in citing their experiments, have left out two points of infinite consequence as to the descent of the air, and the result is to diminish greatly the importance that ought to be attached to their opinions as to the amount of descent. In the first place, the moment you take a coloured medium for experiment, you introduce an element of confusion, in the right interpretation of the facts; for there is no coloured medium known, not even smoke, or coloured transparent gas, which is not heavier than air. When, therefore, you throw in smoke, or anything that is visible in that way, you have a descent caused by the gravity of the material, utterly independent of the air which may accompany it. Hence, then, a small portion of smoke descending by its absolute gravity, might, to those who did not reflect upon this, be interpreted as indicative of a certain current. Whereas the whole of the air, as a mass, might go across the ceiling, the heavy smoke alone descending.

3525. Were not your experiments all conducted with smoke?—No; I use it, to a certain extent, for illustration; but in calculating the effect, that is an item to be considered. Then the next item is, that the question of descent is not a mere question of the specific gravity of the air. It is a question compounded of the specific gravity of air at different temperatures, along with the velocity of the movement; and if you take a case in which the House requires little air, and you have a proper difference of temperature, then, from the

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slowness of the movement, there may be time for the descent to take place, and for the consequent ascent. But if you have a great crowd within the building, and they demand a great additional quantity of air, then you are obliged to throw in air with a greater amount of velocity, and to take it out with a greater velocity than in the preceding case; and in such an instance, you will find, by the indication of threads suspended in the air, that there is a lateral movement, to a very considerable extent, across the ceiling, so that, in the case of your greatest demand, you have the largest portion of air escaping away, without doing good to those below, whereas, when you least demand it, then you may have the greatest descent. Now the very facts of the case will show that this has been felt practically in the House of Peers; for, at first, the whole ventilation intended being subverted, and the plenum movement recommended in 1841 and 1842 being also subverted, a system mentioned by Dr. Faraday in his lectures was tried, by which the air descended by the sides; that was tried practically on crowded days, and immediately the Members of the House of Commons said they would not have that ventilation, and my plans for the ventilation of the House of Commons were not sanctioned till Members of the House of Commons had tried the ventilation of the new House of Peers.

3526. When was that tried?—In 1847, when it was first occupied; it was in the winter of that year, after the Session, that the Treasury authorized the application of my plans to the new House of Commons.

3527. Who tried it?—It was tried by the House of Peers, when it met in 1847, in the new House.

3528. Viscount *Palmerston.*] How do you mean that the House of Commons tried it?—The Members of the House of Commons went to the House of Peers, and they stated publicly in the House of Commons their opinion of it.

3529. They tried it standing below the bar?—Yes; then if you trace this historically you will find that the next point was that a pump was used; then you will find they began to use the ascending movement on particular occasions; then afterwards you will find the fan introduced, and now you have the plenum movement and the exhausting movement combined, and there is also a descent from the centre of the ceiling of the House of Peers, (this was at first from the sides); and the system in operation now in the House of Peers, has thus approximated more and more to that in the House of Commons; so that they practically find

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find there that a descending movement will not suit for a crowd, such as you have on a prorogation or in extreme cases; but, compared with the House of Peers, the House of Commons is always crowded.

3530. *Chairman.*] You mean to say that it is necessary to have both an ascending and a descending movement in order to produce a perfect system of ventilation under all circumstances?—I do not say that it is essential under all circumstances; but I say that it is convenient and very desirable.

3531. Viscount *Palmerston.*] Do you mean that both are necessary, or do you mean only that if you have a descending, you must also have an ascending movement?—Certainly; unless we introduce an enormous quantity of air.

3532. Do you mean that if your general principle is an ascending movement, you must also, for particular occasions, have a descending movement?—No; I would not state that it is necessary, but it is convenient; I will state, in a moment, the positions under which it would become desirable; the cases in which I have found a descending movement most convenient are where there are few Members, for many hours, carrying on the business of the House; in that case, especially in particular kinds of weather, they are exceedingly sensitive as to draught, and it is very desirable, if you can have a movement more nearly approaching natural ventilation, to have the means of permitting air to descend at one place, and ascend at another, in consequence of the numbers in particular districts in the House, being so very various; but when you come to very hot summer weather, though you may get cold air from the vaults, that is not always so suitable, because you have to deal with constitutions that have been exposed to the sun; we, therefore, obtain a different circulation in summer weather; I know of nothing, when you have so many crowded in a small spot, that at all approaches the system which removes the breath, and removes the exhalations directly upwards; in such a case we would give warm air, that it may not affect the feet, and be off and away as soon as possible, with the breath and exhalations.

3533. *Chairman.*] How did you ventilate the old House of Peers?—The old House of Peers was ventilated with some variations, nearly as the new is at present; there was an instrument used for the plenum movement; there was a means of giving a limited infusion in different parts of the floor; there were means of throwing the air up between the sides and the external walls, coming in principally over the head; openings near the head were stopped up, for the draft was too strong,

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strong, but it came over the head, and then passed down into the House; then on all occasions when the temperature suited there was a large opening towards the east end of the House of Peers, where the air was let down from above and gained access to the House; but the House of Peers was never substantially ventilated by an independent movement, even before the Earl of Cardigan's trial; till that period, when it had been in operation for some time, you will find the testimony of Lord Besborough, stating that the Peers were generally satisfied with it; but it should be observed, that at that time the House of Peers had merely a loan as it were of the shaft used by the House of Commons, for it never had any independent discharge, and we were subject to many difficulties. No movement of air has been shown in the recent demonstrations at the House of Peers, which could not be shown at the old House of Peers. In making these remarks, I must explain that I do not take Sir Charles Barry's account of the ventilation there, but describe what I have seen and known as to the facts of the case, exclusive of those movements that ensue when the supply and discharge ensue at the ceiling alone.

3534. Is your system what may be termed a natural or an artificial system of ventilation?—I should say that in that respect it may be called a natural system, with artificial addition to meet those peculiarities by which the natural operation of ventilation is obstructed; I will therefore state, with respect to the many observations which have been made on this point, as to one being a natural, and as to another being an artificial system, and so on, that I have never done anything, except to overcome, as far as I could, the impediments which artificial circumstances throw in the way of ordinary ventilation.

3535. Is a natural system of ventilation applicable to a building such as the House of Commons?—It does not appear to me, that a natural system alone is at all sufficient for such a building, because you have so many artificial circumstances to contend with of such extreme irregularity; it was argued that the arrangements should be fixed, and left to themselves. Now a strong current coming for a moment to any particular part, would at once upset all the ordinary arrangements of ventilation. Again, suppose 500 persons go out in a few minutes, and leave 20 or 30 to conduct the business, it is evident that great discomfort and inconvenience might result, if the whole were left simply to the natural system. But if we have a movement in action increasing or diminishing in proportion

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proportion as the Members retire, then shall we have a much more ready method of meeting the difficulties of the case.

3536. A good deal has been said with regard to the sources from whence you draw your air, especially with reference to the vaults; have you anything to say upon that portion of the evidence?—I have to mention, that although the air may be sometimes taken from the surface of the ground, there are certain states of the barometer in which air from this source, in consequence of the vicinity of certain graveyards and other things, would be as bad as it is in the most offensive parts of London.

3537. Some of the witnesses have stated, that it is not a satisfactory method of procuring a supply of air, that it should come from large vaults which are subject, more or less, to stagnation of air from imperfect construction, and to disagreeable smells, and that it would be much better, instead of that, to bring it through pipes of a certain specified dimension, the interior of which is quite certain of being kept constantly clean?—Keeping the air clean is perhaps the most important thing that can be attended to; I entirely concur in the observations as to that; the question is whether those vaults cannot be made what is desirable; my plan was, that those vaults should be made absolutely air-tight, and that they should be used when the air outside was so bad, that we could not take it; and that they should be used only as an additional means of controlling the quality of the air supplied.

3538. When you say "the air outside," you mean air from other sources of supply?—Yes; will the Committee allow me to mention that this subject was very much discussed before certain letters, written in 1847, were laid before the House. Here is the answer given by Sir Charles Barry as to the examinationof the vaults which I suggested; I got this paper before the House of Commons, because I thought the question of the vaults was important; he states, in reply to a question from the Board, "With reference to the observations which you state Dr. Reid has made to the Board relative to the vaults and the state of the concrete in the foundation of the New Palace at Westminster, I beg to acquaint you that the vaults generally are perfectly dry; the only exception is in a very insignificant proportion of the entire building, where the drainage is or has been incomplete, and the floor is not brought up to its intended level; when the vaults are completed, the whole of them will be perfectly dry, and it is not likely they will ever afterwards be otherwise; with respect to the concrete I beg to observe, that it is thoroughly set, it is exceedingly

exceedingly hard, and, in my opinion, forms such an excellent foundation for the building, that I consider the examination suggested by Dr. Reid to be altogether unnecessary;" it was to such vaults that I allude: I have always, at all times and seasons, taken the air most quickly and directly from the external atmosphere, when it is pure, as a source of use; but when I cannot get it pure from any ordinary aperture, from that source, I am obliged to have recourse to other channels that bring it down from a high altitude.

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Veneris, 30° die Aprilis, 1852.

MEMBERS PRESENT.

Mr. Drummond.	Mr. Locke.
Mr. Stephenson.	Mr. Henry Hope.
Mr. Thomas Greene.	Lord John Manners.
Sir D. Norreys.	Viscount Palmerston.
Lord Robert Grosvenor.	Mr. Bankes.
Mr. Deedes.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

David Boswell Reid, Esq., M.D., called in; and Examined.

3539. *Chairman.*] WHEN the Committee terminated yesterday, the subject of the air-channels was being discussed. Having asked you some questions relative to the cleanliness of those passages, I now propose to ask what you think as to the size of them; whether you think the air is just as manageable with such large air-passages and so much friction as those which you showed us when we went through the House, consisting of three arched vaults of considerable dimensions, or whether you prefer smaller ones, and think that, the channel being small, it is the more manageable, and therefore the more useful dimension?—My opinion as to the great channels is, that none should be less than what a man can walk into or inspect with facility. In all cases where the channels are less, inspection is neglected, cleanliness becomes difficult, and

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it is impossible for the ventilation to be provided with so pure an atmosphere.

3540. When, therefore, it exceeds the size of a man, do you see any reason why it should be large or small?—None whatever of such importance as to render necessary extreme expense when the areas given can, by mere lining, give the requisite passage for air; for instance, if I had a vault having an area of 50 or 60 feet (and a passage of half that area would be sufficient), I would never think of having another lining or tube; I would rather take the whole vault, as a matter of economy.

3541. Now, with regard to shaft, I believe you have already given your opinion with regard to the propriety of having a number of different places from whence to take the air, under various external circumstances?—I have, but I have not adverted to the main points that regulate the construction of the great flues of the Houses of Parliament.

3542. What are those?—Those were, that the necessities of the case required many hundred rooms that were continued, courts within courts, and had no direct access to the external atmosphere except from above. Hence, if chimnies of the ordinary construction were used, these courts in whatever way the wind blew, would generally be full of bad air and of smoke to a greater or less extent, except in the case of absolute calm and absence of intense frost. Under these circumstances it was determined that it was advisable to lift out all the air from these bad courts, or rather from the buildings surrounding them to such an altitude that none could be thrown down, and on consideration of the plan of general ventilation, accompanied with such local ventilation as was necessary, it was finally agreed that there was no comparison in respect to the general effects of that system which is indicated in Diagram No. 1 of this series, where the extreme towers are used for supply, and the central tower for discharge. The other diagrams show all the different ways in which the Houses could be worked in the event of a failure in the vaults, or in the event of a descending current being required through the House, or mixed ventilation.

3543. Considerable objection has been made to the air entering the House through the carpet, on account of the dust it carries up; have you any remark to make upon that portion of the evidence?—The statement that I have to make upon that point is, that in the House of Commons there are physical difficulties connected with the structure which it is essential to meet. I admit as fully as any man can do that it is objectionable

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objectionable to take air through any thing that the shoe touches; but if a moment's reference be given to the kind of House of Commons contemplated by the Committee of 1835, when my evidence was printed as shown in the Report of the Committee in the September of that year, it will be seen that a diagram was given of a House wherein entrance of air was contemplated under circumstances that supposed special provision to be made for it in the construction. Now the difficulties connected with the present House of Commons, so far as entrance of air comes into play, is that every inch of space is so valuable that no special locality, and no increase of breadth or size has been given for that proper and legitimate entrance of air that would best suit the ventilation of the House. Under these circumstances we are driven to take it at this place, and at that place, and at the other place, at risers at different parts of the House, to supply the deficiency, giving there the required supply from the least objectionable part of the floor. Now that is the root of the difficulty. At the courts of law, which were planned in the same year at Liverpool as those here, there is a legitimate entrance given for air; that is, an entrance is provided at a place comparatively unobjectionable, near no one; that is, less near than any place that can be given in the House of Commons; and when the ventilation is put into operation the air is admitted there alone, and it only enters at other minor places, which are all, however, in rising steps, or at the side, or at a particular portion of the ceiling, when more and more is demanded, either from the state of the weather or from intense crowding. The great object, at all times, is to get this entrance of air. You will find it commented on by almost all the witnesses in these terms: they say, "They would bring in air at places that would be inconvenient to the Members." It has been the main question, for 15 years, to see and get places designed at such a position so distant from Members, that you can give a gentle influx of as much as is necessary for the body, without an influx too cold for the feet or too hot for the head.

3544. That is, I believe, the great fact which has induced so many ventilators to look to the descending current for the purpose of avoiding the dust?—It is so; but there are many things that can be done at the House of Commons still, if we could get quit of other arrangements; for instance, if we could get an agreeable material to walk upon, that did not produce a disagreeable acoustic effect by interrupting The House, we should have much more opening. Between the

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table and the bar is the place where the largest opening takes place at present. As a general principle, we would say that if many risers, which we should have had, but which we have not at present, were thrown in, we could have additional facility of ingress, which is nine-tenths, or I may say ninety-nine one-hundredths of the difficulty of a room which is not built large enough, so as to give a proper supply wherever it may be most suitable.

3545. That causes, in your apprehension, therefore, the dust in the air, of which the Members complain?—That must undoubtedly be, to a certain extent an objection, but it is by no means the general cause, or the sole cause of the dust. In many cases, during the present Session in particular, the locks not being on the doors, as I have unfortunately often had occasion to mention, any people on the roof can go and walk up there during any time they please; and unless I put a man to prevent these iron doors from being forced open, it is impossible to prevent people walking on the ceiling, and consequently dust falling down. At the present moment there are Sir Charles Barry's workmen cutting stone and making dust at the strangers' gallery, while at the other end of the House, in the corridor leading to the ladies' gallery, whirlwinds of dust may from time to time be seen; open doors and windows, and places where there are no doors, giving free access to the air, while carpenters and other workmen engaged there give it more the appearance of a workshop than of a passage connected with the House of Commons. These men ought to be stopped at once, and what is not now finished ought to be left unfinished till The House adjourns, and the men ought to be under one clerk of works, instead of under two clerks of works; you will then have the means of preventing dust in many places. Secondly, at times when the external air is not watered dust is often blown in, and the air is then injured to a certain extent; but there is undoubtedly a certain amount due to that arrangement connected with the carpet. It has always been a question whether you will have more diffusion with the chance of a certain amount of dust, having provided the most extreme means of cleanliness outside by numerous mats of hair over which the Members unconsciously pass, and take down dust at certain parts, or whether you will admit air risers alone with less diffusion.

3546. It has been stated to the Committee that in consequence of defective arrangements on your part the air has become to a certain extent decomposed, desiccated, disagreeable to breathe, and that that proceeds principally from the method taken

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taken to warm it; that is in reference to the mode of heating, No. 22?—I am not aware of that. Allow me to explain that none of the witnesses have correctly described, or even taken the trouble to inquire or ascertain, so as to know accurately how that apparatus is worked. That apparatus has, to my certain knowledge, rarely exceeded 100 degrees. They imagine that I have that apparatus, at least a reference to the evidence will show that that is often imagined, at an extreme heat of as much as 212 degrees; that I then thrust in the hot air, and afterwards bring it up to the equalizing chamber. That is not the case. The apparatus is set at a particular mark, say 70, 80, 90, 100, 120, or 130, whichever may be necessary; so that we can, as a principle, draw air through that apparatus without change and without mixing with any other air. But on all occasions when transitions are wanted (and the transitions are extreme in the House of Commons) we can shut off the channel in which the apparatus is placed; we are prepared for emergencies, but these are the exceptional rules to meet particular cases, and not the regular routine mode of working. With respect to a surface of iron, it has been always contemplated to have that glazed, or covered with a special composition. In that department of practical science recent results have so far exceeded what was the case when the present apparatus was ordered, that without the renewal of the apparatus we could not get it to the same high condition that is now available.

3547. Do I understand from your answer that you had previously contemplated that the external surface of the iron pipe should be glazed?—Most certainly, and the whole interior of the vaults glazed. I have reason to believe that compositions may be got similar to silica, so that the whole surface may be rendered vitreous finally, as if electrotyped with silica.

3548. Are you at this moment acquainted with any other material besides that carpet which is now down upon the House which you would recommend preferably to that carpet as a means to the passage of air from the floor upwards, or from any portion of the floor?—I am not at the present moment precisely acquainted with that, but it is a thing that I am daily pursuing, and I have very recently met the manufacturer, who is endeavouring to alter the fabric; so that if he should succeed in weaving it in such a manner that the space below would be comparatively open, then any dust that fell there would at once be precipitated into the chamber below, while he would have enough texture to soften the tread of the foot and prevent noise.

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3549. I see you have put in "Delicacy of movement of air, and currents and eddies," in the things you wish to refer to, No. 30; do you wish to make any observation upon that?—I think that the extreme susceptibility of movement in air has scarcely been insisted on, perhaps, to that extent which is desirable to convey a true idea of the numerous eddies within the House of Commons, as doors open and shut; and on this point I will give you the following illustration: If I set so many different parties to stand at the door, as they do at the entrance to the House of Peers from the outside, where two men open the door in one way; if I set two men behind the Speaker's chair, to hold these doors accurately and steadily in one position, and to allow them to be opened with a gentle movement, the other doors opening freely backwards and forwards, the blast of the other doors is such (for the movement is more rapid inward than outward) that the breath is thrown upon one side, and the breath will then accumulate towards the Speaker's place, in its outward movement; but if I do that on the opposite side, I shall in many cases find the breath in the opposite direction. From one of the doors at the strangers' gallery, to which I have had so often to refer, there is a continuous current going inwards, which inclines the gallery air towards the House. If we take the case of a downward movement, it will be seen that wherever this delicacy of movement takes place, we may have a downward movement in one place which will entwine and carry off so much of the breath as is involved with the fresh air descending and carried downwards, while at another place we may have it upwards. The great point that I wish to make out from this is, that we have local eddies where there are Members sitting in every line in every place along the body of the House; wherever there are local arrangements connected with doors or windows, however small, and where there are continual eddies on every side, the attending to the doors is of immense practical importance; and I could name Members who are ready to give evidence upon this point, who have sat near the doors, and been subject to the influence of the currents produced by the flapping of the doors, and who know the difference between the mere ingress or egress of air, from that local eddy which is constantly produced by the fan movement of the doors. This was a point that I particularly wished to submit to your notice.

3550. Now do you wish to state anything with reference to the exit of air?—I consider that the discharge from the ceiling is under the most absolute and perfect control, when air is required to be discharged there in a given quantity. It would

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would have gone, undoubtedly, still more equally out if the the whole ceiling had been absolutely porous, as I have had it in some places; but as there is a complete circle of openings round every panel, suppose a current to be escaping, there may be a little rebound if it pass rapidly up to the centre and then to the side; but practically there is a uniform discharge as far as the result is concerned. There may be eddies in the ceiling at the altitude, but they never operate upon the House. The exit of air from the floor is reduced to a most extreme minimum. I should doubt if we have a foot going away from particular parts of the floor to 1,000 from the ceiling, because I have always gone upon the principle that the breath tends upward, and I do not concur in the statements which have been made as to carbonic acid separating from the breath. The statements which have been laid before the Committee upon that point, by Mr. Gurney, all involve two totally different questions. Carbonic acid, as a raw material, may be got in quantities from a lime-kiln, or by chalk from the action of an acid, or it may be produced by chemical processes during fermentation; and in this condition much may, for a short time, retain a position in unison with its specific gravity; but the surface exposed is continually diffusing itself into the external atmosphere, and there are laws of diffusion that prevent the separation of gases when once they are mingled in certain proportions with each other; so that, for instance, you find carbonic acid upon the top of Mount Blanc, as well as you find it upon the surface of the earth. Carbonic acid evolved during respiration I never knew separating from the air; take, for instance, air respired at Stockholm, or Berlin, when the cold is extreme, or in any assembly in this country, no such separation ensues.

3551. Have you anything to say in regard to the control of drains?—That is a subject which has been admitted at all times to be of the most extreme practical importance. Many of the arrangements there are still unfinished, both in the closets and in the drains. I could undertake to have them finished entirely, I should say within a single day, if I had full authority to have them completed, and a proper communication with those required to execute the work.

3552. By drains, do you mean drains for the carrying away of soil, or what?—Everything.

3553. Sewage drains?—Yes, drains leading to sewers.

3554. Are there any drains which you want to alter in that part of the House under your control?—There are several that have been working imperfectly. Whether they are finished this

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this day or not I cannot tell, but there are also arrangements above the closets connected with the finishing of the ventilation tubes there, where there is work still to be done, and it is only done temporarily at the present moment.

3555. Do you consider that the escape of gas from any part of the gas-pipes not under your control is a cause of the deterioration of the air in the House of Commons?—It has been continuously since the House opened. Even yesterday we found out a pipe that was producing a discharge of gas in the reporters' room.

3556. Is that pipe under your control?—It is not.

3557. Why not?—It is connected with apparatus that I have never seen before, and connected with a system of tube-lighting that was not used by Sir Charles Barry during the present Session, although the tubes for the burners to be employed hereafter are fixed in the walls. I asked for authority to control those gas-tubes that passed through the substance of the wall, or through my channels. In the reporters' room they have never used gas yet; but it did happen that they have had some tubes there which leaked for the first time a day or two ago.

3558. Is that in the process of mending?—Attention was instantly directed to it, and it was reported to be mended yesterday morning, or the morning before, but it leaked again, and I have not been able to trace from what meters it comes, in consequence of the difficulty of communication.

3559. Who has the charge of those works; is it the Board of Works?—I cannot say who has the charge of them at present; they are being connected with works that are not yet completed, to which burners are not applied or brought into operation, I presume. Therefore they are still in the hands of the architect, according to the statement which was made yesterday.

3560. Under whose orders were they laid?—Undoubtedly under the orders of the architect.

3561. You wish to say something about moistening?—I was desirous of mentioning, as it was given in evidence before you that the thermometer was not applied to the air till it was in the House, that this is a most complete mistake. If the slightest inquiry had been made by the gentleman who said so, he would have seen that all our principal thermometers and hygrometers are in the equalizing chamber, where we had provision for 20 instruments to check the temperature—the introduction of that chamber by me was for the purpose of equalizing and adjusting the moisture—it was for the purpose

pose of equalizing generally the quality of the air; and when it is stated that we take no temperature till we come to the House, I can only say there never was a greater mistake.

3562. Have you any addition to make with respect to doors?—I am desirous of calling the attention of the Committee to the totally different circumstances here in the old House of Commons, in the present House of Peers, and in the old House of Peers. My anxiety was simply to mention, although I do not wish to enlarge upon it, that many of the circumstances that presented peculiarities connected with the ventilation in these different apartments arise from the driving of external winds in cross currents from different sides or ends of the house, and that in these respects no house is so much exposed or so much beset with doors as the present House of Commons.

3563. Have you anything to state with reference to the committee-rooms?—In reference to the committee-rooms, I have to state that all arrangements there are entirely subverted in the practical effects they produce, from the manner in which the flues for ingress and for egress are used, and from the manner in which the air is introduced, as well as the state of the fireplace that is connected with these rooms. These plans which I hold in my hand point out the distribution of the great air channels in the vaults, and the mode in which these air channels should set, according as the Houses meet or the Committees meet, or to meet the case of a prorogation. Now although these arrangements were made with the greatest care before a single channel was built, and every adaptation and means of resource laid down, they are practically inoperative at the present moment. I shall take one case as a single illustration. Suppose this to be the central hall, and that it is the receptacle of fresh air, and that the Houses were meeting, the committee-rooms being unoccupied, the valves placed at the point I indicate would be shut, and the air would then pass to the House of Peers by the north and by the south channels from this central hall. But let us suppose that the committee-rooms were occupied, then the channels supplying the House would be shut, and instead of one channel, comparatively small, supplying all the committee-rooms, means were arranged for sending by a special instrument so much to the centre portion of the committee-rooms, while others that would operate upon the House of Peers and the House of Commons could be put by a side drift upon the terminal committee-rooms north and south of the centre. That is the arrangement that ought to be in operation now, and instead of having one blast operating upon

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upon these numerous rooms (the whole of the river front), there ought to be three distinct powers dividing this into three districts, and therefore giving facilities to the attendants in checking the changes produced in one room by the influx or setting of the valves in another. If you have a blast operating upon one room only, the moment you put it on a dozen more this will change the effect upon that one, and the greater the number you have to command at a time given, the greater will be the difference of effect. The discharge from the committee rooms should be 100 feet; 90 feet at least; and by the arrangements made in the roof, instead of taking it to either end through a narrow channel of 50 feet, there should have been 100 feet available at three different places, there being three parallel discharges in the roof to carry it away. Thus, instead of the discharge at present given, there would have been three discharges of greater area; and means were prepared for temporary discharges from these at different places, so that they could be adapted at once, in the event of the rooms being occupied before the centre tower was used, in which these flues terminate. Again, without entering into details, observe the extraordinary position of the valves; the apertures of discharge were made under my direction for every one of them. They were finished, and in 24 hours it would have been perfectly easy to have made a valve to every one of them. Notwithstanding that, for no less than six years have many of them been without a valve provided to them, so that they take their chance of receiving the plenum impulse blowing from any room; there may be one going outward, and coming back into another room; they discharge according as the circumstances may determine. These then are two important points connected with the ingress and connected with the egress; that is, the vast provisions in this immense building have been for these many years utterly useless in comparison with what they might be in respect of accommodation and power. Again, in respect of windows, where a most powerful local effect is produced, one of the very first things that was done by me was to represent the necessity of double windows; and I stated to Sir Charles Barry, pointing to the interior stone of the window, that it would be perfectly easy to get portions of double glass made in such a manner that it would scarcely be seen, from the large size of glass that is now manufactured, and the daily increasing facilities of mechanical operations in extending with economy the size of plate glass. Now that is admitted to be a desirable point. This room, and the committee-rooms in general, have never been tested by a sharp winter and a bitter east wind since

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since they were occupied. If with intense frost this room should be occupied, the effect would be far beyond anything ever yet experienced. At Berlin, it is considered in general, that with a certain thickness of glass, and with a space of one to two feet, you may consider double glass equal to a solid wall; but with very thin plates of air between the two portions of glass, it is not equal, and the less valuable is the double glass. The next point I have to mention is that the ingress and egress is arranged in such a manner that it is impossible that it can produce equal effect. According to the description given, one-half of the ceiling apertures let in air, that is the principal supply, and the other lets out; consequently all those Members on the window side of the room are subjected to the impulse, to the first contact of air in addition to the cold produced by the window itself, while those on the fire side receive the excess of heat; so that nothing can be more unequal than this arrangement, while the quantities admitted below are comparatively small. The arrangement proposed by me, and for which the flues were made to a certain extent, was, that the whole of the skirting all round the room, on every side, should be capable of admitting air, and that although there was a crowd at one end and none at the other, by regulating the amount admitted at the skirting or above the dado we could have a complete and absolute control. Then again, the discharge should be from the entire ceiling, or from a more equal distribution at the ceiling. I think that the discharge anywhere from the ceiling, comparatively, would do if I had enough of it under my control. But where does the air go out? because it does go out. It may go into a chamber already too full, and as I showed to the Committee some time ago, the air from one room may actually go down into another; that was, I believe, practically the case in the committee clerks' office, where I took so many Members at the time they complained of it. In my report, one of the first things I said should be done would be to liberate these flues, which are at present rendered comparatively useless by the narrow contracted channels, and where you may hear by the intensity of the noise the power they are endeavouring to put on by steam, and that steam was always avoided by me, not because I considered it less economical, but because Parliament said, "You must produce no visible vapour." I could give the Committee innumerable details, but having mentioned these leading points, perhaps more is not necessary. I am, however, prepared to enter into any amount of detail that the Committee may desire.

3564. Were any objections made to the double windows to you?—

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you?—Yes; Sir Charles Barry said (I am giving my impression of what took place in 1840, 12 years ago) that he would rather endeavour to get quit of the cold draft in another way than have the architecture interfered with.

3565. The same remarks would apply to the passages and library?—Yes.

3566. And refreshment rooms?—Yes.

3567. There is put down here "external air;" what do you say in reference to that point?—I wish to mention particularly in reference to the external air, that for 12 years there is not a day that there have not been, when the Houses have sat, hundreds of observations made on the subject of the quality of the air. While admitting the importance of taking the air, when good, as directly to the lungs as possible, it is a totally different thing here, from the state of the atmosphere furnished on every side, but particularly from the state of the atmosphere during February and March, or other winter months, when very generally there is a certain amount of dew and fog, mixed with air to a considerable altitude; but if you take it in from the towers, then you avoid that visible fog to a very great degree, if not entirely. At times there are also some factories that give so strong an acid smell, that I have found no relief to the restlessness of the Members till I have thrown in ammonia to counteract its effect.

3568. Mr. Gurney has given the Committee the result of some experiments which he has made. Have you anything to say upon those experiments or the method adopted in carrying them out?—Yes; I have first to submit that I think Mr. Gurney has taken a very unfair advantage of me, in experimenting in direct opposition to the instructions of Lord John Manners, after communication with Lord John Manners; and I must say that I did everything I could to meet him as a gentleman and a man of science. Lord John Manners directed by letter (on my showing to him the system of experimenting that Mr. Gurney had adopted in 1839, in connexion with the ventilation, and on pointing out specifically the mode in which he conducted these experiments, and saying that I thought some person should be present), that if he was to see my unfinished arrangements, it was at least fair that I should have the means of checking his statements. Now Mr. Gurney has generally made his experiments and observations without giving me the notice that was arranged, and therefore I have not the means of correcting any statement should it be necessary to do so; but notwithstanding that, the correspondence in his own report will show in a moment the system that he has adopted, and that

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it is impossible that he can have conducted these experiments in a manner that will bear examination. I will call the attention of the Committee to the different points connected with this system of experimenting, and of which there were witnesses. He took, in my presence, a certain degree of velocity of current in the shaft, and while taking it there was no supply; the supply was cut off, and I mentioned to him the necessity of having that supply. He was taking the velocity of the movement in the shaft by an instrument, while the ingress to that shaft from the House was cut off; he was doing this with one of the gentlemen he mentioned. The moment I mentioned the circumstance to him, it was so far corrected. Then he mentioned some points about retrograde currents; he insisted upon continuing experiments in that way, without looking to the state of the ingress. Now there is no use in his making a difficulty about the thing; it is either a matter of fact, or it is not, that there are retrograde currents not under control; and it would have been important if he could have proved before me, by fair and downright manipulation, that it is so; but he did not do so. There is a certain central chamber in the roof that receives all sets of currents; and upon the opening of the valves, if I put the power in the House alone, and leave the corridor in a particular way, I should discharge powerfully from the House. Anything from the corridor would follow the general movement; but suppose I shut the House valve, and there was no discharge from the House, and I put the discharge entirely upon the corridor, why then the currents would go exactly in the other way; there being no discharge from the House, there would be no exit there; but there would be the discharge from the corridor, and anything going into it would go by the House into the corridor. We have a most perfect power of making any retrograde current we like, and of putting the whole power of the shaft upon the House and corridors; and as there is no balance so delicate in the world as air upon air, it must be obvious that there always will be, with the nicest possible adjustment, a tendency one way or the other. We could make anything retrograde by the setting of the valves; and I say it should have been proved before me. I meet Mr. Gurney in this way: I say to him, "Come and show me, with a fair action of the air of the House and with a proper action of the valve, where a retrograde current takes place."

3569. Mr. Gurney, in his report, referred to the effects that would be produced from the different altitudes of the House and corridor. Have you observed that portion of the report?—

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report?—I recollect it perfectly, although I do not know at the present moment whether it was in the first or last one, having been so much engaged; but, however, my answer to such a statement is simply this, that the power in the extracting shaft is so far beyond the power of any pressure of air that could arise there that it is practically nothing; and though it would be quite easy to make the current go up and down in any direction from the equalising chamber, by the opening and shutting of the valves, yet as a principle that is entirely under control. Now, in reply to the specific statement of Mr. Gurney, as to the difference of altitude in the House, and in the corridor, I have only to mention that, practically, all air comes from the same level below to all these places, and goes out at the same altitude above, so that whether within or without the House the absolute height is the same in both, in all cases. The real difference that may be produced before proceeding to the shaft can only arise from a difference of temperature given by the apparatus, or a difference of heat given by breath, or a difference given by gas lights. Then another point upon which I think Mr. Gurney's experiments are deficient is this: it has been stated by me, times without number, in evidence before this Committee, that the windows are not secured, nor the doors. There is not the slightest notice in this report taken of the fact whether the doors were open or shut, or whether I had cut off the supply of air from one place or another in consequence of the offensive smells from drains or gas. Unless I had been present to explain that, he could not arrive at a correct conclusion. Now the experiment is fair, or not fair, from the local effect, and I therefore say that it is impossible that these experiments should be relied on.

3570. Mr. *Stephenson.*] Did Mr. Gurney not make those experiments when The House was sitting?—My impression is that he made some when The House was sitting, and some when The House was not sitting, and he does not give the details to enable me to check him. He does not mention the state of the windows, or of the external atmosphere. Then again, I think there is no Member who has attended the House of Commons who has not been aware of lamps producing heat. There is not a word of that in his report. The heat is all attributed to ventilation or differences of temperature.

3571. In this report Mr. Gurney particularly refers to the softening at the floors as an objection to the present system of ventilation, and he recommends the carpet to be removed in consequence, or some larger apertures to be made there.

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If that were the fact, how would you remedy it, or do you know that it is the fact?—I am certain that it is not the fact; but I should like to make the answer complete by adding this statement to it. I have uniformly on all occasions that I could, unless there was some extraordinary peculiarity to determine otherwise for the moment, provided an infinitely larger ingress than egress. Now the floor may be considered universally porous when liberated from the oily matter, and from the coverings connected with it. I know of no case in which the throttling can take place unless there be some local and special evil to be guarded against. At the same time I wish to add, if it be desired to equalize the movement of air coming up through the floor generally, and supplying the Members, it must be obvious that we must use something for that purpose specific; as was suggested by Members, there might be an indefinite increase of the amount of medium used below the floor for the purpose of increasing the equalization; but we consider that with the means we have at present, and with the carpet, there is sufficient. But if air be blowing in from the external door or lobby, or even if there be no current, it is obvious that it will be easier for the air to pass through a space where there is no interruption whatsoever, than where a medium is used with a perfect knowledge that it produces a certain interruption with a view of getting a greater benefit, namely, an equalizing effect. When there are no double doors to protect the House, the equalization on the floor does not act with the full beneficial effect that it otherwise would have.

3572. Then you do not agree in the conclusion which is stated here, that from want of control over the ingress and egress in the air passages there seems to be no means of regulating a legitimate break of balance?—It is to my utter astonishment that Mr. Gurney, knowing the old House of Commons, which he had to do with, could for a moment make that statement.

3573. Have you the means of regulating both the ingress and egress of air in the present House?—Yes, we have; and I am prepared to show that experiment before Mr. Gurney, if he will come forward with all the professional men he chooses to bring with him, and show him the air going inward to the House or outward to the corridor, according to the modes in which the valves are set.

3574. With regard to the regulation of the air in the House, suppose you had no means of regulating the ingress, but let all the passages be quite open, and you confined your attention only to the egress in the draft that you have from the

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the furnace, would you not then be able to regulate the quantity of air passing through the House with the greatest nicety?—Certainly, if the doors were shut.

3575. Then what is the proper use in your arrangement of the door for regulating the ingress?—It regulates the quality of supply to the body of the House. Without such door regulating the ingress, whenever a door opened we should have no means of applying a plenum impulse to a certain extent, and counteracting the effect of that door.

3576. When you have a free ingress, and a very large egress, do you not think those are the nearest circumstances to a plenum that you could possibly obtain, except by the use of mechanical agency?—Certainly.

3577. Therefore, adopting your furnace arrangement, and producing a natural draught up through the House, confining your attention only to one valve, would you not then maintain the House very nearly in a state of plenum, or rather more?—I perfectly understand the question.

3578. Having made doors for the purpose of regulating the quantity of air passing through the House, if you have the egress too much open, and the ingress too much shut, that instant there is a vacuum in the House produced by the furnace. Now if you confine your attention instead of to two doors to one door, and that between the House and the furnace, it appears to me that you would always maintain a plenum in the House, or at all events as near a plenum as possible; would you not then reduce the effects of doors and windows to a minimum?—We should certainly do so. Of course I perfectly understand that it is not meant an absolute plenum, but it is a reduction of the vacuum to the greatest possible extent; and I should say that were the most perfect convenience and facility given for the largest possible entrance from the floor everywhere, and if the door places were also secured by double doors, so as to prevent the effects of interrupting currents from without, that then the action of apparatus and other things below would be comparatively unimportant; but when we have so many doors, and lobbies within lobbies, surrounding each other on every side, I do find that it enables me to set my valves with less trouble, and to have a greater certainty in preventing retrograde currents, if I have a slight plenum; but in everything I may say of plenum or vacuum, I always desire it to be understood that I wish, if possible, to get the nearest degree to the condition mentioned in the question, namely, the nearest possible approximation to a balance.

3579. Mr.

3579. Mr. *Locke.*] I understood you to be of opinion that you would obtain that rather by having a throttling power at egress with a large ingress; that I understand you to admit? —I have not only admitted it, but I have always acted upon it.

3580. Then I ask you whether the effect of the opening and shutting of doors would be greater by a large ingress or a small one?—The larger ingress, of course the less the effect of the doors.

3581. Then to increase the ingress into the House would not be at all events an objection, in reference to the opening or shutting of the doors?—Not at all; I have sought at all times the largest possible ingress; there is no amount to which it can be extended which would not be advantageous.

3582. Mr. *Stephenson.*] You spoke this morning of always taking, or at least very generally, a small portion of air through the floor of the House; that is, converting a portion of the floor into an exit; be kind enough to explain what is the particular object of taking any portion of the air out at the bottom?—Only one object. Where 600 Members enter and pass and repass so frequently over a particular place, there is a degradation of the material used in the carpet itself, which makes a considerable portion of dust. Further, with all the arrangements I have hitherto been able to secure in the present House of Commons, I do not think we have anything approximating to what we had at the old for cleaning the shoes unconsciously. These were principally arranged at the lobbies. I have in vain asked for similar arrangements here. I have got them to a certain extent, but have not got enough. If a foot introduced nothing, and if there were no degradation of material (I mean by degradation wear and tear from attrition), it would not be so material. Now in the old House, before I had anything to do with it, the wear and tear of the carpet were so great that people were in the habit of getting their coats brushed occasionally who were in attendance at the ventilation. The perfection of ventilation in such a place, subject to movements in divisions, would be to have such ingress in the risers that you could give an ample supply of air with a porous material, and such an inclination of the air as would rather send dust downward than upward.

3583. Are you referring to ingress or egress now?—To the ingress when I speak of the supply, but supposing 1,000 feet to be delivered for supply, 999 would follow the proper course of ventilation; but one foot would be distributed over a large space in inclining the dust down. In some of the

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evidence formerly it was imagined that actually the air came in at the floor and went out at the floor.

3584. According to your own showing, a portion does perform that particular office?—Yes; but it was a hundredth part, or may be reduced to a mere nothing; it was not done for ventilation, but for cleaning.

3585. Then did you contrive to put the egress apparatus near that portion of the carpet which you thought underwent the greatest degradation, or was it practicable to do so?—It was perfectly practicable, because that portion of the carpet is encased up into an air-tight chamber, from which a small tube leads away descending; and if you shut the valve of that tube you will have no escape at all.

3586. I understood you to say that 99-100ths of the floor is employed for ingress of air?—I did not say so much as that; I said a large portion.

3587. Another portion is employed to have egress?—Not egress for ventilation.

3588. Egress not for taking away vitiated air, but for the purpose of removing dust in such portions of the carpet as may become loose from degradation; is that the object of it?—Not the sole object, because it is also for the removal of that amount of mud that may be separated from time to time from Members' shoes, from the particular state of the weather. The part I refer to is between the door and the bar, where many Members come in, stand there for a short time, and then go off again, and where therefore the carpet is subject to a greater extent of injury than in any other place.

3589. There is a maximum amount of degradation there, and you therefore confine the egress through the floor to that portion of the carpet?—That is what is done at present; I have had it applied over a more extended portion at times, but that is what is done at present.

3590. Then, if I understand you correctly, that large area, larger I conceive it to be from your previous answer, between the bar and the table, is the portion over which Members walk in passing from the bar to the Speaker?—From the bar to the door.

3591. With regard to your hot water, which you described to me the other evening in the vaults, you would prefer hot water apparatus to any other kind of apparatus for heating the air going into the Houses?—I do if the service be properly arranged.

3592. Would there not be a great advantage in being able to change the temperature in a short space of time?—There would,

would, and we constantly have the power; the boiler is always at a high temperature, and the individual apparatus is regulated by the action of a stop-cock, which is connected with it.

3593. Was not some of the great recommendations to the employment of the hot-water apparatus, that its change of temperature would never be sudden?—It was.

3594. Then inasmuch as you have occasionally 500 Members, and then suddenly 100 in the House, do you not anticipate that you might be called upon, and have you not been called upon frequently, to change the temperature of the air to be supplied to the House?—We have.

3595. What is your reason for employing that apparatus, whose original recommendation was that it could not be changed suddenly?—Because, though we do not change the temperature of the hot-water apparatus suddenly, and still less that of the large chamber, we can produce a completely equivalent effect upon the Members who desire it, by altering the velocity.

3596. Then that is employing velocity for changing temperature, instead of actually changing it; creating sensation?—I think it comes to one and the same thing in the end, although it assumes a different form at first, in this way: if we suppose we have 2 lbs. of air at a given temperature, and one at a little lower, and the body at a much higher temperature than either, the 2 lbs., being a little warmer, may still cool the body as much as the 1 lb., a little less warm.

3597. You therefore, in order to temper the air, have two processes to go through, one to regulate slowly the temperature of the water apparatus, and also to so divide and adjust the proportions of supply in the hot chamber and the cold. You have two things to attend to for the purpose of accomplishing your object, have you not, in that case?—I am not certain that I take it up distinctly; I would rather state it in this way: that we have three different ways of attaining one and the same effect. A Member desires that the House shall be cold, and that is a request coming through the Speaker, or the Serjeant of his own authority, and we wish to make the change; we may at once produce the effect by altering the velocity; we may produce a parallel change, in point of effect, by sending the air from the hot chamber to the cold; or, thirdly, we may lower the temperature of the water by running cold water into the hot water pipes.

3598. Have you made any experiments with respect to the rate at which you can reduce the temperature; say, suppose

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you have a temperature in the water apparatus of 160°, how soon might that be reduced to 100°, merely approximately, 10 minutes, or a quarter of an hour, or about that?—Even less than that, I should say, according to the state of the external atmosphere that can be brought in contact with it. In very cold weather we could do it in less. We have always the means of giving a full supply, without coming through the hot chamber at all; so that we have simply to pass by the hot chamber, take what the gasfitters call the by-pass; then, if the wind were dashing in at a particular place, and were allowed to dash through the apparatus while we disconnected it from the House, we could occasionally cool it with greater rapidity. The next remark I wish to make with respect to the system of experimenting adopted by Mr. Gurney is, that not a word is stated with respect to the windows, which have been the constant subject of complaint. These might have been open, and produced all the currents of which he was complaining; nor does he state that he examined the doors to see whether they were subject to currents externally. I may remind the Committee that the other evening that I have spoken about previously, I also took Mr. Fitzroy, Lord John Manners, and many other Members, and showed them that the external wind was blowing open the doors in the lobby, after passing through Westminster Hall and all the other places, and this was done when the House of Commons door was shut. Then, again, there is another point connected with Mr. Gurney's experiments in reference to the hygrometer; I am not aware that the details of that are brought out with sufficient fulness to enable me to answer them; our hygrometers are placed below, and the question was whether he at that particular period tested the air that I supplied to the House, or that was rushing in at the window; I ought to have been present to have seen that. Then another point where I think the register made under the authority of the Serjeant-at-Arms, as recommended by me for the last 16 years, as to temperature, will prove in a moment that Mr. Gurney has not taken sufficient care to make himself acquainted with the accuracy of the facts which he asserts; for instance, he says that such and such arrangements, or such and such results, cannot be at all dependent upon the lighting, because the same effects took place on the Wednesdays, and the same temperatures were observed. The returns of the temperature from the beginning of the meeting of the present House to this day are all available; they are made by a messenger, under the authority of Lord Charles Russell, and an appeal to these will show that Mr. Gurney is really quoting what

what is not the case; he is not correct. I might enter much more into detail; I am prepared to take up every paragraph, but I think I have tendered sufficient evidence to show that these experiments have first been made in opposition to the rules and courtesies of the case, as laid down by Lord John Manners after the letters submitted to him; and, secondly, that the report is full of inaccuracies in point of fact. In making all these statements I have carefully avoided everything connected with the general case between Sir C. Barry and myself, understanding from the Chairman that that is the principle upon which I am to proceed in my answers to this Committee.

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Mr. *George Appold*, called in; and Examined.

3599. *Chairman.*] ARE you a Civil Engineer?—I am an Associate.

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3600. You have turned your attention a great deal to the subject which is now being discussed before this Committee?—Yes.

3601. Have you ever applied the principle which to you seemed best for the purpose of warming and ventilating to any buildings?—Yes; I have ventilated the London Institution, only as a manager; an improvement, that is all.

3602. Are you a resident in London?—Yes.

3603. Have you during the last few days observed the state of the House of Commons and committee-rooms?—This committee-room; that is all.

3604. What is your opinon as to the present state of the House?—While I was in the House, in the part in which I sat, it was very pleasant and regular.

3605. What part did you sit in?—The Speaker's gallery.

3606. Did you sit there for some length of time?—I staid there the whole of the evening last night, till half past 11.

3607. Have you done so upon more occasions than one?—Only twice, for the sake of witnessing the state of the ventilation.

3608. You have sat there, I understand, twice latterly?—Yes.

3609. For some hours?—The whole of the evening last night, from five till half-past 11, and last Friday from five till the House closed.

3610. Did you take a thermometer with you?—Yes.

3611. Did you take the temperature by that thermometer?—Yes.

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3612. Did it vary much?—Not a great deal; it continued to rise, but varied very little. Last Friday, at one time, I had a sensation of cold over my legs. I looked at the thermometer a short time before. I looked again, and I then found that it had fallen one degree in five minutes, which I was rather surprised at.

3613. Did you then place the thermometer lower to find what the temperature was, where you felt the cold?—That thermometer was at that time at that particular place, it was hanging on the balcony in front, near the palisade.

3614. It fell very rapidly?—One degree, and my thermometer was a very bad one; it happened to have a very large bulb; but last evening I had a better one.

3615. What was the result of your experiment last evening?—It kept very regular indeed, rising nearly all the time.

3616. From what degree to what degree?—I noticed from six o'clock. I was there sooner, but I did not begin to notice, because the thermometer had been in my pocket, and I waited till it was correct. At six o'clock it was 67½; at half-past six, it was 68; at seven, it was 68½; at half-past seven, it was 68½; at eight, it was 68; at half-past eight, it was 68½; at nine, it was 69; at half-past nine, it was 69; at 10, it was 70; at half-past 10, it was 70; and at 11, it was 70.

3617. What was the extreme heat of it?—At half-past 10 and 11 it was 70°.

3618. Did you sit in the House of Commons before the lighting was introduced?—Never; I take no interest in politics.

3619. Have you any opinion to give to the Committee as to the present state of lighting in the House, whether you think it good or bad; what is your opinion as to the sort of air that you breathed during the time; its purity or agreeableness?—Last night I found it unpleasant; I attributed that to the light being in the House, on the windows. First of all I thought I had a taste of oil being burned; whether there was or no I do not know,

3620. Did you find it unpleasant the first night?—Pleasant, except once I had a smell. Last Friday I had a smell at one time, which I supposed was from a drain; but since that I think it was a very small portion of gas mixed with the air.

3621. You went through the corridor?—I did.

3622. Did you smell anything offensive there?—There was a smell of gas, decidedly. I was going to call the Chairman's attention

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attention to the smell of the drain; but just at that moment you shut the door, and I found the smell went off. It struck me it was a very bad smell indeed, and that a very small quantity of gas mixed with air had caused that particular smell; it was different from the smell of a gas.

3623. Was the light agreeable to your eyes?—It was very pleasant to me. I do not think you can have a better plan than a light up in the roof. I think the light being in the roof is decidedly the best plan. If you put light outside the windows, and get the light through stained glass, you will have three or four times the heat that you now experience.

3624. Why is that?—Because you must have so much more light, and that light must strike upon the coloured glass and make it so hot. As a proof of this, I may mention an instance connected with my own dining-room. I have a stained glass window, and I have only six gas burners in the room; outside the window I have 40, in the summer time; I had some friends who have asked me to put the gas out in the room, as an experiment, and the light was very poor from the 40; when we put the other gas out it was about six or seven inches from the glass, and the glass got very hot indeed.

2625. You have rather studied the effects of light, have you not?—Yes, for my own convenience, and for the London Institution as well. If they have anything connected with light then they generally abide by what I say.

3626. Did you observe at all the effects of the shadows cast upon the roof by the light in the ceiling?—I did observe that a little; but, as far as my fancy went, I did not object to it.

3627. You do not object to sit in a room part of the roof of which is in the shade?—No; I think the present light cannot be improved or put in a better situation; but with more panels light it would be a little better.

3628. A greater diffusion?—Yes.

3629. Have you been up to the roof at all, where the lights are lit?—No.

3630. Do you think there is any danger?—No, there can be no danger there, I think, because the part above does not get hot enough; the gas is so far from the outlet; and I understand that it is a reflecting surface, plaster of Paris and copper.

3631. It is much nearer to the ribs, is it not?—I do not know; the distance is so great from it that it cannot get too hot.

3632. Do you think there is no danger also to the ribs of the ceiling, that portion of them which is near to the flame of

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the gas?—None; if you could go up there I think you could bear your hand upon it very easily indeed, although I have not been there.

3633. What is your impression as regards the ventilation; did you imagine it was a plenum whilst you were sitting down?—No; that we could not tell, sitting there; I could only judge from report whilst sitting; except this, that a current of air was coming in. Last night when the gas was lit, a current of air came decidedly to my back the moment it was lit; but it might have been from some valve being open.

3634. By that you mean when the gas was increased in intensity?—Yes, that is what I meant to say; when it was turned on full. I noticed on Friday last, when the gas was turned on full, that there was a current of air, as it were, coming down all at once. I supposed from that that Dr. Reid had opened another valve to let more air in.

3635. Have you any opinion to give as to the combination of the plenum and vacuum, or to one of these systems being preferable to the other?—The plenum is most decidedly the best. If you had it there you would have no current coming in when the doors were opened; there would be air going out; three times the air going out will give the same cooling effect as one portion coming in.

3636. Are you aware of any place where the plenum system is in full operation?—No.

3637. Now as to extracting the vitiated air, would you do that by an ascending or descending current?—I should not extract it at all. I should have a plenum ventilation, and allow it to go out most decidedly, if I could afford it.

3638. Then you would have everything closely shut in your habitation except the entrance, by which you come in to produce the balance, and the egress I presume from the roof of the building?—Yes.

3639. Would you make any use of any attractive power at all?—None, if I could have a plenum ventilation. I should use not any attractive power at all, but the vacuum ventilation is so much cheaper; that is the reason; generally speaking it is cheaper, but not in such a case as yours.

3640. In what respect is it cheaper?—Suppose you wanted to ventilate this room, you make an opening at the top; that is the common way, and the cheapest.

3641. How do you propose to give it in?—By openings in the floor; it is the common and the cheapest way; I open the floor all over, let the air in upon the surface of my rooms, and so does the London Institution; the theatre there used to be very

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very bad; I proposed to let in the air under seats all over the place. The rest of the managers were very much afraid of the ladies finding fault with their feet. At last they tried it, and they were rather surprised that the ladies were so well satisfied, and then the other rooms that wanted ventilation were done in the same way.

3642. Have you any power of forcing the air in?—No, they do not go to that expense; the sum was about 30 *l.* to ventilate the theatre, which held about 500 or 600 people.

3643. In order to have a plenum you must take care your ingress of air is larger than the egress?—Yes, or else there must be more force.

3644. Have you no attractive power by jet or hot air, or anything of that kind?—No, not there, but at home I have for the egress; I have tried the steam jet, but I did not find it answer so well.

3645. What had you then?—I have a chimney kept warm with a hot-water pipe, so that it is always in a drawing state.

3646. What do you mean by keeping up a balance without an effective power?—You cannot keep up a balance without a forcing power; you would have a fan; but when I have a little more time to spare, I mean to fix one for myself. I like it much.

3647. With regard to warming, do you believe the air is injured by being passed over iron pipes, those pipes being warmed by steam or hot water?—If the air rests too long upon the surface with boiling water or with steam, I would be bound to smell that it had stood too long upon the iron surface; it would not smell if it were passed over very quickly.

3648. It is sensible to the smell?—Decidedly; so much so that I use a stove, and I would not allow any part of that stove to get hot enough to boil water.

3649. A great deal then depends upon the regularity of the temperature of those pipes?—Undoubtedly; but now I use a gas stove, so as not to allow the temperature of the iron to get more than about 150 or 160.

3650. That is a self-regulating stove, is it not?—Yes.

3651. Be good enough to describe it shortly?—You can hardly call it a stove; it is a square iron case with a large gas burner inside. There is a connexion of about 1,000 feet of pipe from the top; the air goes up the stove; the pipes are all vertical, and connected with the bottom of the stove as well. There is a current of air through the stove down the pipes

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pipes which comes to the bottom of the stove again. And besides that there is another connexion to carry off a certain current of air up the chimney, to give more warmth up the house. By that means we have a very large surface altogether. There are about 1,000 feet of pipe. I keep that at a very low temperature, and then the heat of the stove is regulated by a self-acting thermometer, about two stories away from the stove, that is to say, up stairs; and when the house gets half a degree warmer in the staircase, the gas is turned off and put completely out, except in the cigar jet, which is a little jet which is merely kept alight, being handy. By that means, the instant the house is warm enough, then the stove is out, and afterwards the house gets cool. Supposing I am going to have a party, lighting and other heat warms the place. My stove is then put completely out, which before I found a nuisance with the stove. With hot-water pipes you have your hot water; your friends come and the house keeps warm. I think there ought to have been here a very large chamber to heat the House, so as to get about the quarter of the size of this room with gas inside, and pipes passing through that channel, and air through the pipes. The instant the House is warm enough, instead of shutting the air off to let it out in contact with the hot pipes, you could let the gas out entirely if you like, or only partially out, as I do. I go out, and nobody knows anything about the stove but myself, and it is never out of order except I show it to some gentleman and forget to put it to rights again.

3652. If the pipe gets too hot the hygrometic balance is destroyed, is it not?—Yes; in that case I only care about my bed-room. I have a hygrometer there; if the atmosphere gets too dry the hygrometer opens the valve, which lets about 10 quarts of water on to 300 feet of pipes, which are covered with blotting paper. Here is a drawing, with a description.

3653. Just hand it in?—

[*The Witness handed in the following Document:*]

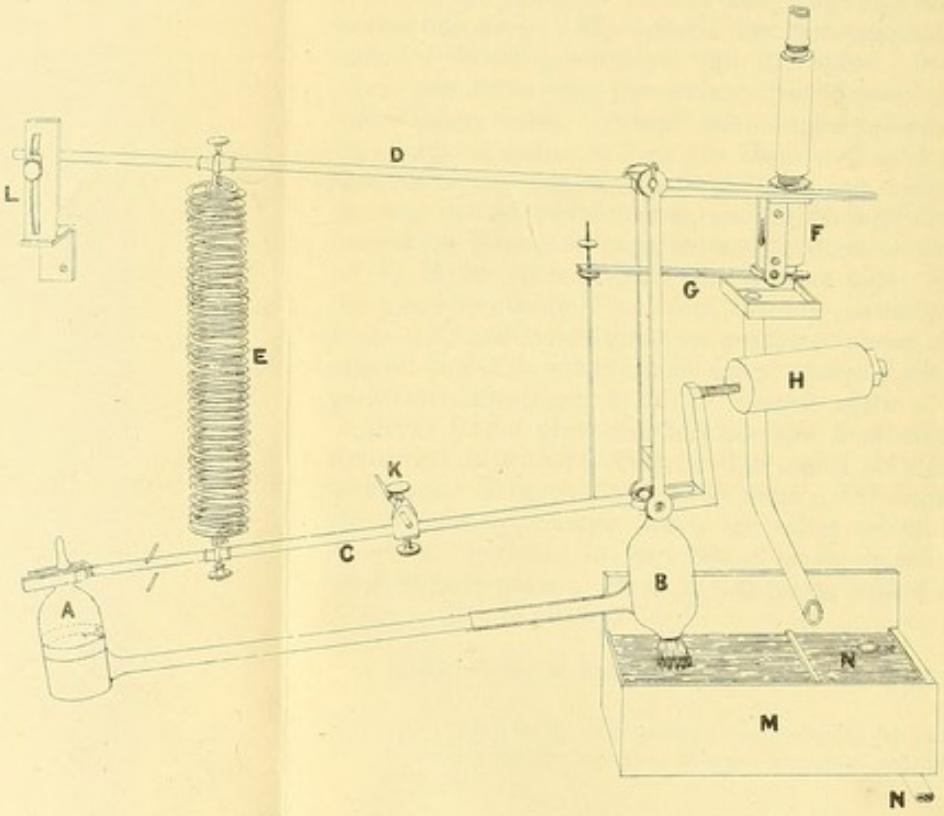
APPOLD'S REGISTER HYGROMETER, invented by him for keeping the Atmosphere of his House at one regular degree of Moisture.

This instrument, with a variation of one quarter of a degree in the hygrometric state of the atmosphere, opens a valve capable of supplying ten quarts of water per hour, conveying it on to the surface of warm pipes covered with blotting paper, by which the water is evaporated until the atmosphere is sufficiently saturated, and the valve thereby closed.

A lead

[To face page 507.]

APPOLD'S REGISTER HYGROMETER.



Reference.

A *The dry bulb*
B *The wet bulb*
C *Lower Lever*
D *Upper Lever*
E *Spring connecting the two levers*
F *Valve*
G *Valve lever*
H *Weight*
K *Pencil*
L *Set Screw for Upper Lever*
M *Cistern that receives the water from the valve, the overflow of which goes on to the pipes*
N.N *Overflow Pipe*

J. Basire, Lith.

No. 402. Ordered, by The House of Commons, to be Printed, 24th May, 1852.
Henry Hansard, Printer.

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A lead pencil attached, registers the distance the hygrometer travels, and thus a sheet of paper moved by a clock would show the hygrometric state of the atmosphere at any period of time. The instrument is made with two bulbs of a cylindrical shape, 1 inch diameter, and 1¼ inch long, placed vertically so that the surface of the mercury may always be the same size; the bulbs are about nine inches apart, with mercury enough in them to fill one, and connected together by a glass tube that the mercury may flow freely from one to the other. A little ether is placed in each bulb, the remaining space filled with the vapour from the ether. The bulbs are fixed upon a balance, so that when one bulb becomes warmer than the other, the ether forms vapour in one, and condenses in the other, by which means the mercury is driven from one bulb to the other.

It will be observed that the wet bulb is placed under the fulcrum, for the purpose of keeping it always in contact with the water; the other end is held up by a spring, connecting the two horizontal levers, so that it can be adjusted to agree exactly with the action of the mercury; this is done with both bulbs dry, and made to stand in any position, the spring counteracting the weight of the mercury. When in use, the spring and levers are lowered, allowing as much mercury to flow into the dry bulb as may be required; the drier the atmosphere is required to be the lower the dry bulb must be placed. The valve is fixed to one end of the top lever, that the lever which opens the valve may be always in the same situation relative to the hygrometer. In the place to which it belongs, the water is laid on with a gutta percha pipe. The brass vessel at top serves for a temporary cistern to show the action of the valve.

(*See diagram annexed.*)

3654. Sir *D. Norreys.*] Do you use common fireplaces and the common arrangements that we all do?—Yes, simply for the look of it.

3655. Mr. *Stephenson.*] Would you in ventilating the House of Commons attempt to regulate the temperature for the ingress or egress of the air by an aperture at the outlet or inlet?—An aperture at the outlet.

3656. Would you depend upon that alone?—Certainly, with a plenum ventilation. I do so in my own case, in my dining-room.

3657. You do not care about the ingress at all; you leave plenty of space for that?—I fixed a damper to regulate the ingress, but I have found in practice that I never had any occasion to regulate it; I always open it wide.

3658. You heard a witness the other day state that the velocity of a current of air upon a dry bulb thermometer immediately causes the temperature to sink?—Yes.

3659. Have you since that time taken an opportunity of repeating that experiment very carefully?—Yes, very carefully indeed.

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indeed. Yesterday I tried it more particularly still. I have got a thermometer that is divided into the tenth of a degree, and the divisions are so large that you may by observation take the quarter of that. Last night when I went home, I took the bellows, which I use for cleaning the sieve in my house, and put into a room with this very thermometer, so that both bellows and thermometer should be of the same heat, and the room and all; and I was the first to go into that room this morning, and I took the bellows, and kept on working it for 50 or 60 strokes, so that the inside of the bellows should be the same heat as the air that passed through; then I moved the bellows very regularly, so as to have pressure always the same. I looked at the thermometer; I could make no difference.

3660. Sir *D. Norreys.*] Has this reference to evidence previously given before this Committee by another Witness, and which stated a different result, in which the result upon the dry thermometer was found to be different?—Yes; and it was through that evidence that I tried this. I then tried another experiment. I blew on the thermometer, and that made a variation of five-tenths. I did that this way. I held my finger at the mouth of the bellows and drew it about half a dozen or a dozen times, keeping it under pressure, squeezing the air out and warming the inside; I blew on to the thermometer, and made five-tenths difference. I should have thought you would have found it worth while to sift the air. I sift the air that goes into my house in a sieve, which is cleaned every morning. I thought you would ask me the mesh of the sieve. I have got some small portions cut out.

3661. *Chairman.*] What is the size of the wire?—About 44 to the inch.

3662. Where is that placed?—Outside in the yard, so that the air that goes into the stove can pass through it.

3663. What do you imagine the effect of that sieve to be?—To prevent so much dirt from going into the house.

3664. How do you manage with your doors and windows?—I generally keep the windows shut; there is nothing particular with the doors except to keep the smell of the kitchen away; the door opens of itself. In such weather as this, in 24 hours that wire sieve, a piece of which I produce, would be completely choked.

3665. Then how do you keep it clean?—By cleaning it.

3666. Are you in the habit of endeavouring to get pure air?—No more than sifting the air.

3667. By what means do you do that?—By letting the air pass through the sieve.

3668. What

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3668. What is the description of wire through which you pass the air?—Copper wire.

3669. Mr. *Stephenson*.] Of what mesh?—Forty-four to the inch.

3670. *Chairman*.] How often is it cleaned?—Every morning.

3671. Does that suffice?—Sometimes in foggy weather; in winter it will get choked in about three hours; but as I make it a rule to have it only looked to every morning, it takes its chance afterwards.

3672. But after that time you may be deprived entirely of ingress of air into your house if your windows are shut?—Then it is just the same as other houses that have the windows shut; the air comes down the chimneys when the fires are not alight, or something of that sort.

3673. Do you use fires?—Yes, in the dining-rooms, for the look of the thing, but not in the bed-rooms or other places, because they are so warm and comfortable.

Martis, 4° die Maii, 1852.

MEMBERS PRESENT.

Mr. Thomas Greene.	Sir Denham Norreys.
Lord Robt. Grosvenor.	Mr. Deedes.
Mr. Henry Drummond.	Mr. Locke.
Mr. Bankes.	Mr. Henry Fitzroy.
Mr. Henry Hope.	Viscount Palmerston.
Mr. Stephenson.	

LORD ROBERT GROSVENOR IN THE CHAIR.

Thomas Brown, Esq., called in; and Examined.

T. Brown, Esq. 4 May 1852.

3674. *Chairman*.] YOU are an Architect, living in Edinburgh?—Yes, I am.

3675. Have you, in the course of your profession, been attentive to the ventilation and warming of buildings?—Yes, I have.

3676. Have you erected any public buildings of a considerable size?—Yes, several; and some of them of very considerable size.

3677. Perhaps

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3677. Perhaps you will be good enough to mention them; there are one or two prisons or hospitals, are there not?—Almost all the prisons erected or enlarged in Scotland for the last 12 years have passed through my hands; that is to say, they have either been planned by myself, or the plans have passed through my hands.

3678. Has some plan of warming and ventilation in those prisons been adopted under your directions?—Yes.

3679. Can you give the Committee any general idea of what the system is that you have recommended?—The system is by a vacuum, by the removing of the vitiated air from the different apartments occupied, and the introduction of fresh air into them, the one going out at the ceiling, the other coming in on a level with the floor, or nearly so.

3680. Has your motive power been furnace or steam jet, or what has it been?—It has been furnace on nearly every occasion.

3681. Perhaps the Committee may infer that the buildings which have been erected under your direction have had a shaft?—Yes, they have.

3682. How long have you adopted the shaft?—I have adopted it for the last 12 years.

3683. Was the shaft your suggestion originally, or how did you come to use it?—No; that system was suggested to me by Dr. Reid.

3684. Has Dr. Reid given you plans for ventilation in any of the buildings that you have erected?—Yes, for three of the prisons, he has.

3685. What are these three prisons?—There is the General Prison at Perth, and there are the two prisons in Edinburgh.

3686. Now, have you any mechanical power there for the purpose of forcing the air in?—No; none.

3687. You have, what may perhaps be described by a term that has been often used before this Committee, natural ventilation?—Yes, natural ventilation; with the assistance of the furnace creating a vacuum to a certain extent, rarefying the air and causing it to pass through the apartment.

3688. Have you found that mode to be successful?—Yes, I have found it very successful when it has been properly applied.

3689. Have the arrangements for ventilation for any of those public buildings to which you have alluded been extremely complicated?—No; very simple, extremely simple.

3690. Where has the air been generally admitted into the apartments?—At the floor.

3691. Then there has been no attempt to draw the air from above, and to carry it out below?—In no instance in the Scotch prisons, but I have seen it done in others, and I have done it in others.

3692. Will you be good enough to state to the Committee where you have introduced that movement?—In the prison at Berwick.

3693. How long is it since that prison was built?—It is about two years since it was completed, and has been occupied between two and three years.

3694. Is the movement solely descending, or is it both ascending and descending?—Descending.

3695. Solely descending?—Solely descending.

3696. Always upon the vacuum principle?—Yes.

3697. The air, I presume, enters at the top, and is moved through to the bottom by means of some attractive power, which attractive power, I understand you to say, is a furnace and a shaft?—Exactly.

3698. Which do you give the preference to; the ascending or the descending movement for purposes of ventilation?—As far as I can judge, I should say the ascending, decidedly.

3699. Why then have you in those prisons introduced the descending movement?—The prison at Berwick is under the management of the English Prison Commissioners, and we had to adopt their system of ventilation in that instance.

3700. You say that it is as much as three years since that prison was built?—Yes; about three years since it was built, but it is about eight years since the plans were made.

3701. Are you aware whether that system has been altered in any of the prisons anywhere; has the fact come to your knowledge?—In all our Scotch prisons the ventilation is ascending; in England the ventilation all goes downwards.

3702. I understand you to state that the Berwick prison was erected under the authority of the English Prison Commissioners?—Yes.

3703. Is it within your knowledge that there are any prisons which have been constructed under the auspices of the Prison Commissioners where the system of ventilation has been altered from the descending to the ascending?—I believe that in all the English prisons which have been erected within the last 10 or 12 years the principle has been the descending one; the air descends in the cells.

3704. The question is, whether it is within your knowledge that that plan has been altered?—No, it is not within my knowledge.

3705. I believe

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3705. I believe that you have inspected the arrangements which have been made for the ventilation of the House of Commons and the adjacent parts?—I spent a few hours yesterday in looking over the arrangements in question; they are very large, but still I have got a general knowledge of them.

3706. Were you in the House of Commons last night?—I was.

3707. What is your impression as to the success in the first instance of the system which is there in operation?—In the early part of the evening I was in various parts of the House, but in almost every place, when I was near a door, I thought I felt a gentle current inwards; I believe that towards the end of the evening, before 11 o'clock (and I was going in and out the whole evening), Dr. Reid made some change upon the movement, and instead of allowing the air to come in from the corridors there was then a gentle inclination outwards, except at two of the side doors, near the principal entrance; that is, right in front of the Speaker.

3708. Where the in-draught still continued?—The thread vibrated backwards and forwards, but the draught was rather inwards. In all the other side doors that we tried (and we tried the whole of them) there was a general inclination outwards.

3709. Are the Committee to gather from your evidence that you consider, as far as last night, the system there employed to have been successful?—I felt very comfortable, particularly towards the end of the evening, from 10 to half-past 11 o'clock.

3710. Do you mean that there was less current, or that the temperature of the air was better?—I did not feel the current at all then, but at the earlier part of the evening I did.

3711. Having stated your opinion as to the movement of the air, will you be good enough to inform the Committee what you thought of the sort of air that you breathed?—As far as I could judge, I thought the air was very good; I was perfectly comfortable. It struck me in the early part of the evening, and I made the remark to Dr. Reid, that there was a little thickness in the air; that appeared to me to disappear afterwards; it may have arisen from the gas lights not being fairly on; there was a portion of light coming in from the windows, and there may have been some deception from the mixture of daylight and gaslight.

3712. When you use the word thickness, do you mean that it looked thick, or that it tasted thick?—I mean that it looked thick.

3713. Was

3713. Was there any disagreeable odour in the air last night?—No, not in any part of the House that I was; I did not experience any.

3714. Did you go into the corridors?—I did

3715. Both the upper and lower one?—Into both.

3716. What was your feeling with regard to the warming and ventilation there?—I thought they were very comfortable.

3717. Does the evidence which you have given with regard to the inside of the House hold good also with respect to the corridors?—Yes, I think so; I thought the corridors, at one time were a little colder than the House.

3718. Did you sit down in the corridors, or remain any time in either of them?—I sat down for a few minutes upon one occasion, but, in general, I walked slowly through them.

3719. Did you go into the gallery of the House?—Yes, I was in the gallery several times; I was in every part of the House, except the gallery opposite to the Speaker; I only looked in there for a very short time.

3720. Were you in the Reporters' Gallery at all?—Yes, I was.

3721. Have you anything particular to remark with regard to that gallery?—In the early part of the evening I thought a little cold draught came down there. I was sensible of that, sitting a good way up the House; as much as half-way up the House.

3722. Are the present arrangements, and the mechanical contrivances for ventilating the House, such as you approve of?—The arrangements for heating, and the arrangements for the escape of air, I think are really something like coming very nearly to perfection, if they are properly managed; but it must be borne in mind that this is the great thing to be looked to; everything depends upon management. Here you have the means of ingress to a certain extent; you have the means of heating, and you have the means of egress, and carrying off almost any quantity of air from such a building as this; and if you manage these things properly, and prevent currents driving in at the windows and doors, which is the case very often, I do not see any reason why you should not be very comfortable. From ten to half-past eleven o'clock last night I was in almost every part of the building, and I certainly felt very comfortable.

3723. Had you any thermometer with you, or did you examine the thermometers in the House?—I examined the thermometer in the House, and I had the list shown to me by the messenger who takes the temperature every hour.

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3724. Then what was the variation?—I think the variation was from 63 to 66½ in the course of the whole evening.

3725. Will you be good enough to inform the Committee whether in the buildings which you have erected the warming and ventilating apparatus has been ordered by you, and arranged by you, or whether you have simply given directions for certain air channels for ingress and egress to be constructed?—Yes; with the exception of the first building, the General Prison at Perth, and the two prisons in Edinburgh, the plans of which were prepared by Dr. Reid. I have had all the rest to do myself.

3726. Then allow me to ask you, do you in these buildings keep out the outward air?—Yes; we keep it out as far as we can by a close window, but we leave the power of opening the window, for summer weather. The windows are made as tight as we can possibly make them.

3727. Are all the windows windows which will or will not open?—They are all windows which will open if you choose to open them; you can fix them if you please.

3728. But they are all windows that will open?—Yes.

3729. Then there is no portion of the window what is in point of fact a sealed channel, so to speak?—No, we have not done that, but we have the power of doing it, and I have seen it done. I have seen the window screwed up and fixed with a view of trying the system of ventilation. It is done in almost all the cells to try what the power is.

3730. Do you know whether they do open the windows there or not, practically speaking?—Yes, in the summer time they always open them.

3731. Can you give the Committee an idea to what extent in summer and winter the windows are opened in these buildings?—In the winter time they never open the windows except on a warm day, but in the summer time they are as frequently open as they are shut. The air is drawn in at the same time by the usual channel for ventilation.

3732. Now, in your opinion, is it an advantage to have windows to open in a building?—Yes, I think so.

3733. In your opinion, is it possible to contrive a system of ventilation which shall be perfect without that?—Yes, perfectly possible.

3734. In point of fact, do you conceive, in cases where the windows are so sealed, that the system of ventilation has been contrived as practicable as you can desire?—I have myself screwed up a window in an apartment 12 feet by seven feet, and nine feet high, with three men in it, a shoemaker, a weaver,

weaver, and a man picking oakum, for two or three hours together; I have then gone into that apartment, and have found that the air was as fresh as it is in this room.

3735. That remark applies to a single room, does it not?—I had 60 rooms in the same place. The remark applies to any one of them. If a thing can be done once, it can always be done, of course.

3736. Then you think that for a great building like this it is quite practicable?—I should say so; it must be borne in mind that you require to go about the matter carefully, and to attend to it.

3737. In that case, I presume, it would be necessary that the sources of supply for the fresh air should be highly cared for?—Yes, no doubt about that.

3738. Do you think it advisable that the air which is to be the only source of fresh air for a building like this should pass through vaults?—If you have vaults large enough, you would have air coming in very fresh; but at the same time, if I were sitting in this room on a warm summer's day, I should like to have the window open, I must say.

3739. Do you think that such vaults as you have seen lying between the Clock Tower and the House of Commons, through which the air passes occasionally to come into the House of Commons, such as you would recommend as the only sources of fresh air to a building of which the windows were not open?—If you wish to avoid draughts, I should say that these vaults, and the air passing through them, is perhaps about the best way you could do it. In sitting in a room like this, if you wish to have a blow of fresh air, the best thing you can do is to open the window. I would be satisfied to exist in the House of Commons with the draught through these vaults coming in, as far as ventilation went.

3540. As an architect, would that be your recommendation to a Committee of the House of Commons sitting to inquire into the process of ventilation?—I should say that I would recommend it.

3741. Mr. *Greene.*] I understand you to say that you see nothing objectionable in the state of the vaults?—Some of them had a very bad smell in them.

3742. Are they not then objectionable accesses of air to the House?—If they were used as such, they would be; but then, I understand, they are not used as such; they have been, as I understand, prepared for that purpose, but have been shut off.

3743. I understood your last answer to the Chairman to be,

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that you should have been perfectly satisfied with having these vaults as the chief means of access of air to the House? —I meant the vaults that I saw used for that purpose. There was only one vault that I saw in good condition; there were several others where the smell was insufferable.

3744. *Chairman.*] In your reply to a question which I recently asked you, you imagined me to speak, not of those vaults which are in bad condition, but of certain vaults which were shown to you under the House yesterday, by which the air was admitted?—That is what I referred to.

3745. And your answer therefore referred to vaults kept quite clean and dry?—Yes.

3746. Do you consider that their being kept quite clean and dry is an absolute condition to the salubrity of the House thus ventilated?—Yes, I should say so. Those vaults that are damp, and that have a damp smell, may be used afterwards for the purpose of giving air to the House, but at present they do not perform that office; they are shut off.

3747. The vaults between the Clock Tower and that portion of the vaults under the House of Commons you state to be now cut off?—I do not know exactly where they are placed, but I saw the vault that the air passes in through to the House, and that is all in pretty good order; but there are vaults adjoining to that, and leading to it, and which I suppose were constructed to pass in the air, which are not in a good condition, and are not fit to be used.

3748. Do you consider that the vaults which were shown to you give a sufficient amount of air for that purpose?—There was a large quantity of air flowing in; I should say there was enough.

3749. In the course of your profession, have you ever advised that mechanical power should be used for the purpose of forcing the air in?—No.

3750. Would you advise that?—Never, in such buildings as I have ventilated.

3751. You find that, however, in the House of Commons, do you not?—Yes, I see they have the power of doing so here.

3752. Would you prefer keeping that, or doing away with it; if you were desired to give a plan for ventilation, would you retain that power or get rid of it?—I do not see any reason for it, as far as my experience goes; I think you have quite enough without it; but if there are difficulties in controlling the doors, it might, perhaps, be used advantageously.

3753. Do you consider the furnace in a shaft to be a very manageable

manageable power?—Yes; it is the most simple thing in the world.

3754. I presume that the value of attractive power must very much depend upon the command you have over it?—Of course.

3755. If you had no command over it, it would naturally cause a very untenacious temperature of the currents of air?—Yes.

3756. But you say that you consider the furnace to be a very manageable power?—I do.

3757. Upon the whole, upon your view of what you saw here, and have had explained to you, do you consider that there is unnecessary apparatus used in the warming and ventilating of this House?—It is impossible for me to give correct information after only the two or three hours' examination that I made yesterday; everything seemed similar to what I had previously seen; all the heating pipes, and the means of bringing on and letting off the air, seemed much like what I have seen before at other places, with the exception of the machinery for throwing in the air.

3758. Have you any opinion to offer to the Committee as to the lighting of the House?—No, I have not any opinion to give upon that subject,

3759. Did you consider the matter of the lighting of the House at all, in regard to its effect upon the ventilation?—There was a strong current through the reflectors.

3760. Do you consider that the lights assist ventilation?—Yes, I should say they do so very much.

3761. Mr. *Locke*.] I understood you to say that you were in favour of the system of exhaustion?—Yes; I have found it to answer the purpose very well in many places.

3762. Have you had any experience at all of that which is called the plenum system?—No, I have not.

3763. Did you ever know it adopted anywhere?—Yes, it is adopted here.

3764. But, within your knowledge, is it adopted at any other place?—I am not aware of ever having seen it done.

3765. Now, do you know what the practice is in the ventilation of the House of Lords, with respect to the letting in air at the roof, and drawing it out at the roof?—No.

3766. Supposing it were proposed to ventilate either the House of Lords or the House of Commons by bringing air in at the top and carrying it out again at the roof, would you consider that a good system of ventilation?—I am hardly able

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to answer that question, not having considered it; but I should doubt whether the air would descend to the floor.

3767. If, on the other hand, it were suggested to you that, in another building where it is taken in at the floor, there are appliances and means to take it out again at the floor, would you consider it a good or a bad system of ventilation? —If you were drawing it in at the floor, and letting it out at the floor, I should think there would be some difficulty; but with respect to certain parts only, I do not see any difficulty.

3768. Supposing there were parts, and that those parts were interspersed in spaces of six inches, for instance, do you think that that would have the effect of bringing the current up, and at the same time of keeping the dust down?—Only over a certain portion. If you extended it over the whole surface I think it would be more difficult.

3769. In the one case you would stop the action of ventilation altogether, whilst drawing the dust down through the carpet; would not that be the effect of it?—Yes. I will tell you what I have done in that way: in some of the prison cells the inmates use a chamber vessel of ordinary earthenware, and in the wall close upon the floor is formed a small cast-iron box with a door upon it, in which this vessel is set. While drawing off the air from the cell at the ceiling we have also a draught on this small box to take away the effluvia. We are there then drawing off at both floor and ceiling. In the one case it is a small flue, and in the other it is a large one.

3770. *Chairman.*] If I understand you rightly, there is a pipe attached to the box which contains the utensil, which goes into some flue, and there is a method by which, from a certain portion of the floor, you draw off foul air at the same time that you draw the general foul air of the chamber from the ceiling?—Yes.

3771. Sir *D. Norreys.*] Have you ever paid attention to the effects on the quality of the air by heating it at different temperatures?—The only way in which I have ever heated it myself has been by large hot-water pipes, where the temperature of the water has been so very low that I have never found the air damaged in any way, or heard any complaint of it.

3772. What do you call a low temperature to keep hot-water pipes at?—The temperature at which we generally keep them is somewhere about 100 degrees, from 100 to 150. That is the water in the pipes.

3773. Do you consider, or have you been led to believe by others, that heating air, or that bringing air in contact with pipes at a temperature of 150 degrees has a deteriorating effect

effect upon the quality of the air?—No; but I have been sensible of this when the water was overheated; I have seen pipes so hot that the air must have been injured by them; I have never, however, used that high temperature apparatus.

3774. Suppose the pipes were kept at 150 degrees, would that have any effect upon the quality of the air?—A good deal would depend upon the quantity of air passing over them. If you raised the temperature of the air from 54 to 64 degrees, it would not be damaged.

3775. At what temperature would you conceive that deterioration would commence to any extent?—It is difficult to say; I have never examined that subject as a chemist.

3776. The system adopted in this House is to heat a certain portion of air which enters the House to a temperature beyond what its ultimate temperature is to be, and to mix it with cold air so as to bring it down to a low temperature. Would you prefer that all the air that was required to supply the House should be brought to the same temperature, by means of pipes or other arrangements, at a much lower temperature, and that there should be no mixture of air subsequently?—Certainly; I would prefer it without mixing if possible. But I do not understand that it is mixed, unless when required to meet sudden changes in the number of Members present in the House.

3777. Therefore, whatever your heating apparatus might be, you would keep it at so low a temperature that all the air which would be required for the House should be merely heated to that temperature?—Certainly.

3778. And that there should be no subsequent mixture of cold air?—Yes; I should do so if it were in my power.

3779. Now, have you had experience in the use of glazed stoneware pipes for the conveyance of water?—Yes, I have.

3780. Can you state to the Committee what is the largest diameter that pipes of that kind are made?—I am not sure as to what size they are made, but I believe I have seen them upwards of two feet in diameter.

3781. But can they be made to any size?—I dare say they can be made to three feet; those that I have seen may be three feet, perhaps; I am satisfied they are upwards of two feet.

3782. Mr. *Greene.*] You have stated that most of the prisons that you have ventilated have been with the ascending current, but that one of them was with the descending?—Yes.

3783. Are you at all aware whether any difference was

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found in the state of health of the inmates of either the one or the other?—I am not aware of the state of health of the inmates of the Berwick prison, but the ventilation there never was so satisfactory to me.

3784. You have had opportunites from time to time of seeing what was the state of health there?—Occasionally.

3785. Mr. *Stephenson.*] In the ventilation of those prisons to which you have alluded, have you a series of rooms in connexion with one common channel?—Yes.

3786. Then at what part is the air admitted into the cells?—The form of the cell is generally about 13 feet by 7; the door at one end, the window at the other.

3787. How many feet is the swill of the indow from the ground?—Seven to eight feet.

3788. And the whole of the air coming into that small cell is on a level with the floor?—The window is from seven to eight feet up from the floor, but the opening where the air comes in is at the level of the floor.

3789. Then the air, in fact, comes in on a level with the floor and goes out at the top?—Exactly.

3790. Have you valves at each cell by which you regulate the admission of air into that cell?—We have, but they are very seldom used. When you get all the adjustments made, the whole thing works on very quietly and very well.

3791. Have you had any experience in ventilating large rooms by a porous floor?—Yes, in one or two chapels I have brought the air in, not exactly through the floor, but close upon it.

3792. But the apertures were quite open?—The apertures were first in the floor; then the feet of the people were shut off by a board placed there for that purpose; the air came in first through the floor, and then sideways.

3793. Then the air did not come up immediately in contact with the feet?—No.

3794. Mr. *Locke.*] Supposing an objection to be found in the present House of Commons from the dust rising from the carpet by reason of the air coming through the floor, will you state to the Committee how you would propose to remedy a defect of that kind?—Then you must get the air to come through somewhere instead of through the floor; you would have to get the air to come up some sideway, if possible.

3795. Do you know what the available area of the House of Commons is, irrespective of the parts occupied by warming?—I do not.

3796. Looking to the size of the building, and supposing the objection

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objection to which I have alluded to be a serious one, do you see any difficulty in so arranging the means of access through the floor of the House, as to make a perfect ventilation, without passing the air through the carpet?—I would require to consider the subject a little more before answering.

3797. Do you think that passing it through the carpet is a good mode?—If a better mode could be applied I would prefer it, but at present I do not see how you could do it otherwise.

3798. Sir *D. Norreys.*] Objections have been made to the carpet; first, that its small fibres of hair and the closeness of the texture, however open it may have been made, still will create a throttling effect on the admission of the air; secondly, that the small fibres of hair rot and become dust; and, thirdly, that it has the effect of collecting dirt from the shoes of the Members, which drying, ascends in the form of air: could you suggest any covering for the floor of the House of Commons, which should admit a freer passage of air through it, and not be liable to the objection of being inconvenient for Members to walk upon?—I have nothing to suggest; I have not thought upon the subject at all. When you are down below looking up, the apertures in the floor seem very open; no doubt they are closer than the openings in the iron, and throttling, to a certain extent, may take place; but it gives a greater diffusion, and it seems so open that I do not see any great obstruction from it.

3799. Therefore you do not attribute much value to the objection in respect to the carpet?—I certainly can imagine a carpet in such a state as to damage the air passing through it. the carpet seemed to me so clean that any air passing through it could hardly be damaged by it.

3800. Mr. *Locke.*] In fact you have no means of judging whether the air is, or is not, in a bad state?—No chemical means.

3801. If it is observed daily by Members of the House that dust does arise whenever Members walk upon the floor, you would admit that that is an objection, and a thing that required alteration?—Yes; it is the first thing I would attend to.

3802. But you have not made up your mind as to what course you would adopt in order to get rid of the defect?—No.

3803. Sir *D. Norreys.*] Would it be possible to use perforated lead in certain parts of the floor?—It would be perfectly possible to use it, but to a certain extent you would have the same objection; any dust resting on the openings would be carried up in the same way.

3804. *Chairman.*] Of course the more rapidly the air passed

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passed through that carpet, the more would be increased the probability of the dust being carried through it?—Undoubtedly.

3805. Mr. *Locke.*] I think I understood you to say that you were in favour of a fire as an exhausting power?—I said it was the only thing I had ever used, and that I found it act so well and simple, that I saw no reason to change it.

3806. You would not change it for the jet?—No.

3807. Nor for the fan?—No.

3808. *Chairman.*] You have known Dr. Reid for some time, have you not?—Yes, for 13 years.

3809. You are so eminent in your profession, that not any of the public prisons have been built in Scotland of later years without your being either absolutely the architect, or consulted with regard to them?—The General Prison Board of Scotland, in getting plans from the local Boards in the different parts of the country, did me the honour of submitting these plans to me, asking me to report upon them, and almost in every case I have assisted the local committees; but in most of the cases I received the employment from the local Boards themselves.

3810. Did you consult Dr. Reid in reference to the ventilation of those prisons?—At first I did, certainly, with regard to those prisons to which I refer, which were nearly the first that were built.

3811. Do you consider that the principle which Dr. Reid has laid down, and the practice which he has recommended, to have been carried into effect with tolerable facility and with success?—I find every day that the more I attend to carrying out the views which he originally suggested to me, when fair opportunities occur, the better I succeed. We introduce his system of ventilation from prison to prison as we go on.

3812. That does not extend to the adoption of both plenum and vacuum, or to a complicated system of upward and downward current, but simply to the admission of warm air at the bottom of the building, and the carrying it off by means of a furnace and a shaft?—Exactly; but you have to guard against currents too. I have seen a current, by opening a door, put an end to all ventilation that could be adopted under any circumstances. A provision ought to be made for this in every instance.

3813. Then what provision would you suggest?—Sometimes that of a double door, sometimes that of a treble door, so that you might always have one or two shut doors between the external atmosphere and your main reservoir for air, which is the corridors.

3814. The

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3814. The principle being, depending for your ventilation upon air that you introduce from some external point, as pure as you can get it, and in no ways depending upon the air you get from the windows?—Yes, particularly when it is warm weather.

3815. Sir *D. Norreys.*] Have you made yourself acquainted with the general plan of the Houses of Parliament?—From what I saw yesterday, I know pretty well about the House of Commons; the House of Lords I have only casually seen some years ago, and that is all.

3816. Having reference to the number of halls and corridors and passages which have communication with the House of Commons, or the lobby immediately adjoining to it, do you conceive it possible for a person who may be in charge of the ventilation of the House of Commons to carry it on perfectly, unless he has control over the several passages which lead either from the external air or from these large halls into the House of Commons?—He must have command of both, undoubtedly.

3817. *Chairman.*] Do you consider for a building of this size that it would be a great advantage that the whole should be in the hands of one directing authority?—I should say so, unless two that work uncommonly well together.

3818. Sir *D. Norreys.*] The paper to which I am now directing your attention is the Return of the temperature at the different hours of last night, and of the number of Members who were present at the corresponding hours, as taken by the messenger of the House of Commons; do you consider that it is possible to carry ventilation to a more perfect state than that paper shows?—(*The Witness looked at the following Return*):

Hour.	Speaker's Gallery.	Serjeant's Gallery.	East Gallery.	West Gallery.	Strangers' Gallery.	Members.
4	64	64	62	63	62	150
5	65	65	63	64	63	280
6	66	67	64	65	64	350
7	66	66	64½	65	64	280
8	65	65	64	65	64	250
9	65	65	64	65	64	300
10	64	64	65	65½	64	500
11	65	65	66	66½	66	500
12	65	65	66	67½	66	550
1	66	66	66	67	66	150

Really

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Really it seems to me to be very perfect; the difference I think is from 64 to 67½.

3819. And the number?—From 150 to 550.

3820. And that paper shows that for three hours there were at least 500 Members in the House?—Yes.

3821. And yet the temperature for that time does not appear to have varied, what?—From 63 to 67½; I have seen in a large prison-wing with nearly 200 cells, and a corridor 200 feet long, and from 50 to 60 feet high, that the difference so far as we could judge, did not exceed three degrees in every cell, trying it all over in different parts of the House. That was when you kept all the doors shut, and allowed the ventilating apparatus and heating to go on without cold currents blowing in and upsetting the arrangements.

3822. The best ventilation that you have been able to create is where all parts are stationary, where there is no opening or shutting of doors, and there you have not been able to equalise the temperature within less than three degrees?—Yes, I think so. In the instance to which I alluded just now, as you approached these long prison wings, or as you came near the windows, the temperature perhaps went down a couple of degrees. Sometimes double glass is introduced.

Lunæ, 10° *die Maii*, 1852.

MEMBERS PRESENT.

Lord Robert Grosvenor.	Mr. Hope.
Mr. Bankes.	Lord John Manners.
Sir Denham Norreys.	Mr. Locke.
Viscount Ebrington.	Mr. Greene.
Mr. Stephenson.	Mr. Ricardo.
Mr. Drummond.	

THE RIGHT HON. LORD ROBERT GROSVENOR, IN THE CHAIR.

George John Stone, Esq., called in; and further Examined.

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3823. *Chairman.*] I BELIEVE you gave evidence upon a former occasion in regard to the state of ventilation and warming in the Votes and Proceedings Office?—I did.

3824. You

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3824. You mentioned then that the only unsatisfactory circumstance was a certain current of air, which was disagreeable?—Yes; that is all I said at that time.

3825. Since that time have you found any alteration in the state of that room?—The air has appeared to me to be thicker and more unpleasant; it has appeared to be very thickly loaded with dust at times; it has not been always the same, but sometimes excessively so, most unpleasantly thick and dusty; particularly on Friday night I remarked it.

3826. Have you yourself suffered from it?—I have occasionally a cough at night, which is very troublesome indeed.

3827. Is it something which you have never had before?—I do not recollect having had it so disagreeably; I will not say that I have never had it before. In the old House it was very disagreeable too; in the room which we occupied for the transaction of that particular business, namely, the Votes and Proceedings, of course the atmosphere was dreadfully bad, and I used to suffer from cough there at night.

3828. You say, of course the atmosphere was very bad; was there no attempt at ventilation there, do you mean?—There was a little sort of trap-door in the ceiling, but the room was very small, and extremely unpleasant.

3829. I understand you to say that the ventilation of the present room is not at this moment very much better than that?—It is not very much better, I think, just now.

3830. What makes you think that there are a great many dusty particles in the air?—A few days ago it was necessary for some one to ascend to the interval which exists between the ceiling and the roof above in the Public Bill Office, and the person who went up there came down covered with dust, as black as possible, and I imagine, from the accumulation of dust which exists up above the ceiling, and from the ceiling being perforated with holes, it is very possible that a great quantity of that dust may descend into the room, and occasion the disagreeable feeling of which I have complained.

3831. You have now spoken of the nature of the air you breathe. Have you any further evidence to give as to the heat?—The room becomes extremely hot at night. There are gas lights which occasion a very great deal of heat, and it certainly does become excessively hot late in the evening. As to cooling it, it is to be cooled by opening the window; that is the only method of cooling it that I find at all available.

3832. As far as your own feelings go, you consider that the

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the office which you inhabit for the transaction of business is exceedingly badly ventilated?—I think it is. I should like to remark that the lower Journal Office, of which complaint was made at the commencement of the sitting of this Committee, has been very much improved, and, as far as I am concerned, (and I have not heard anybody else complain of it), I have no fault whatever to find with it. The air there is very pleasant. I allude to the rooms on the river front, on the ground floor; there is a long line of rooms on the same level as the smoking-room of the House of Commons; that is the lower Journal Office.

3833. Is that a room in which you transact business?—That is the room in which the business of the Journal Office is transacted in the day, and the Votes and Proceedings Office is that in which the night duty is performed.

3834. That in which you transact business by day has been remedied as to the evils complained of; that in which you transact business at night is still badly ventilated?—That is, in my opinion, the case.

3835. Both on account of the air being filled with particles of dust, as you imagine, and also that it is inconveniently hot? —At times inconveniently hot.

Alfred Meeson, Esq., called in; and further Examined.

A. Meeson, Esq.

3836. *Chairman.*] DID you hear the evidence of the last witness?—A portion of it.

3837. He occupies a part of the House which is, I believe, under your superintendence?—He does.

3838. Can you account for the disagreeable properties of the air and the heat of which he complains?—The dust may be accounted for in this way, that only this session have the channels been finished and completed; the workmen have been in these channels almost up to the present time in cleaning and finishing them; therefore there would naturally be dust in the room to which the channels lead. That will be remedied now, and I imagine there will be no more dust.

3839. With regard to the extent of heat which is complained of, can you account for that?—I cannot; I think it is quite under control, if a complaint of heat had been made. I have not heard of any complaints from that office at all.

3840. The Committee observe that under the windows of the committee-room in which they are sitting there are coils of pipe?—Yes.

3841. And I believe you have stated that there are coils of pipe

pipe under all the windows in the committee-rooms to the river-front, for the purpose of counteracting the cooling-down of the air by the large surface of glass?—Exactly so, excepting the windows in the oriel rooms, those have no coils. *A. Meeson, Esq.* 10 May 1852.

3842. In all the others those coils exist?—In all the others they exist.

3843. Are you in the habit of using those coils?—Yes, in very cold weather we use them.

3844. If it has been stated in the course of evidence by any witness that the power of those coils is insufficient to counteract that effect, what would be your opinion of such evidence?—I think that that evidence is not correct, because I have found that the power of those coils is quite sufficient, and the only difficulty in using them is to keep it within a moderate degree of heat; we have more difficulty in that than in getting sufficient heat.

3845. In point of fact, the difficulty with those coils is more to regulate the heat, than on account of any want of power?—Exactly so; the power I think there is no doubt about at all; it sometimes is offensively powerful if neglected.

John George Appold, Esq., called in; and further Examined.

3846. *Chairman.*] IN the former part of your evidence, a conversation arose with regard to Merchant Tailors' Hall, and an impression existed upon the minds of the Committee, that the conversation which you related to have taken place between yourself and the master of that company had taken place two years ago; what is the fact?—The fact is, that the conversation took place that very morning. The master was master two years ago; that was where the mistake arose. *J. G. Appold, Esq.*

3847. In point of fact, in answer to the question whether the master is now satisfied with the state of ventilation of the Merchant Tailors' Hall, your statement applies to the present moment; that is to say, to the time when he spoke to you?—To the present moment; when I returned home there was a letter on the table, saying that they had now got an estimate for altering it from Dr. Chowne.

3848. In point of fact, you state to the Committee that you have the authority of the master of Merchant Tailors' Hall to say that they are not satisfied with any previous attempts to ventilate that hall, but that they have proceeded to get themselves an estimate of an alteration for that purpose?—Yes; the

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the past master, Mr. Complin, told me of it, and this is the letter which I found on my table when I went home.

3849. Do you wish the Committee to understand that, in your belief, the present authorities of that company intend to alter the ventilating apparatus of that hall?—Most decidedly; it is such a failure that they must do it.

3850. Some questions have been asked relative to the dust of which Members of Parliament generally have complained, more especially in the House of Commons, and it has been supposed that that dust has arisen from the air passing through the carpet over which the members walk; have you any opinion to give the Committee as to the sources from which you believe that dust to be derived?—Yes; my opinion is that the hair-cloth is so thin that when the dust lies upon it, the currents of air being supplied from below, rather irregularly, it allows the air to come up at particular parts much faster than is convenient. I had an opportunity last Tuesday of going below to see it. Now if there were three or four thicknesses of the same cloth put on, it would check that. To supply the House they never want more, I believe, than a current to go over the whole surface of about two or three feet a minute. Now if the air passes at two or three feet a minute, the dust, however light it may be, will almost settle in that.

3851. With regard to the two or three thicknesses of carpet which you propose to add, would you put them immediately upon one another, or allow a space to intervene?—I would put one upon the other, for this reason; one half the space consists of openings, and the other half of iron grating. When the air comes through the openings, if it had a second layer it would cause the air to spread over the iron, and then come up bodily over the whole surface; it wants something to check it to cause it to come up bodily over the whole surface.

3852. Then, in your opinion, the air that passes into the House is not sufficiently diffused before its ingress?—No.

3853. And you would put a carpet for the purpose of giving a check to the ingress of the air, and to diffuse it, and make it penetrate through a greater variety of openings than it does at present?—To spread it over the whole surface.

3854. You think it does not do so now?—I am sure it does not. When I was below last Tuesday there was a current of air coming through at different parts, which, if it came up near the hair-cloth, would go through at those particular parts; it ought to have a check sufficient to prevent it from going through

through those parts, and to be squeezed through over the whole surface.

3855. Is it your opinion that the additional carpets would produce that effect better than some arrangement before the air arrives there?—Rather better.

3856. Why?—For this reason, it would be a positive check, and whatever other arrangement you made; suppose, for instance, you put a false ceiling below, with openings to supply a certain quantity of air in three square feet——

3857. By "ceiling" you mean a second false floor, do you not?—It would be more a ceiling, because it would be down below the joists.

3858. A ceiling to the chamber below the House?—Yes; if between that ceiling and the hair-cloth it was divided into spaces of about three feet square, then you would have a little difficulty, wherever the air went through the smaller openings, if you had smaller openings; still there would be a chance of its flowing through that part which is so very free.

3859. How did you discover what you consider a somewhat irregular ingress of air through the carpet?—I was there last Tuesday night, when the House was sitting, at about 11 o'clock.

3860. How did you make your experiments?—Only by looking at it.

3861. What was perceptible to the eye?—You could see through, like through a lady's veil almost.

3862. Did you see the air pass through?—No.

3863. How do you know that it passed more through one place than another?—With respect to the air coming through, it came through the place that I walked on; there were round places with flaps; then there was a cloth put over the top to check the air from coming through; then the air rushed up the sides. Now I knew by the current which I felt that, as it came up the sides, it would continue; and if it went to the ceiling at any part, it would go through the haircloth.

3864. That is the ceiling of the room below the House?—The ceiling of the room below the House; it would go through the hair-cloth, and form a current sufficient to carry dust with it; but if that current was checked by a second or third or fourth thickness of hair-cloth, it could not carry it through, because the first quantity of holes would be covered by the second.

3865. Can you specify what part of the floor of the House that air would go through?—Where I stood was under the seats.

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3866. Was it near the table of the House, or near the entrance to the House, or whereabouts was it?—It was to the left of the table; to the Speaker's left hand.

3867. Sir *D. Norreys.*] You do not agree with the opinion of a previous witness, who stated that the present single breadth of carpet had such a throttling effect, as he described it, on the current of air, that it effectually checked its passage?—No, I have not that opinion; and what is more, if I could obtain some of the same hair-cloth, I would put 100 thicknesses together and try the effect; and you would find that the effect through 100 thicknesses would be very little; the air would go through 100 thicknesses.

3868. Does that opinion of yours result from experience or from theory?—From theory.

3869. You never have tried the experiment?—It is from theory in one respect with this cloth; but at home I use the cocoa matting and carpet as well, and find no obstruction.

3870. You find that you can draw the air through both those substances without its being impeded?—Quite sufficiently.

3871. When you recommend the three layers of carpet as a means of diffusing the air beneath the lowest layer of carpet, would not the weight of the carpet pressing on the iron prevent that diffusion of air?—Excuse me; I did not say carpet, it is a hair-cloth, which is different from carpet; one thickness of carpet would check the air more than six thicknesses of this hair-cloth such as is used in the House.

3872. You have stated, that you would place three thicknesses of hair-cloth on the present iron grating, in order to diffuse the air, so that it might pass beneath the lowest of the layers of hair-cloth, and be more generally diffused in its passage through the House?—Yes.

3873. Would not the weight of the carpet, pressing on the iron grating, prevent that diffusion of the air beneath the carpeting which you desire to effect?—No, I think it would not prevent what I desire, because there would be quite sufficient air passing through them. I want to prevent it a little, or it would be of no use putting it there, if it did not check it a little. I want to check it, to prevent that rush of air which you have at times.

3874. What would be your opinion of a division in the chamber under the House by means of some perforated metal, such as a diaphragm of zinc or any cheaper metal, which would prevent the air ascending in local currents from below, and force it to diffuse itself beneath this diaphragm before it

was

was drawn up into the House?—That would be a considerable assistance, but then you want partitions as well.

3875. In what respect?—Because a greater quantity of air would get through parts of them. You would get what you want, though at a greater expense, and would not accomplish the object so well.

3876. Would not the question of the effectiveness of such an arrangement depend upon ascertaining the exact size of the perforations, which would offer a certain resistance to the air, and force it to equalise itself below the diaphragm before it ascended?—I think that would not answer the purpose so well as the hair-cloth; besides, you would have a very considerable advantage with hair-cloth; you could try it for no expense, as you may call it, because you have plenty; and if three thicknesses did not do, you could put four or five, and it would be pleasant to walk on as well.

3877. *Chairman.*] You have seen lately at Liverpool the plan of lighting in the Philharmonic Concert-room which was described to us by Mr. King?—Yes.

3878. Will you have the goodness to state to the Committee whether you think such a method advisable to be adopted for lighting the House of Commons, or if you do not, what your objections to it are?—The sun-burner method is very good, and would do very well in the House of Commons if the Members do not object to a direct light; the direct light was not unpleasant at all to me, but was very pleasing; perhaps it may be unpleasant to some in the House; the lights round the sides I do not see that you could bring in to suit the House well.

3879. Is your objection an architectural objection, or an objection on account of the light itself?—The lights round the sides I thought would not do quite so well, on account of the ventilation. The sun-burners which Mr. King described here are very good, because you get rid of the whole of the products of the gas, the same as at present.

3880. How near to the roof is the sun-burner?—About the same distance that you have now.

3881. About the same distance as those lights now used in the House of Commons?—As the present lights.

3882. Did you go to the roof of the House?—No.

3883. Are you at all aware of the heat created by that burner?—There could be no heat produced in the House; the heat would all go up to the top, and the heat would not be so much as from your present burners, because the gas is burnt in the very best way there.

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3884. Are you aware of the method by which the products of combustion are carried off?—The same as here; they go up through the roof.

3885. It was described by the witnesses, if I recollect rightly, that the products of combustion were carried off by a circle of tubes, and that that circle of tubes became at times exceedingly hot; can you say anything as to my recollection of that description of the means of carrying away the vitiated air?—Your Lordship is quite right; the burner is under a tube which sometimes gets very hot. Then they put another tube outside. It is only because the tube is brought so close to the burner. The burner in the House now is much better, because there is more room. That is the only reason why the tube gets so hot, because it is so close.

3886. Then, in point of fact, the heat communicated by that sun-burner to the surrounding material is much greater than that communicated by the present burner of the House of Commons to the material which approaches nearest to it?—It is so; only that their material which carries the ventilation off is so much closer than yours, otherwise for the light produced by the gas it would give as much heat.

3887. Does not it occur to you, that if it is necessary to use those tubes to carry off the products of combustion, it is a reason in favour of the present method, that it is not necessary that so much heat should be communicated to those conduits which carry off the burnt air?—The only reason is, that at Liverpool they have made them so small; they have brought the metal into contact with the burner.

3888. Could those products of combustion be carried off in a different manner?—Yes.

3889. Are you sure of that?—Those same burners could be placed in your House, just as it is, without any alteration.

3890. Then the difference would be that that would be direct light, whereas at present it is reflected light?—Yes.

3891. You have had experience in both, which do you prefer?—I like the reflected light best, but it would take such a quantity of gas.

3892. You think that the direct light is more economical?—Yes; and that direct light at Liverpool looks very cheerful and pleasant.

3893. Might it be as near the roof as the present light?—Certainly, I think so.

3894. Do you believe that it would produce as great an effect?—Yes, I do, quite so. I think it is worth your trying most decidedly, to see how you like it. The light is not so intense

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intense as that which you have at present, and would do without a shade underneath, because the gas is thrown out horizontally, and though you have a direct light, it is fainter. The present lights are altogether, and perpendicular, something like the Bude light, so that the present lights would be very intense without a shade underneath.

3895. With regard to the side lights, what do you think of them?—The side light I do not think would do for you, because you would have some of the products of combustion in the House. I do not think that could be well prevented, whatever arrangements you made.

3896. If you could have it, would you prefer it to our present system, or to a system of lighting by the sun-burner?—No; I like your present system decidedly best; that is to say, with the sun-burner, because it takes the products of combustion off so well.

3897. How low might the sun-burner be brought without exposing us to the injury arising from the products of combustion?—I think it might be brought two or three feet down from the ceiling; but I should not like to bring it more.

3898. Would not that to a certain extent be in the eyes of the people sitting in the galleries?—It would be up so far above their eyes then that it would not signify.

3899. Still it would come more within their range of vision than the present system, or any system which should bring the light close up to the roof?—Yes; but two or three feet is nothing.

3900. In an economical point of view, you conceive that the sun-burner is superior?—And for the appearance as well; it looks a cheerful and pretty light.

3901. Sir *D. Norreys.*] Is it a direct light?—It is a direct light, but the gas comes out horizontally; it is thinner to look at; it is not so brilliant as when they burn up together, it does not dazzle your eyes so much; I noticed that particularly.

3902. As that horizontal light must always be viewed from below, it must have as much effect on the eye as if it were a vertical light, must it not?—No, it is fainter, and the vertical lights which you have now are a quantity brought together; you bring the gas lights all together instead of spreading them out; I did not find it so dazzling.

3903. Is not it a question of the amount of gas or of the purity of the gas?—I think not; if you go up in the roof in the evening here, and look down upon the light, you will find it is very intense. If you go into Westminster Hall and look

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at the light there, you will find just what I am saying—it is thinner; whilst the others are brought close together, and are more intense.

3904. Is it not necessary that there should be a larger amount of gas, if the House is to be lighted by a reflected light, than if it is to be by a direct light, such as you have described?—Certainly.

3905. *Chairman.*] You stated that you were in the habit of sifting your air though a wire sieve; have you any further explanation to give upon that subject?—The wire was 44 to the inch; if you put up that wire 44 to the inch, and allow the air to go through it, it will not choke in a week or a fortnight; but if you lacquer the wire, it makes the hole a little smaller, and the hole itself, if you measure it, is about 120th part of an inch; that with this weather will choke in about a day; it stops the whole of the fine dirt, which the other will not stop.

Robert Stephenson, Esq., a Member of the Committee, further Examined.

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3906. *Chairman.*] YOU have been kind enough to take the trouble to go down to Liverpool, to look at the lights in the Philharmonic Concert-room, have you not?—I went on Thursday evening.

3907. What is your opinion of those lights, as applicable to the lighting of the House of Commons?—The chief feature that struck me on entering the Philharmonic-room, was the great advantage of the extreme diffusion of light; there was a diffusion almost as uniform as that of day, and it was not unpleasant, excepting when you came under the sun-burner, which is a very partial part of the lighting; the sun-burner in the Philharmonic Hall at Liverpool may be regarded as simply lighting the orchestra; in fact, those who occupy the other parts of the room may be said to receive all the light from the cornice, which being very elevated, and no one light being very intense, the effect upon the eyes is very agreeable. The application of the cornice light, if I may so call it, to the House of Commons would be difficult, because it would be brought down to too low a level; if any Member were speaking on one side of the House, from the third or fourth bench, his eye would infallibly feel the inconvenience of it, although diffused. I felt it myself a little when I was in the gallery; but when you are on the floor of the Philharmonic-room, then the elevation is so great that the eyelids protect the ball of the eye,

eye, and therefore there is no pain; one of my eyes is extremely sensitive, and I think that is a very fair test. With regard to the sun-burners, I think, for such purposes as lighting an orchestra, or a small space from above, so as to give as it were a radiance as over the altar of a church, the effect is very beautiful, but it is not I think a good plan of getting what we really, I believe, want in the House of Commons, an extremely diffused light; I am inclined to think that the clusters which now compose the sun-light, it being composed of seven or eight or nine little rings of jets, as the case may be, would be an objectionable method in the House. I am inclined to think that if 64 of those clusters were diffused over the flat part of the ceiling of the House of Commons, the effect would be extremely good. The effect of the light in the Philharmonic-room at Liverpool is very much the same at present as the effect of Dr. Reid's lights in the hollow pyramids, because the room has been simply plastered, and it is now perfectly white, therefore a great deal of reflected light comes to the eye, and perhaps the larger bulk of it is still reflected light; although the lights are not screened, they extend over such a large surface that the eye does not receive from any one point an inconvenient amount of intensity.

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3908. Those remarks perhaps might not apply in a case where the room was of a very different colour?—Where the room was of a different colour they might not apply. I believe that a great deal of our difficulty, as regards the shadow under the gallery, may be traced not to the mere shadow of the gallery, but to the colour of the House. I think if the House had been of a much lighter colour, the reflection from the opposite sides would have been almost sufficient to have enabled the Speaker to recognize any one under the gallery.

3909. I did not quite understand your remark with regard to the sun-burner. I understood you in the first part of your answer to state, that you thought it not favourable to diffusion, and afterwards that if there was a sun-burner put in each of the panels, it would produce an agreeable effect. Will you have the goodness to explain that?—I think one sun-burner as at Liverpool, placed in the centre of the roof of the House of Commons, would be amply sufficient to light the whole House, and the intensity at that point would be very great; it is not called a sun-burner until it is composed of clusters. Now, I should take the 64 clusters and diffuse them over the whole of the roof; it might not require 64; however, I should take the individual clusters, which together compose the sun-

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light, and diffuse them over the ceiling of the House of Commons, and I think the light would be as good, but that a smaller quantity of gas would be used, because now we only use the reflected light. Here, if you used a direct light, dividing the intensity, as it were, spreading it over a large surface, I think still it would be so soft as to be free from any inconvenience, and I should recommend the Committee certainly to try two panels, or something of that kind; the cost would be very trifling. Burners might be obtained, I believe, in Liverpool, at a few days' notice, and I think 40 *l.* or 50 *l.* would put them up, and it would be immediately obvious to any one whether it was an improvement upon the present plan or not.

3910. Your opinion then entirely coincides with that of Mr. Appold, that in an economical point of view it is to be recommended?—Certainly.

3911. The only question remains whether it is so agreeable a light, being a direct light, as that which we now have, being a reflected light?—Precisely. The cornice light I think inapplicable to the House.

3912. Sir *D. Norreys.*] I understood the previous witness, Mr. Appold, who accompanied you to Liverpool, to state that he preferred the present system of lighting adopted in the House of Commons to that system of sun-lighting of which you have just spoken; you do not appear to agree with him in that view?—It amounts to the same thing exactly; and Dr. Reid's opinion coincides with my own, because he first of all proposed to put a separate light into each panel. I objected to that in the beginning to save expense, so as to have the experiment fairly tried; and I think Dr. Reid perfectly right.

3913. At present the lighting is so contrived as to have a very material and a very beneficial effect on the ventilation of the House; would the placing these sun-lights, which you have now described, interfere with that arrangement?—Not in the least; it would rather improve it.

3914. Would you have hollow pyramids placed above each of these 64 sun-lights?—I should be disposed to confer with the architect on that subject. The hollow pyramids are not very sightly; they are executed in a hurried manner; and their form, even supposing the hollow pyramid to be the best, is not nicely worked out. It is a crude construction at present; I think if the architect were to devote his good taste to it, it might be made unexceptionable.

3915. Still the hollow pyramid, as it exists now, is a form peculiarly

peculiarly well contrived for assisting the ventilation of the House?—Admirably.

3916. Can you conceive any other mode of filling up the 64 panels better contrived for assisting the ventilation, as well as the lighting, than the hollow pyramid?—No, but I should not make it so high; I think at present it is too chimney-like; I think the architect would immediately flatten the pyramids; and I do not think it would materially interfere with the amount of light which they would throw into the House.

3917. You would require from the hollow pyramid still that it should act as a reflector?—Certainly.

3918. Then that involves the necessity of its being of a certain form?—It is desirable to have it in the curved form, because the dispersion of the light is greater than it would be from a flat surface; but I think the curved form may be a little objectionable in an architectural point of view; it is the best, optically speaking, certainly.

3919. Then, in point of fact, your proposition is, that the central portion of the ceiling shall be a series of hollow cones, more or less approaching the appearance of the present cones?—Yes, more or less.

3920. Would you have the burners surrounded by the reflecting rings which surround the burners at present in use?—That would depend entirely upon the result of the experiment which I have suggested to the Committee; I think it not improbable that the naked light, as at Liverpool, may be really found agreeable and unexceptionable; and if so, then the large loss of light, which is now experienced by the interposition of something below the light, would be saved, and therefore probably half the quantity of gas would be sufficient. I cannot mention the fractional part exactly, but a very considerable saving would be made.

3921. *Chairman.*] It is upon the assumption that it consumes less gas, in fact?—Just so.

3922. Sir *D. Norreys.*] By reducing the height of the hollow pyramid in the way which you have suggested, would you not be able to get the lights a certain amount lower in the House, so as to be below the large beams surrounding the compartments, and thus avoid the shadow which those beams now throw on the ceiling?—I think that is a necessary consequence.

3923. However the general House might be illuminated, if it were from the ceiling there would still be that very great depth of shadow beneath the galleries, owing to the great projection of the galleries?—No doubt.

3924. Is

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3924. Is it not desirable that there should be portions of the House on which the eye might rest without being continually affected by the large amount of light which is necessary for the general purposes of the House?—Personally I have great comfort from going into that part of the House under the gallery; frequently, when I am fatigued, I resort to that place for relief.

3925. Have you not found many Members express the same feeling in favour of having a portion of the House which shall not be so brilliantly lighted as the rest?—I have several, very strongly.

3926. If that amount of shadow under the gallery be so great as to prevent the proper discernment of feature, in order to preserve order in the House, or to call on Members to speak, could not it be mitigated by having small lights so placed behind the columns which support the gallery, as not to be within the line of vision of the Members sitting under them, or in the line of sight of the House, and which yet should mitigate that great depth of shadow by reflection?—I think it might be mitigated a good deal without producing any inconvenience.

3927. Mr. *Hope*.] I think you propose to take to pieces the sun-burner, do you not?—Yes.

3928. And to convert it into a starlight?—Precisely.

3929. Then this light is to be direct light?—Yes.

3930. Without the intervention of anything below the light to produce a reflection?—Yes.

3931. Do you believe that that same plan could be applicable, or that the experiment might be tried with any other burner than the sun-burner?—Yes; but inasmuch as the circular horizontal light diffuses the flame over the greatest surface, it destroys the intensity which the solid burner has. I was struck very much indeed by the most agreeable effect of the diffusion. I never experienced it so much before. Mr. King was also good enough to have two churches lighted up, in each of which there was one sun-burner, I think, with nine stars, as it were, which illuminated the church with a most soft daylight tone of colour.

3932. Arising from the light being projected horizontally?—Yes; I believe that was it.

3933. Mr. *Greene*.] In making an increased number of openings in the ceiling of the House, do you not conceive that it would interfere with the acoustic principle upon which it was constructed?—I think not; if you fill up those holes all but an aperture sufficient to carry off the products of combustion,

bustion, I think that they would not so interfere. Indeed I do not venture to offer any positive opinion upon it, but I think the roof being broken up is beneficial; its flat surface is perhaps objectionable; if it were broken up it would prevent any confusion of sound; we always find that a broken surface prevents all echo. I think there need be no apprehension about that.

3934. *Chairman.*] Have you any remarks to make with regard to the ventilation in reference to lighting?—Only one or two. We have had so many, and so conflicting opinions before us, that I have been rather at a loss to account for them. Several men of great accomplishments have varied very much in their views, and upon some points so essential, that I was a good deal surprised. Mr. Dawkes, and Mr. Brown, and architects especially, have always succeeded in ventilating their large buildings from their own representation, and from the representation of other people, extremely well. Here is a large building, only larger in extent, where everybody seems to have failed. Now, that puzzled me a little, but I think I have hit upon the real defect in this building. All the large buildings which they have been called upon to ventilate, and which they have succeeded very well in doing, have been composed of small apartments, and there has been no crowded nor variable number of people at any one time in the place. I will take Mr. Brown; he has a vast number of cells in his prisons; he gave the dimensions of each cell to be about a cube of 10 feet; that is rather larger than it is, but I take it in round numbers; he has an aperture coming in at the bottom, and an aperture going out at the top, for the consumption of the air of that one indidual, or perhaps two. If you take that as the datum, there is no difficulty whatever in ventilating it: nature would do it if you only left an apertures. Whereas in the House of Commons, you force an enormous amount of air through a place with a varying crowd of people; it is a very difficult question, a very different one, at all events. For instance, a cube of 10 feet for a prisoner, gives 1,000 feet of cubic content. Now that is exactly equal to only 160 people in the House of Commons. There is no great difficulty in ventilating the House, when there are about 160 Members in it. Take one of the Committee-rooms; take this one. I will call it a cube of about 30 feet, which is the outside; the cubic content of this room is about 27,000 feet. Therefore a prisoner as regards the ventilation in his cell, would be just as well off as 27 people in this room. Now you frequently have three

times

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times that amount; therefore all the apertures in my mind are too contracted; the air cannot get freely enough away. Although the cornice is perforated a good deal, and the aggregate area may be considerable, and almost equal to a channel that would ventilate the room tolerably well, yet a number of small apertures is by no means equal to the same area in a large one, and here the air is prevented ascending from the room, by having to change its course, and it is drawn away I think imperfectly, and with some uncertainty.

3935. Am I to understand you to say, that upon a matured judgment you would recommend a single channel of egress for the air, or a larger area of diffusion?—I think a larger area of diffusion would be the best; but I merely meant that observation to apply to the great disadvantages of subdividing air into small currents. On that point I certainly differ from Mr. Appold. I believe with Mr. Gurney, that the air coming through the carpet is really throttled a good deal; but if you put two or three thicknesses on, I think it would most injuriously affect the ventilation of the House; and the more resistance you place to the air coming in, the greater is the necessity for there being a vacuum in the House to draw it in; therefore that draws you away from that exact equilibrium which it is so necessary to maintain between the interior and the exterior of the House. Anything which contributes towards disturbing that equilibrium will render the use of doors under all circumstances highly inconvenient.

3936. Have you at all considered the question of the quality of the air, as influenced by the means adopted in the Houses of Parliament?—I have not turned my attention much to that; I therefore would rather defer any opinion upon it till I have had more experience.

3937. Sir *D. Norreys.*] Will you be kind enough to state to the Committee what you consider to be the meaning of the vacuum principle as applied to the House of Commons, because we are given to understand that the mode by which the contaminated air is drawn off, or by which a current of air is brought into the House, is by means of the tractive force of a furnace acting on the air; is that what you call the vacuum principle?—Yes. "Vacuum" is an improper word to use; but although tractive, still that traction only exists in consequence of a comparative vacuum having been formed in the stack of the furnace.

3938. Still that vacuum cannot be said to exist within the House itself?—If the furnace, for instance, has a certain power of draught, and if you put over all the apertures of the floor

of

of the House of Commons so many thicknesses of carpet as to throttle the air in coming in, then the furnace is acting from the floor of the House instead of the roof of the House.

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3939. That answer is, presuming that there is a strong tractive power acting on the House of Commons itself, where there is no power of admitting air to supply that which is drawn out?—Precisely.

3940. But supposing the means are adopted, which I believe you have suggested, of having a more complete opening between the bar and the table of the House, than the hair-carpet now supplies, how can a vacuum be said to exist in the House, when the whole tractive force of the furnace may be measured accurately, by the in-draught that will flow through this new opening?—There must always be, wherever you control the entrance of the air into the House, at that very point, a vacuum on the one side, and a plenum on the other; now if you regulate the entrance of the air into the House through the floor, the furnace therefore is acting upon the air from that floor all the way to the chimney; therefore that is in a state of rarefaction; below the floor its density is increased; if you go to the roof and leave the floor to itself, making as many large holes as you can get, and let the air come in any way it likes; if you begin to throttle the air in going out at the roof, that is to say, if the velocity of ventilation is throttled at the roof, then a vacuum takes place between the roof and the furnace, and below the roof a plenum takes place.

3941. Mr. *Greene.*] With respect to the ventilation of these Committee-rooms, I think we have it in evidence that the access of fresh air is from the cornice beneath the ceiling on the river side, and the outlet for the vitiated air from the cornice on the opposite side of the room; do you conceive that that is a mode of ventilation which can be successful in a crowded room?—I think not; I think it is conceived in a way to involve the greatest possible difficulty in the convenient interchange of air, and more especially with the rooms fronting the east; the glass being one of the best radiators almost which we know of in winter, it gets very much colder than all surrounding objects, and in summer it gets much hotter; therefore Mr. Gurney's suggestions would no doubt tend to remove some of the inconveniences; but I am inclined to think that local ventilation will have to be resorted to to render these rooms at all comfortable; and you will bear in mind that local ventilation is similar to the plan adopted by Mr. Dawkes, for I particularly put the question to him, how many distinct systems of ventilation he had; he divided his building

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building into seven or eight portions, or, I believe, more, and each of them acted independently of the other. Now these Committee-rooms are all one, depending upon each other; such a combined system involves an amount of accuracy in the management of it, which would, I think, practically make it fail.

3942. In itself, is not the access of air from above a very unlikely mode to give a sufficient amount of fresh air for persons sitting below in a certain state of the atmosphere?—That would depend entirely upon the arrangement; there is no difficulty in ventilating upwards or downwards, the facilities are as great for doing the one as the other, provided the proper arrangements be made. My own impression would have been, in rooms like these where no artificial light is used, to have ventilated them downwards. In the House of Commons which is occupied at night, and where an abundance of light is necessary, it would be counteracting the very tendency which that light has to ventilate the House; therefore, in the House of Commons, it would be a bad plan; whereas, in these Committee-rooms, which are used only during the day, I believe it is a very good plan.

3943. When you speak of ventilating downwards, would you have the egress of vitiated air towards the floor, or have it as in this room, in the ceiling on the same level with the inlet for fresh air?—I would have it all come in at the ceiling, and go out very near the floor. They are constantly in the habit, in coal mines, of carrying the air in any direction they like. There is no more difficulty in ventilating this room downwards than in ventilating it upwards.

3944. At all events, you would not have the access for fresh air, and the egress for the vitiated air at the same level?—Certainly not; I think that involves an amount of difficulty which, in these rooms, is almost illimitable.

3945. Viscount *Ebrington*.] That is, there is constant danger of the fresh air going out at what is intended to be the exit for the vitiated air, without purifying adequately the apartment into which it is admitted?—Yes; at all events the vitiated air getting away is interfering with the fresh air getting in.

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APPENDIX.

Appendix, No. 1.

STATEMENT explanatory of the Arrangements for Warming and Ventilating the New House of Commons, abbreviated in unison with the Instructions given at the Committee on the Warming, Ventilating, and Lighting of The House.

THESE arrangements having been introduced when Dr. Reid was deprived of means and resources, the use of which had been previously provided, and were always contemplated during the period when the ventilation and lighting was under his directions at the New Houses of Parliament, they are to be considered as the result of a system that forced upon him the necessity of sustaining a continued protest since 1846, and compelled him to act under disadvantages, and amidst incessant alterations, of which he had often no notice till he saw them in process of execution on the works. App. No. 1.

It is also necessary to mention that the warming and ventilating arrangements executed were proposed on the distinct understanding that a system of lighting should be adapted to them that would in no way interfere with them, and Dr. Reid proposed a plan accordingly in unison with the instructions conveyed to him, but this plan was set aside on Sir Charles Barry objecting to it, though Dr. Reid never once had the opportunity of submitting previously any answer to Sir Charles Barry's objections.

The brief explanation required from me in this statement as to the warming and ventilation of the New House of Commons is comprised under the following heads:—

1. SOURCE OF SUPPLY.

a. From the highest available part of the Clock Tower, which would alone be used, could it be preserved at all times free from the action of smoke shafts at the Houses of Parliament and other sources of vitiated air, and connected with all parts of the House where a supply is necessary.

App. No. 1.

b. From the level of the ground floor, immediately under the north portion of the Central Hall; a supply is also available from this level at either side of the House, to be used only under very special circumstances, or in the event of any accidental overflowing of the vaults.

c. From the level of the roof, by a channel opening on the east side of the central portion of the river front, and on the west side at a turret opposite Westminster Abbey.

2. Purification of Air.

The deposition of dust and soot, when the air is loaded with these materials, are the principal ingredients which it is desirable to remove. Until the arrangements for the supply of water shall be more advanced, this can only be effected by temporary measures. When the heat is great, the barometer low, and analysis proves a very marked excess of carbonic acid and other impurities in the air, special chemicals have occasionally been used with great relief; but as a general rule they are avoided, with the exception of water and lime.

3. Modes of Heating.

By hot water apparatus, worked usually at a temperature of 90° during the sitting of The House, but capable of giving to the tempering chambers any warmth that may be required in preparing them for the sittings of The House.

In some places a local heat from steam counteracts the action of cold windows in the corridors, but the measures for this purpose are not yet completed.

The fires introduced in the division corridors and cabinet rooms are intended for the special use of those who desire them.

4. Mode of Cooling.

a. By the introduction into the vaults of air from the greatest possible altitude.

b. By the action of cold water within the apparatus used in winter for heating air.

c. By the direct action of water when the air is dry and requires moisture, though the direct action of water is at other times considered very objectionable, frequently saturating the air with moisture, and diminishing exhalation from the body when it is most grateful.

5. Moistening the Air.

a. By the evaporation of water previously purified when necessary.

b. By the action of steam, used alone when unobjectionable in quality, or made to assist the evaporation of water.

6. Drying

6. Drying the Air.

Generally by the action of heat, which may produce this effect practically for ordinary use without the actual removal of moisture. A space is provided for the occasional use of absorbents of moisture, such as have been used under very special conditions of the atmosphere with great relief.

7. Moving Power.

The air can receive any adequate impulse from a steam-engine below (at present replaced by manual labour), and from a smaller engine above. Power is also obtained both from the ceiling and the floor, by the action of the shaft; *see* No. 9. These, however, are brought into use so as to assist, under those restrictions which the structure imposes on the natural movements of tempered air around the person, the right developement and action of which is considered the most important object which they can facilitate or sustain, according to the ever-varying circumstances of the case, in a building surrounded entirely with corridors or passages at two different levels, exclusive of those connected with higher levels.

8. The Distribution of the Supply of Air

Is as universal as could be given, though far below the amount used by me in rooms where the decorations afforded no obstacle to the introduction of universal diffusion at the walls, floor, and ceiling.

The surface of the floor may, with the exception of certain fixed places, be considered completely porous, though from the state of the paint it has hitherto been only partially brought into use. In the ceiling there is an aperture on each side of the panels, the whole opening amounting to nearly 270 feet in area.

In the lower corridors the whole floor is porous. The supply is by perpendicular surfaces, the discharge by panels in the ceiling.

In the upper corridors it was found impracticable, except at a cost and delay which were considered objectionable, to obtain any supply except that accorded at the upper portion of the inner walls. The discharge is by panels in the ceiling.

In the House Lobby there are supplies at the angles on the floor, and at a high level, to be used under different circumstances. The discharge is effected by panels in the ceiling.

9. The Discharge

Is under the special control of a ventilating shaft, which can by the action of valves be brought to bear in any required proportion on the House and division corridors and lobbies, so that air shall leak from the House into the corridors, or from the corridors into the House, as may be desired.

App. No. 1.

10. Action of the Ventilation.

This can only be understood satisfactorily by a reference to diagrams It will therefore be sufficient here to state that a general ascent from the level of respired air, with a supply from below, alone, or combined with a certain amount of descent from a portion of the ceiling, constitutes the general movement by which the ventilation is effected. Hitherto, from the leakage of gas, the want of proper doors, or excessive heat upon the forehead produced by the lamps, The House has never once known what the ventilation is when not injured by these causes.

From certain portions of the floor a perpetual descent is maintained.

The Table appended shows the extreme area of the external apertures for the supply and discharge of vitiated air, excepting the boiler shaft, which, independent of its special action, commands the action of a tube two feet in diameter, which operates to any required extent on all those portions of the floor of the House and corridors from which a perpetual descent is required.

(signed) *D. B. Reid,*
Ventilation Office, House of Commons,
5 April 1852.

To the Chairman of the Committee of the House of Commons
on the
Warming, Lighting, and Ventilating of the House.

Number.	NAME of SUPPLY.	SITUATION.	ASPECT.	NUMBER of OPENINGS.	SIZE of OPENINGS.	AREA.
					Ft. In. Ft. In.	*Feet.*
1	Clock Tower	At the Top	North End of Building	One Opening	28 0 × 7 10	219 1/3
2	Central Hall	Ground Floor	East and West Sides	Two Openings	16 0 × 6 0 and 11 0 × 6 0	162
3	Ground Floor	Ditto	Ditto	Three Openings	11 0 × 8 0 and 2/8 0 × 5 0	168
4	River Front	Central Portion of Roof	East Side	One Opening	40 0 × 4 0	160
5	Poet's Corner	Turret above Roof	West Side	Three Openings	10 0 × 3 4 each.	100
6	Shaft	At the Top	West of House Lobby	One Opening	12 0 × 8 6	102

The areas given above become considerably reduced by various obstructions.

The area of the Ventilation Shaft is 120 feet, but in some places the main channel leading to it is partially obstructed. By local arrangements the effect of this obstruction may be obviated.

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App. No. 2.

Appendix, No. 2.

PAPER delivered in by Sir *C. Barry*, referred to in his Evidence of 5 April.

THE Order given to the Engineer-in-Chief as to Temperatures.

Central Hall	59° to 60°.
St. Stephen's Hall	56° to 58°.
Westminster Hall	56° about.
All Rooms in occupation	from 62° to 66°.
All Corridors, including Cloisters	60° to 62°.

(signed) *Charles Barry.*

6 April 1852.

App. No. 3.

Appendix, No. 3.

STATEMENT required by the Committee relative to the STRUCTURAL ARRANGEMENTS made by Dr. *Reid*, with reference to the WARMING and VENTILATING of the HOUSE of LORDS, prior to his Removal from the Works in the Year 1846, and the use made of such Arrangements by the Architect, in the System now in use for Warming and Ventilating that Chamber.

THE only knowledge which the architect had of the system proposed by Dr. Reid, was surmised from the drawings and instructions furnished by Dr. Reid himself for the structural arrangements which were then made, or proposed to be made; by which it appeared that the supply of fresh air to The House was to have been exclusively from the floor, and the discharge of vitiated air exclusively through the ceiling.

The system adopted by the architect being altogether different from that proposed by Dr. Reid, namely, that of supplying fresh air upon a plenum principle from one portion of the ceiling, and discharging the vitiated air through another portion of the ceiling, it became

became necessary to make the following modifications of, and additions to, the arrangements of Dr. Reid, and to employ mechanical and other motive power to overcome the insufficiency of those arrangements. All perforations for supply throughout the floor were, therefore, stopped by a sheet of lead; the chamber above the ceiling of The House was divided into compartments for discharge as well as for supply; a discharge shaft was erected specially for the use of the House of Lords, and provided with rarefying apparatus and steam jets; a large portion of the vaults not required by the architect for purposes of ventilation were cut off; a chamber was constructed within them for a pump in the first instance, and subsequently a powerful fan worked by steam, for propelling the air so as to overcome the obstructions to the course of supply occasioned by the insufficiency of the wall flues provided by Dr. Reid, and other flues or channels were made for conveying the supply of air from the basement to the roof; boilers were erected for warming and other purposes, by means of steam; a warm-air chamber was formed immediately below the floor of The House, and also a tempering chamber under the lobby floor to the north of it, in which means were provided for warming, cooling, and moistening the air, according to the season of the year and the exigency of circumstances.

13 April 1852. (signed) *Charles Barry.*

REPLY by Dr. *Reid*, to the Statement made by Sir *Charles Barry*, "Relative to the Structural Arrangements made by Dr. *Reid*, with reference to the Warming and Ventilating of the House of Lords."

I CONSIDER that the assertions made by the Architect convey an impression at variance with the fact, as well by its omissions as by the general complexion given to his statement.

1. The great channels of supply to the House of Lords, leading from the Victoria Tower to the Vaults of the House of Peers, of the House of Peers' Lobby, and of the Central Hall, were arranged by me.

2. The great channels of discharge for final use were equally arranged by me, and may be seen in direct communication with the Central Tower, though intercepted at present by other arrangements.

3. The great chamber for equalizing the temperature below the floor of the House of Lords, was designed and secured for this purpose by me. And in 1844, when Sir Charles Barry was building a place for horses and carriages, as he said, under both Houses, I not only remonstrated with him, but waited on the Duke of Newcastle, then Earl of Lincoln and Chief Commissioner of Woods and Forests, on this subject, who heard me before a Committee of the House of Commons. The Architect's scheme was then abandoned, as both works and drawings prove. Had this object not been effected, a chamber altogether inferior in value would have been constructed.

App. No. 3.

4. The floor was constructed in communication with me, and also the supplies arranged and given at the space behind the Throne, at the open pannelled work at the extremity of the principal benches, and at other places. It is quite incorrect to say that the supply of fresh air, contemplated by me, was exclusively from the floor.

5. Sir Charles Barry conveys the impression that he introduced mechanical power for the ventilation, whereas the fact is, that this was agreed to in 1841 and 1842, on my recommendation, a sum having also been inserted for this purpose in the Estimates delivered and laid before Parliament at that period. Let any one read the Report of Dr. Faraday's Lecture on the Ventilation of the House of Peers in 1847, and he will see that Sir Charles Barry rejected then the mechanical power recommended by me, and that he did not become convinced practically of its necessity till about 10 years after my proposal to the same effect.

6. Again, the apertures at present in use in the ceiling were entirely completed before the ventilation of the House of Peers was taken out of my hands.

7. As to the insufficiency of the flues said to have been provided by me, Sir Charles leaves this assertion in the ambiguous position of rendering it liable to the interpretation of my having provided insufficient flues, whereas those that were provided in communication with me were actually larger than the flues he subsequently used for discharge in the arrangements he made in 1846 and 1847.

8. As to a temporary discharging shaft, that, or some other equivalent power, was always recommended by me, and official documents prove that in 1844 I was quite ready to meet this point.

Regarding the statement in question as one of the most objectionable ever made by Sir Charles, I have only further to declare my readiness to meet him, and to prove that, though at one time he says he supplied air exclusively from the ceiling, and though he has substituted steam for water apparatus, neither of these changes had the slightest novelty or peculiarity, and have both been attended with unsatisfactory results; while in all other respects, whether in the locality chosen for boilers, the source of the supply of air, the use of a fixed power of supply and discharge, the introduction of an ascending movement on crowded occasions, the removal by descent at particular places, and the manipulations for moistening and purifying the air, he has in reality followed more and more every successive year all the great principles arranged in 1841 and 1842 at the New Houses, however much I may still differ with him as to details.

D. B. Reid.

Ventilation Office, House of Commons,
15 May 1852.

Appendix, No. 4.

PAPERS delivered in by *D. B. Reid,* Esq., M. D., 23 April 1852.

Kelsey, £. 36. 0. 4 ½.

To James Kelsey, for Labour and Material used in constructing Hoppers and Pendants for the House of Commons, from the 29th of March to the 19th of April 1852, both inclusive.

	£.	s.	d.
23 days of own labour, a' 10/	11	10	–
21 days of assistant, a' 6/	6	6	–
15 ¼ days of a labourer, a' 3/6	2	13	4 ½
6 cwt. of plaster of Paris, a' 3/6	1	1	–
13 bushels of Keen's superfine cement, a' 7/	4	11	–
23 feet superficial perforated zinc, a' /7	–	13	5
70 feet superficial copper wire gauze, a' 1/	3	10	–
2 lbs. copper wire, a' 1/8	–	3	4
Cab hire	–	18	–
Cartage	–	16	–
	32	2	1 ½
Assistance and materials at the House of Commons	3	18	3
£.	36	–	4 ½

Bernasconi and Riddell, £. 53. 16 *s.* 2 *d.*

Plasterers' Day-work, done at the House of Commons, under the sanction of the Committee for Lighting, &c., and under the direction of Dr. Reid, by Bernasconi & Riddell, 10, Chenies-street, Tottenham Court-road.

		£.	s.	d.
1852: April 23	Modelling ornamental hollow cup for gas-light burners, to be made in unison with Dr. Reid's arrangements, including payment for the copper frame connected with it, and part payment of assistance for the completion of the sixteen plain circles mentioned in the preceding part of the account:			
	18 days, plasterer, 5/5	4	17	6
	3 ditto, coppersmith, 3/5	–	16	3
	3 ditto, labourer, 3/4	–	10	–
	3 ditto, boy, 1/8	–	5	–
	Modelling cups	6	–	–
	One cwt. plaster, 4/	–	4	–
	Refreshments	–	15	–
	3 one-horse journies with cups, 3/	–	9	–
	£.	13	16	9

App. No. 4.

PLASTERERS' Day-work, done at the House of Commons, under the sanction of the Committee for Lighting, &c., and under the direction of Dr. Reid, by Bernasconi & Riddell, 10, Chenies-street, Tottenham Court-road.

1852:		£.	s.	d.
April 20, 21, 22	Plastering partition of air chamber on roof, and making specimens of shades for gas-light burners:			
	49 days, plasterer, 5/5	10	16	8
	13 ditto, labourer, 3/4	2	3	4
	10 ditto, boy, 1/8	–	16	8
	Half cwt. plaster, 4/	–	2	–
	45 feet of wove wire, 1/1	2	8	9
	10 lbs. of copper wire, 1/2	–	11	8
	Refreshments	1	–	–
	£.	17	19	1

PLASTERERS' Day-work, done at the House of Commons, under the sanction of the Committee for Lighting, &c., and under the Direction of Dr. Reid, by Bernasconi & Riddell, 10, Chenies-street, Tottenham Court-road.

12 April 1852:—Attending on Dr. Reid to receive instructions respecting specimens of shades for gas-light burners.

15 April „ Making specimens of shades for gas-light burners, and attending on Dr. Reid at night.

16 April „ Making specimens of shades for gas-light burners, taking down lathing and plastering in air chamber on roof, and removing rubbish.

17 April „ Making specimens of shades for gas-light burners, lathing ceiling and partition of air chamber on roof.

18 April „ Making shades for gas-light burners.

19 April „ Ditto - ditto - ditto.

	£.	s.	d.
33 days, plasterer, a' 5/5	8	18	9
12 days, labourer, a' 3/4	2	–	–
12 ½ days, boy, a' 1/8	1	–	10
40 bundles of laths and wrot nails, a' 1/3	3	10	–
13 cwt. plaster, a' 4/	2	12	–
81 hods coarse stuff, a' /5	1	13	9
1 firkin size, a' 3/3	–	3	3
3 feet of wove wire, a' 1/1	–	3	3
Incidental expenses	1	–	6
6 one-horse loads of materials carted, a' 3/	–	18	–
£.	22	–	4

App. No. 4.

KEPP, £. 70. 2. 3.

COPPER WORK done for Her Majesty, by Kepp & Company, Chandos-street, Charing Cross, under the direction of Dr. Reid.

House of Commons, April 1852.

1852:		£.	s.	d.
12 April -	1 oblong square copper hopper frame, with curved angle bars, filled in on the four sides with copper wire gauze - -	2	16	–
13 April -	1 sheet of copper wire gauze, 9 feet by 2 feet, 18 feet super., a' 1/4 - - -	1	4	–
14 April -	1 copper frame, as before, with four additional bent bars to strengthen the sides, and four copper rings brazed on the top, the sides filled in with gauze as before -	3	7	6
17 April -	1 strong square copper wire work frame for reflector, made to model - - -	–	17	–
19 April -	1 circular ditto - - - - -	–	18	–
	13 reflectors, consisting each of five rings of copper wire gauze, set to various angles, and stiffened with wire on edges, with wire supports above and below, a' 14/9 - -	9	11	9
	Fine copper wire gauze, cut out to various shapes, for three more reflectors, and for additional rings to the 13, but not completed, 15 feet super., a' 1/8 - - -	1	5	–
	Coppersmiths' time, marking and cutting out and partly putting together ditto; copper wire, solder, &c. - - -	–	18	6
17 to 20 April	16 copper hopper frames, as before, with four curved angle bars, and four curved side ditto to each, with extra wide bottom flanges and copper rings on top, all brazed together, and filled in with copper wire gauze, a' 61/ - - - - -	48	16	–
20 April -	Altering circular reflector frame, adding two upper rings - - - - - -	–	8	6
	£.	70	2	3

App. No. 4.

Turner, £. 12. 11. 11.

New House of Commons Lighting Account, 20 April 1852.

Smith's Work done, and Goods Furnished for Her Majesty's Service, by Thomas Turner.

	£.	s.	d.
Wrought iron framework, made of strong T bars, fitted with fillets and tapped screws, to receive plate glass, at exterior of Gallery, House of Commons - - - - - -	10	2	–
Time, removing parts of machinery of external blinds, and fixing the iron framework: smith 5 ¾ days, a' 5/5 - -	1	11	2
Labourer, 5 days, a' 3/9 - - - - - - - -	–	18	9
£.	12	11	11

Freeman, £. 163. 15. 6.

	£.	s.	d.
Taking up slate paving, and sinking holes, taking up brick sleepers and preparing the concrete, removing bricks from vaults, lowering manholes to receive paving, clearing away rubbish, relaying slate, cutting mortice holes in brick work, carpenters, and providing and laying 4,246 feet 7 inches new Yorkshire paving on a bed of concrete 10 inches thick	189	3	5
By allowance for old slate, as agreed - - - - -	25	7	9
£.	163	15	6

Fincham, £. 71.

The probable Amount for Work done under the direction of Dr. Reid, at the House of Commons, up to Saturday night, the 17th instant.

	£.	s.	d.
Opening ground to foundation; putting in pipes; filling in ground, and for supply of lime for getting off paint - -	6	–	–
Gas-fitter, Mr. Farady - - - - - - - -	–	15	–
Carpenter, Messrs. Pritchard; time and materials - -	24	5	–
Plate-glass, and fixing - - - - - - - -	40	–	–
£.	71	–	–

22 April 1852. *J. Fincham.*

Arthur, £. 68. 19. 5.

Assistance in removing Oil Paint, and in Works connected with Lighting.

Dr. Reid's Ventilation, for the Weeks ending 10 April, 17 April, and Monday, 19 April.

	£.	s.	d.
Time, carpenters, paper-hangers, &c., 127 days, 4 hours, a' 5/5	34	10	9
Ditto, labourers, 65 days, 5 hours, a' 3/6 - - - -	11	7	6
2 bales of best Forfar canvas, a' 0/7 per yard - - -	10	1	3
16 lbs. tacks, at 1/1 - - - - - - - - -	–	17	4
6 quires brown, a' 1/3 - - - - - - - -	–	7	6
8 pieces strong elephant, a' 1/3 - - - - - - -	–	10	–
12 lbs. double size, a' 0/1½ - - - - - - -	–	1	6
½ cwt. tow, a' 0/7 - - - - - - - - -	1	2	2
9 small brushes, a' 0/6 - - - - - - - -	–	4	6
A bale of very strong canvas, cut up into slips for rubbers, 174 yards, a' 0/9 - - - - - - - - -	6	10	6
Refreshments, and sundry expenses - - - - -	2	6	5
£.	68	19	5

App. No. 4.

Tyler, £. 14. 17. 6.

Account for part of Labour in Removing the Paint.

Her Majesty's Board of Works to T. W. Tyler, No. 18, Great George-street, Westminster.

House of Commons Ventilation, &c.

1852: March 23 to April 17;

	£.	s.	d.
To removing oil and paint from perforated iron floor of House, clearing away rubbish, and 70 days' men, a' 4/3 - -	14	17	6

FitzGerald, £. 12. 8. 11.

Account for part of Chemicals used in removing Oil Paint, and in Arrangements connected with Lighting.

The Commissioners of Her Majesty's Works.

8 April 1852:	£.	s.	d.
1 lb. cobalt blue - - - - - - - - -	–	6	–
Sash tool - - - - - - - - - - -	–	–	6
Whitening - - - - - - - - - -	–	–	2
5. 0. 10. best American potash, a' 42/ - - - -	10	13	9
Cask - - - - - - - - - - -	–	3	6
1 iron gall cask - - - - - - - - -	–	2	–
10 lb. oxide of zinc - - - - - - - - -	–	5	–
10 lb. nitrate of lead - - - - - - - -	–	7	6
6 paint brushes - - - - - - - - -	–	7	6
4 bags fine plaster of Paris - - - - - -	–	3	–
£.	12	8	11

App. No. 4.

EDGE, £.507. 1. 8.

To Amount of Account for Work already done - - £.324 9. 2.

To Fitting and Fixing Main Pipes and Apparatus for Lighting the House of Commons with Gas, internally and externally:

	£.	s.	d.
To 283 feet cast iron main pipe, including valves, branches, bends, elbows, plugs, double sockets, and cocks - - -	38	6	–
To 143 feet 2 inches strong wrought iron pipe, including nipples, bends, plugs, tees, reducing sockets, short pieces, connections, brass main cocks, with brass unions and wrought iron keys - - - - - - - - -	22	12	7
To 461 ½ feet strong 1 ½ inch wrought iron pipe, including nipples, bends, plugs, tees, reducing sockets, short pieces, brass main cocks, with brass unions, and wrought iron keys - - - - - - - - - - -	34	2	4
To 180 feet 1 inch strong wrought iron pipe, including nipples, bends, plugs, tees, reducing sockets, short pieces, connections, brass main cocks, with brass unions, and wrought iron keys - - - - - - - - -	12	19	4
To 169 ½ feet three-quarter inch strong wrought iron pipe, including nipples, bends, plugs, tees, reducing sockets, short pieces, connections, brass main cocks, with brass unions, and wrought iron keys - - - - - - - -	9	4	3
To 332 feet half inch strong wrought iron pipe, including nipples, bends, plugs, tees, reducing sockets, short pieces, connections, brass main cocks, with brass unions, wrought iron keys, burners, &c. - - - - - - - -	20	18	4
To copper rings, with burners, ornamental husks, experimental burners, wire gauze, lighting torches, vulcanized tubing, copper wire, gas chimnies, &c. - - - - - -	27	4	4
To one square zinc box and cover, for light behind the Speaker's Chair, including all necessary apparatus for the same - - - - - - - - - - - -	5	9	6
To gas floats and frames for painted windows, including burners and reflecting guards - - - - - - -	19	18	2
To five wrought iron floats, fitted complete with burners and cocks - - - - - - - - - - -	22	4	10
To one 2 inch and two 1 ½ inch brass cocks and unions, with tees, branches, and outlets for regulating the supply of gas - - - - - - - - - - - -	11	17	6
To main layers, gas fitters, tin smiths, modellers, carpenters, and mechanics - - - - - - - - - -	94	14	–
To refreshments for workmen working all night, and overtime	4	18	–
£.	324	9	2

(signed) *Thomas Edge.*

App. No. 4.

Estimated Amount for Meter, Governor, and Apparatus connected therewith, £. 132. 12. 6.

Gas Apparatus Works, Great Peter-street,
Westminster, 23 April 1852.

To Amount of Work in progress not completed, for supplying the Gas to the House of Commons, and places contiguous thereto:

	£.	s.	d.
To a 400 light station meter, &c. - - - - -	60	–	–
To 3 inch valves, bends, and connections for by pass to the same - - - - - - - - - - -	9	12	6
To a 400 light governor to equalize the density of the gas at all times - - - - - - - - - -	30	–	–
To a by pass with valves and connections, as before - -	9	12	6
To 3 graduated cocks, with lever keys to regulate the height of the flames within the House, and at the windows - -	12	11	6
To labour, 6 men fitting and completing the same, say 6 days each	10	16	–
£.	132	12	6

(signed) *Thomas Edge.*

Estimated Amount of Works in progress for Testing Apparatus, &c., £. 50.

Gas Apparatus Works, Great Peter-street,
Westminster, 23 April 1852.

The pipes, cocks, branches, burners and apparatus, now in progress, leading to and in room for testing burners, hollow pyramids, and other experimental work for determining the various modes of lighting, cannot properly be estimated at a less sum than 50 *l.*

(signed) *Thomas Edge.*

App. No. 4.

ABSTRACT of Amounts connected with the Improved Mode of Lighting the House of Commons:

	£.	s.	d.
To amount of account for work already done - - -	324	9	2
To amount for station meter, governor, and other apparatus connected therewith in progress, nearly complete - -	132	12	6
£.	457	1	8
To estimated amount of works in progress for testing apparatus, &c. - - - - - - - - - -	50	–	–
£.	507	1	8

Appendix, No. 5.

COPY of Dr. *Lyon Playfair's* REPORT.

App. No. 5.

London, 28, Jermyn-street,
11 June 1850.

Sir,

IN consequence of your suggestion to the Treasury that I should examine into your method of consuming gas, and in accordance with your letter of the 26th April, I have examined into, and now report on the economical value of your several patents in use at the General Post Office.

For this purpose, I was present when your post-office purifier was opened, and subsequently the contents were carefully examined in my laboratory. The trays through which the gas is made to pass contained acetate of lead and sulphate of copper, substances well calculated to arrest sulphuretted hydrogen and ammonia. I found only such a small amount of sulphuretted hydrogen as to be unworthy of remark; but abundance of ammonia, both in the lead and copper trays, as follows:

The trays of acetate of lead contained	7·5	per cent. of dry ammonia.
The sulphate of copper, first tray	3·2 - -	ditto.
Second tray of copper - -	0·89 - -	ditto.
The two divisions of lime -	0·1 - -	ditto.

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Making together 11·69 per cent. of ammoniacal gas arrested by your purifier. Now it is well known (and I have ascertained the fact by direct experiment), that the presence of ammonia reduces to a great extent the illuminating power of gas; it follows that your process of purification tends to economise the use of gas as a light.

It was necessary to test, by careful experiment, whether your mode of burning gas increased the illuminating power at the same time that it effected a more complete combustion of the gas.

I have tested the results in every way to ensure their accuracy, and had the experiments repeated on different nights, and by various observers, so as to elicit the limit of error incident to such a class of observations; and as a mean result, I find that your burner with one of your glass combustion chambers properly adjusted according to the specification of your patent of March 1847, for the combustion of 4½ feet of gas per hour, gave a light (when consuming that quantity of gas passing through your purifier) equal to 20·75 candles burning 125 grains of spermaceti per hour; when gas not passed through your purifier, and consumed at the rate of 4 feet 7-10ths per hour was employed, the light was only equal to 18·83 candles.

The General Post-Office argand burner, consuming the same quantity of the same gas not passing through your purifier, gave a light equal only 11·05 of the same candles.

In order to test the accuracy of this result, I caused a different class of experiments to be made. The General Post Office argand burner was placed at 20 feet distance from, but opposite to your burner; each was made to burn precisely the same quantity of gas, various photometers being used, by which the respective values of the two modes of consuming gas could be accurately determined; then the photometers were equally illuminated, the distance from each burner was found to be—

	ft.	*in.*
From the General Post Office argand burner, using gas not passing through your purifier.	8	8
From your burner using gas passing through your purifier.	11	4

being an increase of light from the same quantity of gas in favour of your system 71 per cent.

Your burner, when consuming the same quantity of gas in comparison with the General Post Office bats-wing burner, gave more than double the light.

I used with your burner, in all cases, gas which had passed through your purifier, in order to obtain an approximation to the condition of the General Post Office before and after the introduction of your patents to that establishment.

The results of this examination you will at once perceive are very favourable to the economy of light introduced by you at the Post Office.

I have, &c.

(signed) *Lyon Playfair*

John Leslie, Esq.,
Conduit-street.

App. No. 5.

Sir, Conduit-street, 7 February 1848.

I HAVE obtained permission from the Postmaster-general to apply to you for a report upon the experiments now proceeding at the General Post Office under my patents for the purification of gas and improved combustion thereof, and shall feel obliged by your favouring me with your opinion on the following points: First, Has there been in consequence any improvement in the sanitary state of the offices?

Second. Has there been any improvement in the lighting of the offices?

Third. What has been the comparative amount of gas expended during the corresponding two full weeks of the experiment, and the two weeks of last year?

I am, &c.

W. Bokenham, Esq., (signed) *John Leslie.*
General Post Office.

Sir, Inland Office, 7 February 1848.

IN reply to your letter of this morning, requesting my opinion as to the experiments now proceeding in the various rooms of the inland department, under your patents for the purification of gas and improved combustion thereof,

I beg to acquaint you that there is a great and marked improvement in the sanitary state of the offices; the hot blasts of air formerly so much complained of no longer exist.

The rooms are much better lighted than they ever were before; some of the burners require a re-arrangement, and perhaps half-a-dozen more may eventually be necessary; but the goodness of the light is shown by the fact, that in the largest rooms the features of the officers on duty can be anywhere distinguished, which was not formerly the case.

The quantity of gas consumed in the two full weeks of the experiment (ending Saturday last) is 371,050 feet, being 115,640 feet less than in the corresponding weeks of last year, notwithstanding in the interim two large additional offices have been added.

I am fully satisfied with the trial that has been made, and it is my intention to recommend the general adoption of your system throughout the Post Office department.

I am, &c.

J. Leslie, Esq., (signed) *W. Bokenham,*
Conduit-street. Superintending President.

RETURN showing the Consumption of Gas in the General Post Office within the undermentioned periods:

YEAR ended 5 January 1848, 8,707,700 feet cost 3,047 *l.* 13 *s.* 10 *d.*
Week ended Saturday, 30 January 1847, 242,150 feet.
Week ended Saturday, 29 January 1848, 188,620 feet. Decrease 53,530; saving 18 *l.* 14 *s.* 8½ *d.*

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Week ended Saturday, 6 February 1847, 244,540 feet.
Week ended Saturday, 5 February 1848, 182,430 feet. Decrease 62,110; saving 21 *l.* 14 *s.* 9 ¼ *d.*
Saving in the two weeks 40 *l.* 9 *s.* 5 ¾ *d.*
Estimated saving for one year, 724 *l.* 3 *s.*

(signed) *W. Bokenham,*
Superintending President.

Inland Office,
7 February 1848.

Appendix, No. 6.

App. No. 6.

REPORT on the WARMING and VENTILATION of the HOUSES OF PARLIAMENT; addressed to the Select Committee of the House of Commons on VENTILATION and LIGHTING, and prepared at their request.

HAVING had the honour of being examined before your Committee, having heard the greater portion of the evidence given by other witnesses, and having inspected the two systems of Warming and Ventilation adopted for the Houses of Parliament, we respectfully submit the following Report to the consideration of your Committee.

Among the principal defects in the present systems of Warming and Ventilating the Houses of Parliament, three may be specified as demanding the gravest consideration:

First. The general supply of atmospheric air to the Houses, which is insufficient in quantity;

Secondly. The nature of the temperature, which is irregular and conflicting; and,

Thirdly. The quality of the air, which is so inferior as to be unfit for respiration.

It naturally follows, and such indeed are the actual complaints urged against the present systems, that

The interior temperature of the Houses is frequently either too hot or too cold. That the ventilation is most commonly insufficient, and at other times excessive. That there is a prevalency of unpleasant odours. That the effect of the general atmosphere of the building is to excite sensations of closeness and oppression; and, in short, that there is nearly a total absence of that consciousness of elasticity and freshness which is incident to the breathing of the natural atmosphere.

In seeking for the grounds of these complaints, and the sources of these great and undoubted defects, we have arrived at the conclusion that

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that the insufficiency of the general supply of air to the Houses arises in a great measure from the imperfect and conflicting arrangements which have been made for the ingress of the fresh air, and for the egress of the foul air.

A large and excessive amount of mechanical power is doubtless provided for propelling the air through the channels constructed for its transit, and a corresponding power is provided for extracting the vitiated air; but before it reaches its destination, which is the interior of the Houses of Lords and Commons, Committee-rooms, &c., its progress is impeded by the mechanical hinderances of a countless number of minute, wire-drawing, and friction-creating orifices in the shape of perforated iron floors, porous hair carpets, and other contrivances; and its intended operation is obstructed by arrangements which violate both scientific and natural principles, and even reverse the intention of the inventors, by carrying off at the ceilings the air that should descend to the floors, and drawing off at the floors the air that should ascend to the ceilings.

The irregularity and contrariety of the temperatures are occasioned by the unsuitableness of the motive powers employed for moving the air through the Houses, and the numerous and contrary operations performed upon the air with a view to attemper and otherwise prepare it for the use of the Houses; first, inflicting upon it a wetting process, then a drying one; secondly, overheating it, then cooling it; and lastly, mixing, or rather attempting to mix intimately two distinct currents of air at different temperatures, both being propelled in parallel currents with considerable velocity.

The remaining, and certainly the greatest and most serious defect of the three, the bad and unwholesome quality of the air supplied to the Houses, chiefly arises from the very unsuitable and impure character of the air passages, by which we mean the large subterranean vaults and other channels through which the atmospheric air is compelled to travel from its first descent down the Clock and Victoria Towers to the interior of the Houses of Lords and Commons, Committee-rooms, &c.

The damp and mouldy state of the surfaces of those vaults, and the large amount of extraneous and contaminating materials, and even persons, that are to be found in those and the other channels for air destined for the use of the Houses, abundantly reveal the source of much of the deterioration and injury suffered by the air in its passage merely through these interior thoroughfares.

There is likewise an extensive contamination of the general atmosphere of the building proceeding from numerous other sources, which, although they operate but indirectly upon those apartments immediately surrounding the Houses of Lords and Commons, yet materially tend to aggravate the effect of those specific and more direct influences to which we are here adverting.

We allude in particular to escapes of gas, leakages of steam, smell of oil and jointings of pipes, suffocating atmosphere of the engine room, emission of noxious fumes from open coke fires, and generally the impure atmosphere of the numerous unventilated, or, at all events, ill ventilated, passages, staircases, &c., which exist in all directions.

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One purpose of the present communication being to present to your Committee, in few and concise terms, the nature of the principal errors committed in devising and executing the systems of warming and ventilation for the Houses of Parliament, and of the remedies that should be applied to them, we designedly restrict ourselves to the foregoing heads, and not because there are not many more, and those very substantial objections, to be raised against other mistakes of principle and practice which have been committed, but because we presume that in respect of any system which does not thoroughly and successfully deal with conditions of such obvious importance as purity and wholesomeness of atmosphere, and equality and uniformity of temperature, it must plainly be matter of very secondary consideration how many or how few of the inferior requirements may be fulfilled.

Accordingly, we will now proceed to the suggestion of those remedies for the evils and annoyances which we have selected for the subject of this Report, to which we desire to ask the consideration of your Committee.

We recommend, in the first place, that the present practice of moving the air through the Houses by mechanical power only should be abandoned, and that for the future the chief reliance (except in the summer months) should be upon the natural power of the spontaneous upward movement.

Secondly. That the downward movement of the air currents shall be entirely abandoned, and with this "noxious fallacy" should also be relinquished the fallacious attempt to produce and sustain such opposite and contrary forces as the plenum and vacuum principles of ventilation in the same rooms and at the same time.

Thirdly. All the present air passages, whether for the transit of fresh or foul air, should be reconstructed, or at all events so remodelled as to combine in one appropriate and uniform system a series of free and unobstructed, but closed, air channels, arranged in strict accordance with the natural upward tendency of warm air currents, and framed with a scrupulous regard to the greatest possible uniformity of form, and by a rigid observance of those definite and proportionate relative areas between the main and branch flues, without which we do not hesitate to assert that no system of ventition, however skilfully devised in other respects, can be protected from those adverse and disturbing influences which must peril the success of any scheme whatever.

Fourthly. We advise that the use of steam at 230°, or even 212°, as a medium of heat for giving temperature to the air-warming surfaces, should be abandoned, and hot water, at a maximum heat of 170°, be substituted. Steam over-heats and over-dries the air, and admits of no gradual control over the extensive range of temperature that lies below 212°. Hot water can be employed at any desired degree of heat below the boiling point, and admits of the most minute and gradual control over that range of temperature which lies below the degree of 212; a point of the utmost importance in relation to one of the most essential requirements of the House of Commons; and hot water

water likewise affords a most ready and simple means of imparting moisture to the air in correction of any undue state of dryness, whether arising from the operation of artificial warming, or a state of absolute dryness in the natural atmosphere itself; a question this of considerable interest, when it is remembered that the capacity of air for moisture is doubled by every 27° Fahrenheit increase of temperature; when, as is also known, that the most salubrious state of the air is when the dew-point is not less than 10° nor more than 20° below the temperature of the room. And, moreover, when, as is likewise understood, that evaporation tends to relieve the unpleasant effects of imperfect ventilation, by producing positive electricity of the air, and by adding moisture, renders it a good conductor of atmospheric electricity, while dry air, on the contrary, is an extremely bad conductor.

Fifthly. We recommend that the air-warming surfaces should be vertically, and not horizontally arranged, and that they should be so altered from their present form as to spread out the air and water in thin and numerous alternating streams; the first condition being essential for the full and free development of the natural ascending movement, and the second material for the rapid abstraction by the cold air of the caloric of the heated water. These features of the warming surface also involve another important element of good ventilation, namely, concentration of large power within a moderately small space.

Sixthly and Lastly. We advise that in the manipulation of any system provided for warming and ventilating the Houses of Parliament, that the attempt—the worse than useless attempt—to meet the continual and conflicting wishes of individual Members in respect of temperature, should be discountenanced; for we are convinced that the operation of no system whatever, however perfectly carried out, can be made generally satisfactory under such a course of proceeding. Neither are any such futile attempts necessary, nor, if practicable, are they advisable. On the other hand, we beg to represent to your Committee, in the strongest possible manner, that in our deliberate opinion, a course the very opposite should be pursued; which is, that the great aim of the person in charge of the ventilation of the House, should be to avoid all changes and fluctuations in the ventilating power whilst The House is sitting, and never to practise any sudden and perceptible changes in this respect during that period. There are doubtless certain contingent circumstances bearing on this point, as also upon the temperature of the House, which are of ordinary occurrence, and we will cite one to which, by common consent, the greatest degree of importance is attached, namely, that adjustment of the rate of ventilation which is supposed to be, and of the degree of temperature which really is imperative, from the sudden and large fluctuations which take place in the number of Members present at the same time in the House; small numbers tending to a depression of temperature, and large numbers causing an inconvenient elevation.

Now most certainly, the way of meeting this contingency is not by suddenly raising or suddenly lowering the temperature of the House 5° or 10°, nor by, with equal suddenness, reducing or increasing the ventilation; since both these courses produce strong

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sensations of heat and cold, and powerful impressions from altered velocity of the air-currents.

These fluctuating demands must assuredly be answered, but it ought to be by some simple and gradual process; not by opening or shutting an indefinite number of ingress and egress air-valves, nor by the projection into the House of forcible and successive hot and cold currents of air, but by permitting all the ingress and egress valves to remain undisturbed, by making no change whatever in the amount of ventilation, that having been properly determined before the sitting of The House; but by simply and gradually effecting those changes of temperature in the warming power which, without augmenting or diminishing the renewal of air, will in a sufficiently short space of time accomplish the desired end, whether that be to meet the demand arising either from a sudden increase or an equally sudden decrease of the number of Members in the House. It is on this principle and according to this mode of proceeding that we are accustomed to act in our own private practice, and we have therefore adequate experience of the results, and are well persuaded that there is scarcely any one point connected with the present inquiry before your Committee, that might be made more conducive to the comfort and convenience of The House: and this being our opinion, it will also, we trust, be our apology for dwelling upon the point with so much prolixity.

We beg to conclude by remarking, that between the two systems adopted for warming and ventilating the Houses of Parliament, the only essential difference we have been able to discover in them is, that in the system applied to the House of Commons' corridors, &c., the real exigencies of ventilation are sacrificed to exaggerated and fanciful views of the actual requirements of the House, and that in the system applied to the House of Lords and remainder of the Houses, the requirements of ventilation are sacrificed to the real or supposed exigencies of the structure; and in reference to the points of resemblance between the two systems, we may observe, that they consist in the application of a similar profusion of power with the same poverty of results, a mutual creation of difficulties for the same apparent purpose of contending with them, but with equal want of success, a similar setting aside of natural and inexpensive agencies, and the like taking up of artificial and costly machinery; and, lastly, they exhibit an analogous complexity of arrangements with corresponding confusion of management.

(signed) *S. W. Daukes*, Whitehall Place.
H. C. Price, Derby Street, Westminster.

Appendix, No. 7.

TO the Right Honourable and Honourable the Chairman and Members of the Committee for WARMING, VENTILATING, and LIGHTING the HOUSE of COMMONS.

My Lord, my Lords and Gentlemen, 27 April 1852.

IN case this Committee should close its sittings at a time when I may be absent, I most respectfully submit, as shortly as possible, the ideas which would have been elicited had I been examined at the first.

I assume that the present mode of heating, ventilating, and lighting the Houses of Parliament is objectionable, or this inquiry would not have been instituted.

Having sent in a design for the House of Commons in 1833, and for the Houses of Parliament in 1836, the subject has necessarily occupied my attention and study.

It appears to me that the result to be obtained by this Committee hinges upon the Committee's opinion of the ascent or descent of the products of combustion and respiration. I unhesitatingly affirm that these products ascend: that carbonic acid gas, as found in coal-mines or in wells, is heavier than atmospheric air, has long been ascertained; but it is probable this gas is never found in an uncombined state, or rather in noxious quantities at the surface of the earth; for if it were so existing, then would the basement floors of our houses be uninhabitable, and the Thames Tunnel would be impassable. On the contrary, that it ascends is proved by the smoke from our chimneys, by the air in a crowded church or theatre being far more agreeable on the floor than in a gallery, and far more agreeable in the open space than beneath a gallery; further, if in a room on fire you remain upright, you will be suffocated; whereas if you creep along the floor, you may breathe in comfort. Moreover, if in frosty weather we see the breath and sweat of horses ascending into the air, we may confidently assume that the emanations of our bodies are combined with sufficient caloric and aqueous vapour to carry them to the top of any room. How unwholesome, therefore, and destructive to health must be the attempt to bring in fresh air by a ceiling, and thus cause these emanations to be breathed or inhaled over and over again! A mode of ventilation like this, which shuts out all ingress of air except through certain tortuous passages, which alters the natural course of our vital support, however it may be admirable as showing the power of mind over matter, is highly objectionable in practice, placing the human beings subject to its operation exactly in the situation of so many mice under the bell of an air-pump, with just as much or as little air as the operator chose to afford them. But living as we do, immersed in a subtle fluid, there

are

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are physical impossibilities against the complete development of such a system, and hence it must ever be unsatisfactory.

Nor is this all; for both in the House of Lords and in the House of Commons, provision being made for bringing in air from the top, from the bottom, and from the sides, commingling together like the waters of a Maelstrom, up and down and round and round, the air is in that state of commotion that the sound of the voice cannot radiate. Throw a stone into the placid waters of a lake, and the effect will be seen in a series of concentric circles. Sir Isaac Newton says, that sound is communicated in a similar manner; but throw a stone into a Maelstrom, and no such effect can be produced; hence the acoustical property of the Houses is rather destroyed by the mode of ventilation than by architectural defects.

In addition to the inconveniencies which are felt, I apprehend it is capable of proof that the expenditure incurred in carrying out false principles has been nearer 300,000*l.* than 200,000*l.*, and that their maintenance involves a cost of some thousands of pounds a year, while the remedies which I propose may be effected at the cost of a few hundred pounds, and be kept in operation at an expense of about hundred pounds a year.

Having asserted a broad and distinct principle, these remedies will be easily understood and easily executed.

The officers of the Houses complain of the draughts of air sent upon them in their apartments. And no wonder; for, like those persons waiting in the corridors, all are blown upon or are stifled, without any power to help themselves. Now, it is clear the chief of every office should have the right of admitting as much or as little air as he finds agreeable; and this, by a simple arrangement of the fire-place, at a cost not exceeding 5*l.* to each room, and by stopping up the holes in the ceiling, with the addition of casements to the windows, I could easily put into his power.

So, also, in the Committee-rooms, a man, as Lord Bacon says, does not know where to "become" to be out of the draughts, besides having the unpleasant notion that he may be inhaling the air just emitted from another person's lungs; a similar arrangement as that just recommended for the office fire-places may be made at an expense not exceeding 5*l.* for each room, reserving the holes in the ceiling for the exit of foul air, and adding a hot-water pipe to the transom of the windows. So perfect would be this ventilation, that as soon as it was brought into operation in this noble pile of buildings, every palace, every public office, and every good house would be fitted in like manner, thereby adding many years to the lives of the occupants, and health and comfort to those lives.

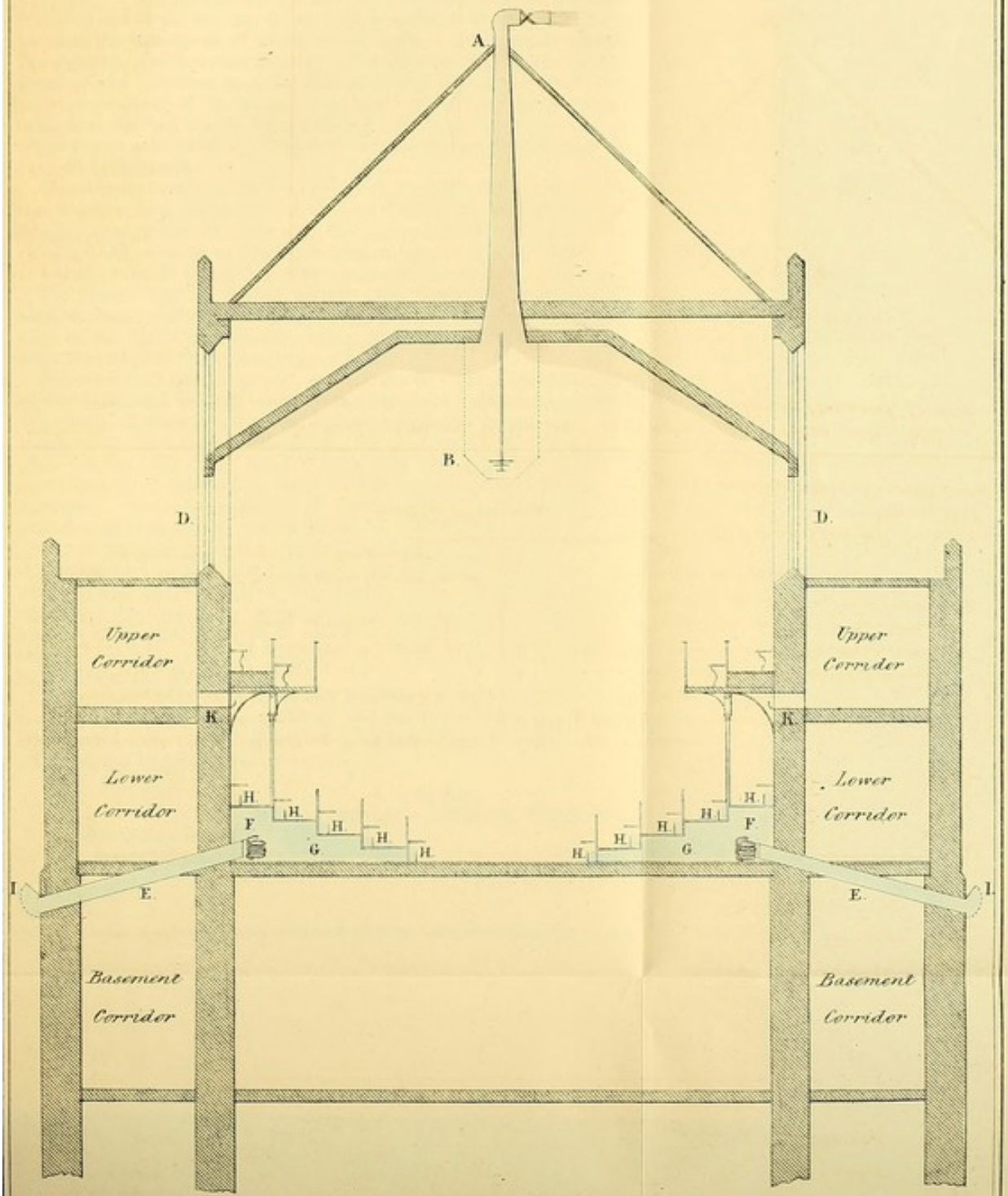
Let me now entreat your attention to the accompanying diagram or section of the House of Commons, explanatory of what I would suggest as the best mode of ventilating and lighting that House.

Both the House of Lords and the House of Commons being beautifully arranged for ventilation, I would introduce an air-shaft four feet by one foot beneath each window on each side of the House, the outer end of such shaft (having a valve to regulate the admission of air) opening into one of the courts, the other end opening into the House at six inches above the floor beneath the graduated seats. In front

[To face page 370.]

SECTION OF THE HOUSE OF COMMONS.

Exhibiting the Natural System of Ventilation.



A. *Section of one of the Six Ventilating Shafts, with Cowl for the exit of Foul Air.*

B. *One of the Six Clusters of Gas-lights, each with five plates of thin pale blue glass, 2 feet square.*

D.D. *Casements for night filled in with plates of pale blue glass.*

E.E. *Air-Shafts, 3 ft. × 1 ft., one beneath each window, for the entrance of fresh air.*

F.F. *Coil of Hot-water pipe, or Hot-water plates, by which the air will be warmed to any desired temperature.*

G.G. *Air Chamber.*

H.H.H.H. *Air-boxes, from which the air passes into the House.*

I. I. *Valves, which may be fixed open at any angle.*

K.K. *Ten Lights on each side of the House, communicating with the open air, or the Corridors. The panel of the Sounding Board in front to be filled in with glass.*

Scale ¼ of an inch.

William Bardwell, Architect.
March, 1852.
4 Great Queen Street, St. James's Park.

J. Basire, Lith.

No. 402. Ordered, by The House of Commons, to be Printed, 24th May 1852.
Henry Hansard, Printer.

App. No.

front

front of this opening must be placed a coil of hot-water pipe; the shafts must be near the ceiling of the lower corridor slanting upwards; the fresh air would then be constantly flowing into the air-chamber (see section), be warmed on entering to any desirable temperature, pass into the House through boxes opening about six inches below the seats; it would then rise upward, carrying with it all exhalations, and pass out at the ceiling, its exit being assisted by the centre gas-burners, the chimneys of which would enter a close shaft running through the roof into the open air. The floor of the House and the floors of the corridors must be laid with tiles, not only to assist the acoustic property of the House, but also to preserve the Members from dust and bad smells, by cutting off all communication with the chambers or vaults below. The floor beneath the rising seats may be covered with boards.

That the air on the surface of the earth is sufficiently pure for the maintenance and promotion of robust health, is proved by the healthy appearance of hawkers, of the sellers of fruit and fish, of the omnibus and cabmen, of the Park-keepers, and of the watermen, all of whom probably at night occupy close and ill-ventilated lodgings.

The House may be lighted equally and uniformly in every part, without heat, without shadows, and with the pure white light of day, in the following manner, using glass just sufficiently tinged with blue to alter the yellow rays of light.

One cluster of gas-burners in each of the five great compartments of the horizontal ceiling, each cluster to have a dish composed of five plates of glass, each 2 feet square, suspended beneath it. The windows to have double casements, the one containing the present glass for day, the other filled in with pale blue glass for night, to open and shut alternately, and to have gas-burners outside the windows. Ten of the panels of the sounding-board beneath the galleries on each side of the house to be removed and filled in with glass, to have a gas-burner behind forming an illuminated panel, the space to communicate by pipes with the open air, or with the corridor, and not at all with the House. Thus no one would ever come into the House for the purpose of lighting it; the centre gas-burners being always alight to assist ventilation, the light is instantaneously heightened by turning a cock; while the other burners are lighted from the outside.

The notes of which this letter is a condensation, were written some time ago; the result of years of toil, and study, and thought. I may add, that I have not heard anything in this Committee that will at all cause me to alter these opinions.

I have, &c.
(signed) *William Bardwell.*

4, Great Queen Street,
St. James's Park.

App. No. 8.

Appendix, No. 8.

COLNEY HATCH LUNATIC ASYLUM.

Each apparatus warms a division of the asylum, containing 350,000 cubic feet of space, and sustains the whole at a temperature of 60°, the maximum temperature of the warming surface never exceeding 160°. The cost of working each apparatus, inclusive of fuel, labour, and management, amounts to 48*s.* per week, of seven days, which, from the admitted fact, that for a long period a great part of the power of the apparatus is expended in drying the new building, irrespective of the consumption of fuel, for the purposes of maintaining temperature, therefore, judging from the usual experience in such matters, the ultimate cost will not exceed 30*s.* per week.

S. W. Daukes.

Appendix, No. 9.

App. No. 9.

Public Buildings Warmed and Ventilated by Mr. *H. C. Price.*

Colney Hatch Lunatic Asylum.
The Wilts County ditto.
The Lincoln County ditto.
The Leicester and Rutland ditto.
The Oxford and Berks ditto.
The Bucks County ditto, in progress.
The Usk County Prison.
The Leicester ditto ditto.
The Oxford ditto ditto.
The Small Pox Hospital, Highgate, in progress.
The Naval Hospital, Chatham.
The Fever Hospital, Bedford.
The County Infirmary, Derby, New Buildings.
The Brecon County Courts.
The Derby Diocesan Training Institution.
The Chester ditto - ditto.
The Rochester ditto - ditto in progress.
The Oxford ditto - ditto ditto.
The Marlborough Clergy College.
The Cirencester Agricultural College.
The Admiralty Department, Somerset House.
The Rolls Court and Chapel.
The Institution of Civil Engineers.
The Indigent Blind School.
The Insolvent Debtors' Court.
Windsor Castle.

Appendix, No. 10.

App. No. 10.

House of Commons, Committee Room, No. 9,
10 May 1852.

My Lord,

We, the undersigned Members of the Committee of the Nene Navigation Bill, sitting in No. 9 Committee Room, must complain of the very imperfect state of the ventilation in that room, and of the very offensive state of the atmosphere in consequence of such bad ventilation.

B. Hall, Chairman.
Villiers.
Guernsey.
J. Dawson Rawdon.
James Baird.
George Manners.
Edwd. Fellowes.
Eliot Yorke.

Right Hon. the Lord Robert Grosvenor.

Appendix, No. 11.

The Date and Terms of the Engagement of Dr. *Reid*, as Ventilator of the New Palace at *Westminster*.

—No. 1.—

Letter from Viscount *Duncannon* to Viscount *Melbourne*.

My Lord, Bessborough, 30 October 1839. App. No. 11.

I am anxious to draw the attention of yourself and the Chancellor of the Exchequer to a subject of considerable importance, before any progress is made in building the two Houses of Parliament, in reference to the warming, lighting, and ventilating them. There can be no doubt of the wish expressed by the Committee of The House of Commons, and the subsequent declarations of The House itself, that Dr. Reid must be employed to carry into effect these important objects; and in that conviction it is necessary that some arrangement should be made with this gentleman, as I am confident, from the experience I have had for the last three years, that it will be absolutely necessary to have his constant superintendence during the progress of the works, in order to secure success in the operations, and to prevent unnecessary alterations, which have tended to so much expense in the temporary houses. The extent of the frontage of the new building will exceed 900 feet, and I need hardly inform your Lordship that if the necessary steps are not taken for the introduction of air and water-pipes, and great care taken, that the attempt at a proper ventilation must fail.

Since

App. No. 11.

Since Dr. Reid has been employed his attendance has frequently been required in London, and he has been under the necessity of leaving his many important avocations in Edinburgh, and his remuneration has caused a considerable expense for the casual visits, without securing to the public the constant superintendence so necessary to works of this description. I must here observe also, that during the last year Dr. Reid has been directed to ventilate the temporary House of Lords, and I have no doubt that his attendance in London will be necessary for this work also during part of the next Session. I have had some communication with Dr. Reid lately on the subject of his residence in London during the Session of Parliament, and constant superintendence of the ventilation of the temporary Houses, and the progress of the works in the new Houses of Parliament; and though I cannot at present name any actual sum, I feel convinced that Dr. Reid's services might be secured, and that he might be induced to leave Edinburgh for a sum not much exceeding that which has been paid him in the last three years for his casual visits. Under these circumstances, if it should appear to your Lordship and the Chancellor of the Exchequer, as it does to myself, for the reason I have stated, that Dr. Reid should be induced for some years to reside in London, I would suggest that I may be authorized to treat with him, and to engage his services at a sum not exceeding 500 *l.* per annum.

I have, &c.
(signed) *Duncannon.*

— No. 2. —

LETTER from Viscount *Melbourne* to Viscount *Duncannon.*

My Lord, Downing-street, 9 November 1839.

I HAVE consulted with the Chancellor of the Exchequer upon the subject of your letter of the 30th ultimo, and we are both of opinion that it will be of advantage if you can make such an arrangement as you propose with Dr. Reid.

And remain, &c.
(signed) *Melbourne.*

— No. 3. —

NOTE from Viscount *Duncannon* to Viscount *Melbourne.*

Office of Woods, &c., 28 November 1839.

LORD DUNCANNON presents his compliments to Lord Melbourne and the Chancellor of the Exchequer, and informs them that he has entered into an agreement with Dr. Reid, subject to their approval, for his superintendence of the works in the present Houses of Parliament, for the proper warming and ventilation of the building, and for superintending the works that will be necessary for the same purpose in the new Houses of Parliament, during the whole progress of the works, and for one Session of Parliament after their completion, for the sum of 500 *l.* per annum.

— No. 4. —

(17,379.)

LETTER from *G. J. Pennington*, Esq. to the Commissioners of Her Majesty's Woods, &c.

Treasury Chambers,

My Lord and Gentlemen, 27 December 1839.

VISCOUNT DUNCANNON having represented to Lord Melbourne and the Chancellor of the Exchequer that he has entered into an agreement with Dr. Reid, subject to their approval, for his superintendence of the works in the present Houses of Parliament, for the proper warming and ventilation of the building, and for superintending the works that will be necessary for the same purpose in the new Houses of Parliament, during the whole progress of the works, and for one Session of Parliament after their completion, for the sum of 500*l.* per annum, I am commanded by the Lords Commissioners of Her Majesty's Treasury to convey to you their authority for carrying this agreement into effect.

I am, &c.

(signed) *G. J. Pennington.*

— No. 5. —

LETTER from *A. Milne*, Esq. to *C. Barry*, Esq.

Sir, Office of Woods, &c., 16 January 1840.

ARRANGEMENTS having been made by this Board, under the sanction of the Lords of the Treasury, for placing the ventilation of the Houses of Parliament in charge of Dr. Reid, I am, on behalf of the Board, to desire that Dr. Reid may receive from you from time to time, as the architect of the building, such assistance as he may require in regard to the plans which have been prepared under your inspection for his use, and that generally, in order to second as much as possible the objects which have induced the Government to select Dr. Reid for the superintendence of this important service, you will in all matters of detail connected with the structure and arrangements of the new buildings afford him every requisite facility and assistance in carrying it into effect.

I am, &c.

(signed) *A. Milne.*

— No 6. —

LETTER from *A. Milne*, Esq. to Dr. *Reid.*

Sir, Office of Woods, 16 January 1840.

WITH reference to the communications which have been made to you on the subject of your engagement under this Board, to superintend the ventilation of the Houses of Parliament, and to the plans which Mr. Barry has been directed to furnish for your use, in connexion with the subject of such ventilation, I have, on behalf of the Board,

to

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to transmit to you copy of a letter which has been addressed to Mr. Barry, acquainting him with the service on which you are to be employed, and desiring that, as the architect of the new buildings, he will afford you every requisite facility and assistance in carrying it into effect.

I am, on the other hand, to direct your attention to the progress which has been made and is now making in the erection of the new Houses, and to impress upon you the expediency from time to time of making such arrangements with Mr. Barry on points involving any interference with the structure of the building as shall at the same time secure the best means for giving effect to your plans, and render any recourse to alterations and extra works unnecessary.

I am, &c.
(signed) *A. Milne.*

— No. 7. —

LETTER from *A. Milne*, Esq. to Dr. *Reid*.

Sir, Office of Woods, &c., 24 January 1840.

THE Chief Commissioner of this Board having laid before his colleagues a correspondence in which he has been recently engaged with you on the subject of the adoption of your plans for warming and ventilating the Houses of Parliament, and also certain letters which have passed between Lord Melbourne, the Chancellor of the Exchequer, and himself, on the same subject, I have to acquaint you that the Board will consider the warming and ventilation of the Houses of Parliament (both those which are now in use and those which are in course of erection), to be in charge with you from the 1st April next, and to continue so in charge until one whole Session shall have elapsed after the completion and occupation of the new Houses.

The sum which Lord Duncannon has recommended, and which the Lords of the Treasury have sanctioned, as the remuneration for your services in this matter, is 500*l.* per annum, and this sum will be paid to you at this office quarterly, or otherwise, as you may desire.

In the discharge of the duties vested in you by your engagement, the Board will expect you to be in London, and in attendance at both Houses during the sittings of Parliament, and that your attention also shall be given generally to whatever services the Board shall consider requisite, in connexion with the warming and ventilation of both the present and the future buildings, for such further periods between the sittings as circumstances shall appear to the Board to require.

During the intervals which may elapse between the meetings of Parliament, the Board, as you are aware, must in great measure be guided by the requisitions of Mr. Barry, the architect of the new buildings; and the Board will require, therefore, that you keep yourself from time to time in communication with him, duly advise him of your plans, and in any arrangements which you may feel it to be your duty to suggest for his consideration, anticipate as far as practicable the progress of the works under his direction.

It

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It is scarcely necessary for the Board to suggest to you, that the authority for and the direction of your proceedings will at all times emanate from this Board, but that the reservation of this control is intended to apply to cases only in which a difference of opinion may arise between yourself and Mr. Barry; and that, as a general principle, without appealing to the Board, you must defer to him upon all points affecting either the solidity or the architectural character of his building.

I am to request your early attention and reply to this letter, and am,

Sir, &c.
(signed) *A. Milne.*

— No. 8.—

(18,406.)

Letter from Dr. *Reid* to *A. Milne*, Esq.

Sir, Edinburgh, 15 February 1840.

I have to acknowledge your communication of the 24th ultimo, stating the terms on which the Right honourable the Chief Commissioner and the Board have agreed to employ me in superintending the ventilation and the warming of the present and the new Houses of Parliament, and detailing the various duties which will consequently devolve upon me; and I hereby agree to undertake the duties therein specified according to the terms proposed, presuming, from the various communications that have already taken place, that I am not mistaken in understanding that the Board concurs in the following points:—

I. That though the term of my engagement commences on the 1st of April, I shall not be required to attend personally in London till the 1st of May, as my classes do not conclude till the last week in April. In the meantime, however, I shall devote all the spare time in my power to the daily reports of the ventilation of the present Houses as they are forwarded to me from London, and to the consideration of the plans for the new Houses.

II. That I shall be at liberty to follow in London my ordinary professional engagements, in the same manner as I have done at Edinburgh, so far as they do not interfere with my duties at the Houses of Parliament.

III. That during the autumn or beginning of the ensuing winter I shall be permitted such leave of absence by the Board, if arrangements can be adjusted for this purpose, as may enable me to make an investigation into the state of the ventilation, &c., of public buildings in some of the principal cities of the South of Europe, similar to that which I completed a few years ago in the North of the Continent.

IV. That in consideration of the nature of my engagements at the Houses of Parliament, and the large portion of time that I shall require to spend there, more especially during the meetings of Parliament, I shall have the advantage of such

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temporary accommodation as it may be found convenient to allow me, when, from the progress of the works, it will be necessary for me to leave the apartments which I occupy at present in Abingdon-street.

I have, &c.
(signed) *D. B. Reid.*

My Lords, Office of Woods, &c., 13 July 1844.

In February last we received from Dr. Reid a letter, calling our attention to the existing state of his arrangements for the warming and ventilation of the New Houses of Parliament, and acquainting us that some of these arrangements could not be satisfactorily adjusted till provision should have been made for the new system of lighting. Your Lordships are aware that the lighting of the temporary Houses had been placed by the Serjeant-at-Arms in the hands of Mr. Gurney, but the contract with him having expired with the previous Session, Dr. Reid, at Sir William Gosset's request, undertook, from the commencement of the present Session, the supervision of the arrangements under which the Houses are now lighted.

Upon the suggestions of Dr. Reid, in reference to the lighting of the New Houses of Parliament, we placed ourselves in communication with Mr. Barry, and we ascertained the opinions of that gentleman to be in entire concurrence with our own, viz., that as the warming, ventilating, and lighting of the New Houses must be intimately connected with, and to a certain extent dependent upon, each other, it would manifestly conduce to the public advantage that Dr. Reid's professional knowledge, and his long practical attention to those objects should, in connexion with his existing engagements, be made available on this occasion.

We desired Dr. Reid, therefore, to furnish us with a report as to the system of lighting which should, in his opinion, be adopted, and a copy of his reply accompanies this letter. On perusal of his observations, your Lordships will perceive the prevalence of a very decided opinion as to the medium to be employed in the lighting of the New Houses; but the result of his report, as regards the purposes of our present application to your Lordships, is, that while he has not seen any system of lighting approaching that of gas in perfection, in facility of management, in equality of action, in economy, and in the endless modifications of which it is susceptible, yet that numerous improvements are daily presenting themselves in details, as to the mode of production, the materials from which gas may be produced, and the methods by which it may be applied, and that, on the last mentioned of these points especially, it would, on obvious grounds, be essential to have the requisite experiments put in progress in connexion with, and pending the occupation of the present Houses.

As some of these services were of a nature which, from the progress already made in the erection of the new building, it became necessary that between Dr. Reid and Mr. Barry there should be the earliest possible understanding, we gave authority to Dr. Reid, in April last, to

to communicate with that gentleman, and to take all such preliminary measures as they might consider to be immediately necessary in reference to the lighting of the new buildings. For the prosecution of these services, however, upon the basis suggested in Dr. Reid's Report of the 18th of March last, it is necessary that we should have the authority of your Lordships' Board, and especially, we may mention, for the employment of Dr. Reid, whose existing engagements, as your Lordships will be aware, are limited to the services of warming and ventilating only, and whose attention has been given to these services at a sacrifice of time, and of other professional engagements, which was never contemplated in the terms of his original engagement, and which we have reason to believe have deprived him of that profitable employment of a portion of his time to which he looked for the means of supporting his family.

The sum to which, under that engagement, Dr. Reid is entitled in respect of the warming and ventilation only is 500*l.* a year, payable while the Houses of Parliament are in progress, and for one complete year after they shall have been occupied for public business; and, considering the lighting to be a subject at least fully equal in importance and responsibility to either of these services, and that under no other arrangements could the public interests be so effectually promoted as by placing it, with them, also under the superintendence of Dr. Reid, we think that 250*l.* per annum would be no more than a fair equivalent for this addition to his duties, or 750*l.* for the whole.

If your Lordships should concur with us in the opinions we have herein submitted, we have to request that we may be furnished with your Lordships' authority for retaining Dr. Reid's services, and that the payment of the 250*l.* per annum should take effect from the 5th of April last, his attention having been directed to the subject, as your Lordships will perceive, for some time previously.

We are, &c.
(signed) *Lincoln.*
A. Milne.
C. Gore.

The Right Hon. the Lords Commissioners
of Her Majesty's Treasury.

Treasury Chambers, 29 July 1844.

My Lord and Gentlemen,

HAVING laid before the Lords Commissioners of Her Majesty's Treasury your communication dated the 13th instant, I am commanded by their Lordships to convey to you their authority for placing the arrangements connected with the lighting of the New Houses of Parliament under the superintendence of Dr. Reid, and for paying to that gentleman an additional annual allowance of 250*l.* as submitted by you.

I am, &c.
(signed) *C. E. Trevelyan.*

The Commissioners of Woods, &c.

App. No. 12.

Appendix, No. 12.

TEMPERATURES at the House of Commons, taken by the Messenger appointed by the Serjeant-at-Arms, on the 12 days on which The House sat immediately preceding the Easter Recess, and on the first 12 days on which The House sat immediately after the Easter Recess. —1852.

In those few places where Temperatures are not inserted, the Thermometers had been removed without authority, or were inaccessible from the number of Members in their vicinity.

HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery.	Speaker's Gallery.	Members and Strangers present.
March 22d.						
4	64	65	65	65	- -	200
5	66	68	66	66	- -	360
6	66	68	67	67	- -	300
7	65	69	69½	69½	- -	250
8	64	69	69	70	- -	200
9	64½	69	69½	69½	- -	250
10	64	68	70	70	- -	200
11	64½	68	70	70	- -	200
12	65	69	69	69	- -	200
1	64	68	71	71	- -	160
March 23d.						
4	65	66½	66	66	66	260
5	66	68	69	69	71	200
6	65	68	69	70	72	200
7	65½	68	69	70	72	230
8	64	68	69	69½	71	140
March 24th.						
12	62	66	63	62	- -	150
1	66	64	63	- -	- -	160
March 25th.						
4	62	65	65	64	66	200
5	63½	65½	65	65	67	300
6	63	65½	66	66	67½	250
7	63	66	68½	68½	69	200
8	64	67	70	70	71	250
9	64½	68	71	71	71½	250
10	65	68	71½	71½	72	300
11	66	68½	72	72	73	460
12	67	69	72	72	- -	460
1	67	69	72	72	- -	100

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HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery.	Speaker's Gallery.	Members and Strangers present.
March 26th.						
4	62	63	65	65	66	200
5	63	64	65½	65½	66½	250
6	63	65	68	68	69	250
7	63	66	69	69	69½	250
8	63	67	69	69	69	250
9	63	67	69	69	69	200
10	63	67	69	69	69	200
11	63	68	70	70	70	200
12	63	68	70	70	71	200
1	64	68	70	70	71	100
March 29th.						
4	62	65	63½	64	- -	250
5	63½	67	64½	65	- -	300
6	63½	69	69	69	- -	400
7	63	68	69	69	- -	400
8	63½	68	69½	69½	- -	350
9	63	67	70	70	- -	400
10	63	67	70	70	- -	350
11	63	68	70	70	- -	400
12	63½	69	70	72	- -	400
1	64	69	70	72	- -	100
March 30th.						
4	64	66	66	66	- -	200
5	64	67	68	68	- -	250
6	64½	69	70	70	- -	260
7	65	70	72	72	- -	200
8	64	70	71	71½	- -	170
9	64	70	71	71½	- -	250
10	64½	70	72	72	- -	300
11	65	70	72½	73	- -	500
12	67	70	72	73	- -	500
March 31st.						
12	63	67	66	66	67	150
1	63	67	65½	66	67	120
2	63	67	65	65½	67	150
3	63	67	66	66	67	150
4	63	67	66	66	67	250
5	63	66½	66	66	67	250
6	63	67	67	67	67	300

 (*continued*)

App. No. 12.

HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery.	Speaker's Gallery.	Members and Strangers present.
April 1st.						
4	63½	65	66	66	- -	150
5	66	67½	70	69½	68½	250
6	65	69	69	69½	69	300
7	65	66½	70	70½	70	250
8	63½	67	69	69½	69	200
9	63½	67	69	69½	68½	200
10	63½	65	69	70½	70	350
11	63	67	70	70½	71	350
12	62½	66	70	69½	70	150
April 2d.						
4	64½	66½	67	67½	67	150
5	66	68	68	68½	68	500
6	66	67½	69	69½	69	500
7	65	68	70	72	70	450
8	64	66	69	70	69½	150
9	65	67	73	73½	73	150
10	65½	70	73	73½	73½	150
11	64	67	70	71½	71	300
12	64	65	71½	72	72	200
1	66	68	72	73	71½	200
April 5th.						
4	63	64	63	64	63½	150
5	64½	64½	65	66	65	400
6	65½	66½	66	67	66	450
7	64½	67	68½	69	68½	300
8	64½	67	67½	68	67½	250
9	62½	65½	67½	68	67½	250
10	62½	66½	69½	70	69	250
11	63	67	69	69½	69	300
12	63	66	69	70	70	300
1	63	66	69	70	70	300
April 6th.						
4	62	64	66	66	66½	150
5	64	65½	67½	68½	68½	300
6	64	66½	68	69	69	200
7	64	66½	69	70	70½	250

App. No. 12.

HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery.	Speaker's Gallery.	Members and Strangers present.
April 19th.						
4	59	58	57	57½	- -	200
5	61	60	59	59½	- -	250
6	64½	64	63	63½	63	200
7	64	66	64½	62	62	200
8	64½	66	64½	62	62½	180
9	68	67½	67	67	65	180
10	68	68	67	67	65	250
11	67½	68	67	67½	65½	250
12	67	69	67	67	65½	150
1	67	68	66½	67	65	150
2	—					
April 20th.						
4	62	63	62½	62	- -	180
5	65	67	64	64½	62½	—
6	66	67	65	65	63	300
7	66½	67	65	65½	63	350
8	67	67½	66	66½	65	350
April 21st.						
12	63½	63	62½	62½	60	150
1	64½	64	63	63	61	100
2	65½	65	63½	63½	61	150
3	65½	65	64	64	61½	150
4	66	65½	64½	64½	62	180
5	66	66	64½	64½	62	150
April 22d.						
4	63	64½	63	63½	61½	150
5	66	66	65	65½	63	300
6	67	68	66	66½	64	350
7	68½	69	66½	67	65	350
8	67½	68½	67½	67½	66	250
April 23d.						
4	65	65	64½	64½	63	180
5	67	67	65½	66½	64½	320
6	67½	69	67	67½	66½	400
7	67½	69	67	67½	66	350
8	65½	69	67	68	66½	220
9	65	69	67	68½	66	400
10	66½	69	68½	68	67	500
11	68	68	69	69½	68	550
12	65	67	69½	71	69½	560
1	64½	68	68	68½	68	100

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HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery	Speaker's Gallery.	Members and Strangers present.
April 26th.						
4	65	65	64½	64½	64½	150
5	66	66½	65½	66	65	200
6	66½	68	66½	66½	66	250
7	65	67	67	66½	65½	180
8	64½	67	66½	66	65½	180
9	64½	67	66½	66½	65½	200
10	65	68	71	69½	68½	500
11	65	68	69½	69½	69	550
12	65	67½	68	68½	69	600
1	63½	66	66½	66½	67	150
April 27th.						
4	65	65	64	64	64	150
5	65	67	64½	64½	64	250
6	65	67	65	65½	65	350
7	66	67	66	66	65½	380
April 28th.						
12	64½	65½	63½	64	63½	170
1	65½	67	64½	64½	64	200
2	65½	68	65	65½	64½	200
3	66	69	65½	65½	65	220
4	67	68	66	66½	65	200
5	67½	68½	66½	66½	65½	400
6	65½	68	65½	66	65½	200
April 29th.						
4	66½	67½	66	66	64	150
5	67	69	67½	67½	65	220
6	67	70	67½	67½	66	280
7	66½	69	68½	68½	66½	280
8	65½	67	68½	68½	67	200
9	66	66	68½	68½	67	200
10	65	66	69½	69	68	400
11	65½	67	69½	70	68	550
12	65	65½	68½	69	68	150
1	65½	65½	65½	69	67½	100
April 30th.						
4	65½	66	66½	66½	65	250
5	66	66	67½	67½	65	500
6	66	66	70½	69	67	650
7	66	66	71	70	68	650
8	64½	65½	68	68	67	300
9	65½	66	69	68½	67	250
10	66	66	69	69	68	250
11	65½	66	69	69	68	280
12	65½	66	69	69	68	150

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HOUR.	Speaker's Chair.	Serjeant's Chair.	East Gallery.	West Gallery.	Speaker's Gallery.	Members and Strangers present.
May 3d.						
4	64	64	62	63	62	150
5	65	65	63	64	63	280
6	66	67	64	65	64	350
7	66	66	64½	65	64	280
8	65	65	64	65	64	250
9	65	65	64	65	64½	300
10	64	64	65	65½	64	500
11	65	65	66	66½	66	500
12	65	65	66	67½	66	550
1	66	66	66	67	66	150
May 4th.						
4	64	64	62	63	62	150
5	64	64½	63	63½	63	300
6	65	65	63	64	64	350
7	65½	65½	64	64½	64	300
8	65½	65	64½	65½	65	220
9	65½	65	65	66	65	280
10	66	66	66	67	66	500
11	66	66½	66½	68	67	550
12	66	66	67	69	67	550
1	65	66	67	68	67	259
2	64	65	66	67	67	180

10 May 1852.

D. B. Reid.

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Appendix, No. 13.

FIRST REPORT of Mr. *Goldsworthy Gurney* on the VENTILATION of the NEW HOUSE of COMMONS.

To the Honourable the House of Commons.

IN obedience to the Order of your Honourable House, dated the 12th day of March 1852, I beg to Report, That I am investigating the arrangements for the warming, ventilating, and lighting the New House of Commons; and, having been given to understand by several Members that it would be acceptable to the House that I should make a First Report on the state of the Ventilation as early as possible, I beg further to Report as follows:

That, although I have been interrupted in my investigations, and hereby prevented from making them as full and complete as I could have wished, I have seen sufficient to satisfy myself of the causes of the great inconvenience experienced at this moment.

That I find the atmosphere of the House in a desiccated and oppressive state, and subject to constant disturbance from initial and retrograde currents passing in all directions, as if at random, and apparently without control, producing direct draughts in particular parts of the House, and oppression in others. I also find that from the same want of proper control, offensive vapours and effluvia (emanating from contaminated sources) are drawn into the House.

That most of these evils can be corrected by a simple arrangement, and at an expense comparatively trivial, and although this is a common-sense question, yet it would be difficult to demonstrate it on paper unaccompanied by actual experiment, or to explain the facts and conditions on which this conclusion is arrived at. And inasmuch as on former occasions an unfair advantage has, I think, been taken of the statements and evidence which I have given from time to time, and portions of my plans have been adopted without consulting me, I am induced to ask permission to refrain from entering into details at present.

The principles of ventilation which have been recommended by me, and, to the best of my belief, acted upon in the Chamber of Deputies at Paris, and now in operation in the Courts of Exchequer and Common Pleas in Westminster Hall (which Courts were previously unsatisfactorily ventilated by a similar arrangement to that now applied to this House), and their success in every Court of Judicature, and other places in the provinces to which they have been extended, afford sufficient evidence (in addition to what I have seen in this House) to justify me in saying, that if the House be placed under the control of the Office of Works for a short time, I would pledge myself, with their assistance, to remove all the material evils that at present exist, at a very trifling expense; and at the expiration of such

such control, to restore the ventilation, if required, to its present state, within the space of a few hours.

Of course it will be understood that this Report applies only to the House itself, and not to the entire building.

5 April 1852. *Goldsworthy Gurney.*

SECOND REPORT of Mr. *Goldsworthy Gurney* on the VENTILATION, LIGHTING, and WARMING of the NEW HOUSE of COMMONS.

I HAD the honour to present a First Report in obedience to an Order of your Honourable House, on the state of its ventilation, on the 5th instant; I now, after further investigation, beg more fully to report on the subject.

I find the system for ventilating the House is of two kinds; one technically called the "upcast, or furnace-system," used for ventilating coal mines; the other that of the "centrifugal fan system." In common language, one "drawing," the other "forcing," air through the House.

The furnace is used for the purpose of drawing off air from above the ceiling of the House; it is placed in one of the towers of the building, and connected with a common chamber communicating with the House under the panels in the ceiling. Air from below is at the same time driven by the centrifugal fan from the basement floor of the House, and, after passing through various openings, in three chambers, to one over the other, it enters the House through its perforated iron floor, covered with hair-cloth.

To arrive at a true knowledge of the condition of the atmosphere of the House, I proceeded first to ascertain whether there was, or was not, much difference in its temperature at different parts; secondly, whether there was much difference, in its hygrometric state; and lastly, to ascertain, as far as possible, the nature and amount of draughts, and other observed pneumatic disturbances.

I called to my assistance in these inquiries Mr. Mather, the honorary secretary of the South Shields Commission for the ventilation of the northern mines, Professor Hann, of King's College, and Dr. John Hutchinson, who have carefully studied the principles of ventilation, and are practically acquainted with its application. Mr. Fincham, an officer from the Board of Works, also attended me.

I beg to Report the following series of experiments, and the deductions we made from them. These experiments were repeated whilst The House was sitting, and at other times.

On placing a thermometer on the hair-cloth carpet upon the floor of the House we found the mean temperature 62°–64°. It also indicated this temperature at the floor of the Peers' seats, and at every other place where there was a communication from the air-chamber below. Above the seats the thermometer at the same time stood at 69°–70°. In the galleries the thermometer against the wall stood at 70° (the mean temperature of the wall and the air of the House). When the thermometer was held away from the wall, and shaded off

from

pp. No. 13. from the chandeliers, it rose to 73°. In the gallery corridors, the mean temperature was only 64°.

The great increase of the temperature in the House, viz., 70°–73°, while the incoming air was only 62°–64°, showed that there was not sufficient air at the latter temperature coming in, to keep down the general temperature of the House. It may be remarked, we found the same mean temperature on the Wednesday sittings, when the chandeliers were not lighted or turned up.

We next proceeded to investigate the hygrometric state of the atmosphere of the House at different levels and other parts. On the table we found the break to be 10°, immediately above the seats 10°, in the galleries 10°. In the corridors 8°, in the ante-room adjoining, it stood only at 4°, in the lobby 10°, in the reporters' gallery 9°. It is manifest from these numbers that the atmosphere of the House was too dry, either for comfort or health :—a break of from 4° to 5° of the hygrometer is sufficient for a healthy state of atmosphere.

We next proceeded to inquire into the origin of the draughts which we felt in different parts of the House. We found generally streams of air coming in and disturbing the atmosphere by secondary currents wherever there was an opening to the external parts; showing the existence of a minus pressure, or partial exhaustion in the House.

On placing open one-half the folding-door by the Bar, and at the same time one-half the folding-door of the House, a strong current set in, which extended to a considerable distance. On measuring the velocity of this current, we found its mean rate to be 420 feet per minute. The sectional area of the open doorway was 21 feet, consequently $420 \times 21 = 8{,}820$ cubic feet of air was the quantity drawn into the House per minute. This was during the time both doors were open. Under ordinary circumstances these doors would be only open while Members passed in or out. During those periods, air would necessarily rush in and produce the intermitting draughts. Through the doorway leading to the Peers' seats, when the Bar and House-doors were shut, and the side corridor (the division-rooms) open, were 1,200 feet per minute. Through the doorway from the lobby leading to the Speaker's gallery, 1,400; strangers' gallery, 1,300; reporters' and ladies' galleries, the "incast" was the same in proportion to their respective areas. Behind the Speaker's chair, when the door was partially opened (about two inches), after the doors of the House had been shut for a short period, the intake blew out a candle. When fully opened, the intake was the same in proportion as through the other doorways leading to the division-room corridors, &c. The longer the doors in and about the House remained shut, the stronger was the incast current on opening any of them. It is clear from this fact, that while the doors remained shut, the air of the House was gradually drained away by the pull of the upcast, faster than it can come in below; which showed that the passages prepared for the admittance of air were, in technical terms, "throttled."

We made many other inquiries on this part of our subject, and then proceeded to ascertain the absolute amount of the observed exhaustion, or minus pressure, arising from this want of free ingress. We measured the break of pneumatic balance, between the internal

and

and external atmosphere, by a delicate differential pressure gauge; the mean of several observations varied from 7° to 8°. This at once opened to us the true condition of the House. Having now obtained absolute velocities, absolute quantities, and absolute pressure, we were in possession of data for accurate calculation.

From these data we came to the following conclusions:—

1st. That from want of control over the ingress and egress in the air passages, there seems to be no means of regulating a legitimate break of balance.

2d. That air would be "drawn in" (to use a familiar term) through every crevice or opening existing about the building, and that hence arose the "incast" from contaminated sources.

3d. That, from the same cause, draughts of air would be drawn into the House through the passages, and other parts of the House, whenever the doors happened to be open. In support of this conclusion, it may be stated that on one occasion we observed, when all other openings with the external air were shut off, and the doors of the House of Lords and the House of Commons happened to be opened at the same time, that air was drawn down through the House of Lords, and came along the passages and went up through the House of Commons. The House of Commons was in this case an "upcast," and the House of Lords a "downcast," with respect to each other. The heavy curtains hanging in the passage were drawn open by the upcast pull of the House.

4th. That we found cold air sensibly coming up through the hair-cloth carpet at the floor of the Peers' seats, producing sensation of cold about the legs and feet. We observed the thermometer 64° at the feet—69° at the level of our heads. We found the same sensation of cold about the legs in some other parts of the House, but not in others. On examination, we found in the chamber below, that a large portion of the perforated floor was shut up, so that no air could pass through. Above these parts it was that the sensation of cold was not perceived, and the parts of the floor that remained open were the places at which we felt that sensation.

5th. That the rising seats on both sides of the House were cut off from below, so that no fresh air could come up to produce the sensation of cold to the feet: but here we perceived an oppressive eddy from above, evidently "the complementary retrograde" formed by the upcast in other parts of the House, where the communication was open. The strong break of balance in the House, would occasion the incoming air to pass with considerable velocity through the interstices of the hair-cloth; sufficiently strong to form "air jets," which acting on the principle of the steam jet, would occasion much disturbance of the atmosphere near the floor of the House. On examination, we found that these currents not only increased the sensation of cold about the feet, but that they disturbed and carried up dust and other impurities, which became mixed with the air of respiration.

In the division rooms, and the House, we expected to find a pneumatic balance; but this manifestly was not so, as shown by the strong incast when the doors between them were open. We proceeded to inquire into the cause. We found the height of the House to be considerably

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considerably greater than the height of both the committee rooms and gallery corridors put together, consequently, the upcast column in the House, was, in the same proportion, longer than that of the corridors. To this fact, the break of balance in favour of the former was due, which would necessarily form a disturbing force. There seemed to be no provision for this, for we found, when the House was sitting, and the full ventilation on, that a portion of vitiated air from above the ceiling of the House retrograded and went down into the corridors.

We next proceeded to investigate the apparatus for Warming; and inquired, as far as we could, into the cause of the great high hygrometric break observed in the House; and of the desiccated state of a portion of its atmosphere.

The apparatus for Warming, consists of a series of iron pipes four inches diameter, and about ten feet long, ranging horizontally one over the other, filling a large chamber specially set apart for the purpose. This chamber is a part of the second floor below the House; the pipes are filled with hot water, and part of the air for ventilation is made to pass over and amongst them, by which it is heated. It then comes into the outer part of the chamber where it meets with a cold current passing up. These two portions (hot and cold) enter a room through certain channels, immediately below the House, called the "Mixing Chamber." Here the hot portion of air coming from the apparatus, is mixed and cooled by the cold portion; and the cold portion heated by the hot. The mean temperature of the two is supposed to be given to the whole. From this chamber, it passes into the House.

The evil of this arrangement is, that the heated portion is raised so high, as to be partially decomposed, or rather partially to decompose the organic matters always found floating in the atmosphere. I need scarcely to observe that it is this decomposition that produces the unpleasant state of the atmosphere in houses heated by stoves. The air is overheated, by laying on the upper sides of the horizontal cylinders, or hot pipes, used in the apparatus for warming the House. Air in passing, remains comparatively at rest, at those parts, long enough to become overheated. On this account it is, that the upper side of a steam, or hot-water pipe, is always found at a much higher temperature than the lower. Air heated above 100°, will partially decompose some of the organic matters always found floating in it, therefore no portion of air for ventilation should ever be heated above this temperature. We were informed that air from the chamber frequently came out 120°–130°, but as we had no opportunity of measuring its temperature, we can only give this as stated to us. Air, "heated and unheated, is unfit for ventilation." Air, for ventilation therefore, should not be warmed by mixing with hotter air; but, passing over extensive sufaces at a low temperature, the whole should be brought up to the required standard. Air, at a high temperature, requires more moisture in exact proportion to its observed rate of expansion.

In regard to the Lighting of the House, it will not be necessary for me to make any remarks at this moment, because I perceive by the Report of the Committee, it is about to be changed during the present

present adjournment. On reading that Report, I have felt it a duty to myself and others to write a letter to Messrs. Stephenson and Locke, appointed to superintend its recommendation; a copy of which letter is appended.

I further beg respectfully to observe, that I have made investigations into the ventilation of the libraries, corridors, refreshment rooms, lobbies, various offices, and other parts of the House, but have not yet obtained sufficient data to enable me to make a final Report satisfactory to myself, or such as I feel due to your Honourable House. I hope soon to do so.

In the foregoing Report, I have stated the series of experiments, we made connected with our inquiry, and have given them in detail; any Honourable Member of the House may draw his own conclusions regarding the ventilation; and judge how far the statements made in my first Report are borne out by facts.

From these details we arrive at the following SUMMARY:—That the temperature of the House varied very considerably in different parts, being in some much too hot, and others too cold either for health or comfort; that its atmosphere was far too dry; that from the too great power of the upcast, as compared with the too small supply of air admitted by legitimate channels to the House—or in other words, from pulling more air out of the House than could come in by the regular channels intended for that purpose, the air was rarefied beyond what the temperature of the House would have caused. That the House was very much like a partially exhausted receiver, or partial vacuum; the consequence being that what air could not come in legitimately, came in surreptitiously by open doors, through chinks, and occasionally from contaminated sources, producing draughts and impurities. These conclusions show that the inconveniences admit of a simple self-evident remedy. The restoration of the pneumatic balance, by proper control, would render the ventilation tolerable as compared to its present state; but at the same time to make the ventilation perfect, a more extensive change must be made in the general arrangement, which could be done at a comparative trifling expense.

13 April 1852. *Goldsworthy Gurney.*

COPY of a LETTER referred to in the foregoing REPORT.

Sir, Palace-yard, 10 April 1852.

I BELIEVE you have been selected, by the Committee on Ventilation and Lighting, to superintend the carrying out of Dr. Reid's Report, dated the 16th March, for improving the ventilation of the House of Commons.

In my examination before this Committee I showed that the atmosphere of the House, under its present system of ventilation, was in a state of partial exhaustion, or minus pressure, arising from inadequate arrangements.

Dr. Reid does not refer to this condition of the House in his Report,

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Report, or does he advise any measures bearing on it; neither did he or any other person in evidence before the Committee advert to it, or seem to suspect it.

As I believe the greater evils complained of in the House arise from this cause, I am anxious to call your attention to the fact, and to place my just interest under your protection. I trust, therefore, you will suffer no advantage, without acknowledgment, to be taken of the evidence which has been publicly given by me; the more particularly since this condition of the House, and its consequences, have been arrived at by a long and careful inquiry, which I have felt it my duty to make under an Order of the House; and on which I am about fully to report. I am the more desirous of expressing this hope at the present moment, since I am given to understand use is about to be made of evidence given by me some years ago before different Committees of the House, and of experiments which at different times I have made on its lighting.

Any disposition on the part of the Committee to show indulgence towards Dr. Reid I can fully appreciate, especially since I feel I am entitled to it myself. The late House of Commons was lighted for 14 years under my direction, without a single complaint of any kind having been made. For the last ten years I have received no compensation whatever for my time or invention; or have I even been examined or consulted on the subject; notwithstanding it is one on which, I believe, my opinion is considered valuable; and on which I have been ordered to report.

I have, &c.

(signed) *Goldsworthy Gurney.*

To Robert Stephenson, Esq., M. P.

A similar letter was written to Joseph Locke, Esq., M. P.

THIRD REPORT of Mr. *Goldsworthy Gurney*, on the VENTILATION, WARMING, and LIGHTING of the NEW HOUSE of COMMONS.

I HAD the honour to present a Second Report in obedience to an Order of your Honourable House, on the warming and ventilation of the House, on the 19th ultimo. I have since made a more full investigation, and obtained sufficient data to enable me to report on the warming and ventilation of the libraries, corridors, refreshment-rooms, various offices, committee-rooms, and other parts of the House.

We find the system of ventilation for this part of the building separate and distinct from that of the House and lobby. It is under a different apparatus; the arrangements are altogether different; in which the House of Lords is also included. Air for the ventilation of the Committee-rooms, Libraries, and Offices both of the Houses of Lords and Commons, and for the House of Lords itself, Prince's Chamber, and Royal Gallery, is taken from the top of the Victoria Tower. It is drawn down and distributed by a centrifugal fan into these various departments. The air is first admitted down two of the shafts in the Victoria Tower; from thence it is drawn along through

through a large tunnel in the basement to a chamber in the middle of the building on the same level. From this chamber, trunk channels, or "mains," are made to extend to the different parts of the House. Again, from these main trunks separate branch channels are made to go to different rooms and apartments. In the entrance to the chamber, from the main tunnel, the centrifugal fan is placed, and worked by a steam engine. The purpose of the fan is to draw the air along the tunnel, and to drive it first into the air chamber, and from thence into all the diverging branches. The principal main leading from the air chamber runs along the basement under the river front, and supplies the Libraries, Lords' committee-rooms, and offices on the principal floor on the river front; and also the Commons' committee-rooms on the upper floor. Another large main goes to supply the House of Lords, Prince's Chamber, Royal Gallery, and other parts belonging to the House of Lords. A third main leads to the Corridors of the House of Commons; a fourth to the House of Lords' corridors; a fifth to the Cloisters and rooms adjoining; a sixth to Westminster Hall; a seventh to St. Stephen's Hall and Private Bill Offices; an eighth to the temporary Law Courts and St. Stephen's Porch. There are also four others of smaller area, which communicate with the Central Hall. All these mains have valves fitted to them to regulate the size of the openings from the Central Chamber, and adjust the areas for giving proportionate supplies. In the branches leading to the different committee-rooms from the main, valves are also placed to regulate the quantity of supply to these rooms respectively. The air, or ventilating chamber, is situated in the basement, immediately under the Central Hall.

The vitiated air from the whole of these departments is carried away through openings prepared above; that from the committee-rooms, through a vitiated chamber, running along over the ceiling, and under the roof of the whole river front; it terminates at each end in a tower, or shaft, communicating with the open air. In these shafts a steam jet is placed to assist the escapage by its momentum; and steam pipes to rarefy the air, to assist the extraction by its buoyancy, are also placed in the shafts.

Into this vitiated chamber or tunnel, all the committee-rooms, libraries, &c. on the river front empty themselves. Separate openings are made from each room, fitted with a valve in the egress or eduction passages, the same as in the ingress passages below. Air is admitted from these passages into the rooms, through a portion of the perforated cornice under the ceiling on one side of the room. A portion of the supply in some of the rooms is admitted under the skirting, and behind the dwarf panneling, but not in others. In all, the vitiated air is drawn away through the perforated cornice on the opposite side of the room. There is a division in the channel above the cornice; one half, namely, that next the river, is connected with the supply from below; and the other half, namely, that on the opposite side next the corridors, is connected with the vitiated shaft above; so that the air comes into the room on one side, and goes out on the other. Having examined the whole arrangement, we next proceeded to measure the quantity of air coming in for ventilation of the building, its rate, and general diffusion.

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We measured the quantity when the House was under full ventilation, coming in through the great main tunnel from the Victoria Tower. We found, after deducting that going to the House of Lords, 74,000 cubic feet of air per minute passing into the ventilating chamber. It was sometimes more, but this was the average quantity. We now proceeded to measure the quantity passing out of the chamber to the different parts of the House, through the main trunks. We measured these quantities at different times, under different conditions of working and weather; and repeated our measurements on different days. We found that 29,000 cubic feet of air per minute was going out of the ventilating chamber into the main of the river front. That going to the cloisters was 6,000 feet per minute; to the temporary law courts and St. Stephen's Porch, 7,000 cubic feet per minute; Central Hall and Corridors, 9,000 feet per minute; St. Stephen's Hall, 3,000 feet per minute; Westminster Hall, 7,000; making together 61,000 cubic feet per minute. This was the whole quantity passing out from the air chamber. Now, this quantity, it may be observed, is 13,000 cubic feet per minute less passing out than that coming in. To account for this deficiency, we took some pains, and made many experiments. On shutting the valves in the mains, so as to prevent any air from going into them from the air chamber, we found there was 32,000 cubic feet per minute lost by leakages from the air chamber somewhere, through crevices and other openings. This extra leakage, it should be borne in mind, was under full compression. Again, on opening the river front valve half way, the compression of air in the chamber was considerably reduced. On taking the quantity now passing out, and the quantity coming in, we found only 17,000 feet per minute loss; viz. more coming in than was going out to the river front main. When this main was fully open the loss due to leakage was only 15,000; and when all the other mains were opened, the compression being still more reduced, the loss of 13,000, the deficiency above stated, was doubtless going away by leakages into other parts of the building. In all cases of "plus-pressure" ventilation, these losses are observed; and in many cases which we have seen, the loss is so great through the passages, that little air ever reaches the more distant apartments at all. In a public hospital, ventilated by plus pressure, gunpowder smoke, with which they experimented, remained in one of the distant wards all night; when the full power of ventilation was on. It must not be considered therefore, in this case, that the loss of 13,000 on 74,000 showed imperfect workmanship. This will more satisfactorily appear when the pressure is taken, as about to be detailed in our next series of experiments.

We proceeded to correct our observations by taking accurately the break of balance between the air chamber and external atmosphere, when under the above conditions; by the differential pressure-gauge. When all the branch mains leading from the air chamber were open and adjusted to their working condition, the break of balance between the chamber and the external air was 24°. When the river-front main supply was half shut it rose to 55°; when it was fully shut off the differential break rose to 124°; and when all the other supply outlets were closed it rose to 216°. On making fair calculation

lation on these pressures, taking the sectional areas of the different passages into account, and making correction for friction, we found our previous numbers supported. I may further remark, that the pressure of 24 degrees, when the valves were open, was the actual working pressure, or compression, in the air chamber; and that 216° was evidently the full compressing power of the fan. It may be well to remark also, that in taking these pressures we invariably found on the side of the chamber opposite the fan, 2½° to 3° more pressure than on the sides. This difference of 3° was due to momentum.

As we may hereafter have occasion to refer to the break of balance of the differential pressure-gauge, to determine by calculation the amount of ventilation in the rooms above, it may be well here to state, that its ratio is 64 to 1, as compared with the ordinary water-gauge. One-tenth of an inch disturbance of water-level (namely, the common water-gauge) would raise the index of this instrument sixty-four tenths.

To ascertain the proportionate quantities of loss and supply going through the separate passages to each room, particularly to the committee-rooms, we made many experiments. We filled several with gunpowder smoke, and noticed the time required to remove it. We also mixed the air in the branch channels below with smoke, so as to make it visible. We noticed the parts of the room in which it first showed itself; its apparent rate and quantity at different points and leakage through the passages. In repeating these experiments, we, sometimes, when an opportunity offered, allowed the escapage to go out at the doors into the corridors. At the same time we shut off the escapage above, and measured the quantity of air passing, which enabled us to judge of its amount, and the value of the respective "plus and minus" forces in operation. We made these experiments under different conditions and at different times; by them we could correctly trace the direction of currents, and the disturbances going on in the rooms themselves. In these experiments we found the disturbance arising from the descending sheet of cold air from the high glass windows to be more important than we had previously conceived; an evil, presently more fully to be noticed. We also measured the actual quantity of air going through each room when the doors were shut, and when the escapage valves were open. It will be unnecessary to detail all these experiments. Their results gave us the quantities, and showed the proper correction for friction and loss through some of the longer channels leading to the upper rooms; and the necessary correction for the interference of the laws of momentum, and complementary retrogrades, which play so powerful a part in ventilation: we sometimes found that a disturbance of the pneumatic balance by these causes, between two committee-rooms, would often change the ventilation of one or the other, and sometimes of both. On mature consideration of the practical interference of these laws of motion, we suspected that under certain conditions there would be a disposition to a downcast from some of the rooms. The experiments made on this question showed that our views were correct, and pointed out the necessity of special regulation below. At this point of our investigations we made many experiments on the ventilation of the different offices on the ground

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floor; also on the principal floor; the smoking and refreshment rooms; and other parts of the House, which were supplied by different mains, and extracted by special eduction passages.

From these experiments, and other modes of investigation, it is evident that the ventilation is sufficient for the libraries, offices, and corridors; and that there is enough ventilation for the committee-rooms when used for select committees; namely, when few persons are present besides the Members of the Committee; but that there is not enough ventilation for these rooms when used for public committees, and moderately full.

With a view further to ascertain by inspection the state of general distribution of air through the building, and the proportionate quantity which passed into the trunks, and thence to the different rooms and apartments, we proposed to mix the incoming air with smoke in the great supply tunnel before it passed into the air chamber, in such quantities as to be visible to the eye; and to continue the mixing until it appeared in every apartment in the Houses of Lords and Commons. By noting the time required for it to appear at different parts, and the time required for filling and removing from the apartments after the mixing had ceased, it would afford good evidence of the state of diffusion and proportionate quantity of ventilation. We should thus be enabled by simple observation to see whether there were any of the rooms deficient in ventilation, or any that had a surplus quantity. It would enable us also to trace exactly the source of leakage above alluded to, and other important points. This general experiment would particularly show what amount of correction should practically be made for friction through some of the long and tortuous passages, and point out how far any alteration was required in the arrangement of the valves for, what is technically called, "splitting the air;" a point always of great difficulty. We proposed to make this experiment on some Saturday evening, when the House would be "up." As it might, however, interfere with some of the arrangements in the House, we did not like to make the experiment without permission from the proper authorities. The authorities of the Lords immediately gave permission, but I have not yet been able to obtain it from the authorities of the House. I should have been glad to have been able to give the general results of this experiment; but as it can be made at some future period, and having failed to obtain permission up to this time, I have thought it best not to delay this Report any longer.

Before making any remarks respecting the draughts perceived in some of the apartments, it will be well to make a few observations on warming; as they are mixed up with each other.

In the central chamber, the air is principally WARMED, and tempered before being distributed into the different mains. The apparatus for warming consists of a number of steam pipes standing vertically in the chamber, amongst and around which the air passes. There is an advantage in this position over the horizontal pipe. By the laws of motion influenced by changes of specific gravity, occasioned by change of temperature, that portion of air next in contact with a vertical pipe, first raised a few degrees in temperature, will move off from its surface before it has time to be heated sufficiently for any organic

organic matter to be decomposed; always found, more or less, in the atmosphere. This is not the case with horizontal pipes, for on the upper side of them there is always an eddy or sluggish movement, and the air will remain sufficiently long to become overheated and vitiated. In the central chamber the air is also moistened and brought to a hygrometric break of about 4° to 6°, and at the same time raised in temperature to about 60°. It is afterwards further warmed by an apparatus fixed in each of the branch channels, going to the committee and other rooms of the main; namely, by a coil of pipes. By this means, more warmth can be given to the air when necessary, which may be going to any particular apartment. The coil is placed in a "bye passage," which passage may be cut off when warmer air is not required. Many of the pipes forming the coil are placed horizontally, and in consequence it is probable some portions of air may be overheated; but as the temperature requires only to be raised 2° or 3° by this coil, the portion so overheated will be small. In Westminster Hall, the Cloister-rooms, and Passages, and in St. Stephen's Hall, the air is principally warmed by pipes going under the floors, and lying horizontally; on this account it is here more vitiated. In cold weather, when much warming is required, the peculiar effects of what is called "stove heat," namely, decomposed air, may be perceived in those apartments.

In most of the committee-rooms and offices there are open fires; but in some of the offices on the ground floor there are no chimnies; these rooms are consequently warmed entirely by hot air. Neither the temperature, nor the ventilation, is under the control of the occupiers of these rooms, which it should be. There are few persons in them at a time, and, therefore, they scarcely require special ventilation.

In all the rooms on the river front, both on the principal and upper floors, there is a large quantity of glass, which in winter reduces the temperature of the air of the room next in contact with it, several degrees, very rapidly. The air so cooled falls, in virtue of its increased specific gravity; and a fresh portion, taking its place, and in turn, becomes cooled; and thus a current is established. This current moves into the room, and produces the effect of a partial draught, by disturbing its otherwise quiescent atmosphere. This occasions much inconvenience. Double glass windows would only remove half the evil; for the glass of the inner window would at all times be much lower in temperature than that of the room: it would be the mean between the external air and the room. In cold weather this mean would be sufficiently low to occasion unpleasant disturbance by currents of air into the rooms.

The Libraries are also, to a certain extent, subject to this inconvenience, which may be mistaken for imperfect ventilation, or partial draughts coming in somewhere from without. This falling sheet or plate of cold air from the high windows is more important than it first appears, as will be manifest from the following facts. The thermometer in many of the rooms on the river front is kept at 65°–66°, and yet no one seems to feel too warm. Persons in health, and in a room having its atmosphere undisturbed, 62°–63° will always

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feel comfortable; but in a room where there is any internal disturbance going on—however slightly, almost inappreciable—a person will not feel comfortably warm even at 68°–70°. The best authorities fix 62° as the proper temperature for a man in health; he seldom feels too warm until the thermometer rises above 63°, or too cold until it falls below 60°; if he does, it is a proof that he is either out of health or that the atmosphere in the room is somewhat disturbed. These effects are explained by the laws of "convection." The same laws will explain the seeming anomaly of two persons, sitting a little apart, on the same bench; when one will often feel too cold, while the other will feel too warm. Very slight disturbance or movement of the air within a room, without a particle of fresh air coming in for ventilation or otherwise, will produce this inconvenience. The falling current of air from the cold glass window, just adverted to, is sufficient in some of the committee-rooms, and other apartments on the river front, to produce this inconvenience, and explains why the thermometer is kept so high as 65°–66°. There is in many of the rooms a coil of steam-pipes placed below the windows, with a view of removing this evil. It is manifest the weight of the falling column from the glass will always overpower the buoyancy of the air warmed by the coil under the present arrangement, and drive it out into the room, powerfully so in very cold weather. If it should, in warm weather, lift the column, it would thereby produce a current the other way. I need scarcely repeat that double glass windows will not remove this inconvenience, without some other arrangement for better insulation.

In summer some means of Cooling the Air for ventilation should be adopted, more particularly in the committee-rooms. These rooms are occupied during the heat of day in summer; they therefore require the air to be cooled more than that of the House; for the latter sits mostly at night, when the temperature is lower.

The Lighting of the House is still under experiment; any observations on it would, therefore, be out of place at this moment.

The lights of Westminster Hall, St. Stephen's Porch, St. Stephen's Hall, Central Hall, &c., are not insulated; the products of combustion escape into the atmosphere of these apartments. The arrangements seem to be temporary; no doubt when they are permanently made, this will be prevented.

In the foregoing Report I have endeavoured fully to develope the real condition of the ventilation and warming of the committee-rooms, libraries, corridors, offices, and other parts of the House by as careful and extensive a series of experiments and observations as the importance of the subject, and the honourable confidence of The House reposed in me, demanded. Our observations and experiments, more particularly the results of the latter, have been fully detailed, that Honourable Members acquainted, as most of them are, with the laws of pneumatics, may follow us step by step, and form their own judgment as to the true condition of the House.

The conclusions, which I feel to be my duty to lay before The House, are embodied in the following Summary:—

1. We

1. We find, on careful consideration of all the results of our experiments, facts, and observations, that the ventilation of the Libraries, Corridors, and Offices of the House is sufficient and satisfactory, except the committee-rooms. The ventilation is sufficient for them when used for select committees, but it is not sufficient for them when used for public committees, and moderately full.

2. That the cooling influence of the large surface of glass in the windows, in most of the rooms on the river front, will, unless insulated, produce great inconvenience by causing cold portions of air to fall from it in winter. Those falling sheets or currents of air will occasion a disturbance of the whole atmosphere of the room itself, which may be mistaken for bad ventilation, or for draughts of air coming in from without.

3. That the steam jet, used to assist for drawing off the vitiated air, is imperfectly fitted up, and, in consequence, makes a disagreeable hissing noise; which it should not do.

4. That the products of combustion from the lights in Westminster Hall, St. Stephen's Porch, St. Stephen's Hall, and Central Hall, escape into these apartments; which should be prevented.

5. That the arrangements for warming are good and satisfactory, with the exception of those parts where horizontal heating pipes are used; for reasons previously stated.

6. That we see no apparatus for cooling the air in summer. The water from the deep wells about London averages 52° in summer; the simple apparatus described in my evidence to the Committee on Ventilation will sufficiently reduce the temperature of any quantity of air, by means of the water from these wells in hot weather, without much trouble or expense.

In conclusion, I beg to add, that these evils may be removed without much expense; but as, under the order of The House, I do not think I should suggest any alterations, I have not done so, but have confined myself to reporting the facts and conditions as I find them. I am prepared to point out to the proper authorities such alterations as I believe would remove most of the evils which I have enumerated, or to state them fully in another Report, should The House desire it.

Goldsworthy Gurney.

19 May 1852.

Appendix, No. 14.

App. No. 14. DESCRIPTION of the Mode of Warming and Ventilating the House of Lords, and other portions of the New Palace at Westminster, amounting to about four-fifths of the entire building, under the control of Sir *Charles Barry*.

STEAM and hot water constitute the heating powers employed, and the motive power for the supply and discharge of air, independent of gravity caused by differences in temperature, consists of a powerful fan worked by a steam-engine, local rarefactions, and steam jets. The steam boilers and engine employed are placed in a court to the south of, and contiguous to, St. Stephen's Crypt.

The supply of atmospheric air is taken solely from the turrets of the Victoria Tower, at the base of which the air is purified by water, and then passes through a main channel in the basement of the building, aided, when necessary, by the tractive power of the fan, which forces it into a chamber under the Central Hall. It is there tempered to any degree of temperature which may be considered desirable, according to the season of the year, and the state of the external air. From this central chamber the air passes, or is forced, as may be necessary, by other main air channels of distribution to the several portions of the building; namely, southwards, to the House of Peers, Royal Gallery, &c.; eastwards, to the libraries, committee-rooms, and refreshment rooms, &c. belonging to each House, in the river front; westwards, to St. Stephen's Hall, St. Stephen's Porch, the Cloisters, and Westminster Hall, &c.; and vertically to the Central Hall. By means of valves in these main flues of distribution, the whole supply may be thrown at pleasure upon any one portion of the building, as the exigency of circumstances may require. Each of the above-named portions of the building, and the several chambers within each portion, have respectively a separate warming apparatus in the basement for special use, when a high temperature is required, and each of the windows of the principal rooms towards the river have a similar warming apparatus beneath it within the room, to counteract the cooling effect of the glass, in severe weather. The House of Peers, the Prince's Chamber, Royal Gallery, House Lobby, and the libraries, committee-rooms, and refreshment rooms, &c. of each House, are supplied with air in a tempered state by means of vertical flues in the walls, connected with the main air channels of distribution in the basement; which air enters through a portion of the ceiling of each room, as well as partially through the skirtings and wall framing; and is delivered in such abundance as to create a plenum, by which all in-setting drafts consequent upon the opening of doors are avoided. The supply to every chamber is separately controlled by valves. The vitiated air from each chamber is discharged through a portion of the ceiling, separated from that which is used for supply, and in respect of the House

House of Peers partially through the floor, into main foul air flues in the roofs of the building, from whence it is conveyed into exit shafts in the Royal Court, and Speaker's Court, the central tower, a tower used for the smoke flue of the boilers west of the central tower, a tower west of the public lobby of the House of Peers, and a tower at the north end of the House of Commons, wherein rarefying apparatus and steam jets are employed to ensure a constant current of sufficient velocity for the purpose required. The smoke from the whole of the fires is also carried into main smoke flues in the roofs of the building, which terminate in the same exit shafts. The total area of supply is, or will be, about 100 superficial feet, and that of discharge about 230 superficial feet. The cubic space warmed and ventilated amounts to about 3,644,000 feet. App. No. 14.

ANALYSIS

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[*N. B.*—In this Index the *Numerals* following *Rep.* i. *Rep.* ii. refer to the Paging of the First and Second Reports respectively; the *Figures* following the Names of the Witnesses to the Questions of the Evidence; and those following *Rep.* ii. *App.* to the Paging of the Appendix to the Second Report.]

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ACOUSTIC PROPERTIES OF THE HOUSE. Opinion that making an increased number of openings in the ceiling of the House would not interfere with the acoustic principle upon which it has been constructed, *Reid* 637, 638. 644, 645; *Leslie* 3212-3215; *Stephenson* 3933——If the ceiling of the House were full of apertures for the purposes of lighting, and the upward current were adopted, it would greatly affect the acoustic properties of the House, *Sir C. Barry*, 1525, 1526——Witness is not aware of any means by which the acoustic properties of the House of Commons might be improved, *ib.* 1527-1542——Taking out the present panels and substituting glass would in no way affect the hearing; but this would be the case if the panels were left open, *Gurney*, 3332-3335.

Admission of Air. There would be no great objection to the admission of air above the heads of the persons occupying the building, if it were necessary, *Daukes*, 1947-1949——Witness is in favour of ventilating the House of Commons, or any building of the kind, from or near the floor, relying upon the natural means of ventilation, with the assistance of an extracting shaft, with a rarefier in it in case of need, *ib.* 1956——The fresh air, warm and cold, should be admitted from as few apertures as practicable; in the House of Commons they must necessarily be numerous, *Price* 2402.

See also *Air Channels.* *Carpet.* *Ingress of Air.* *Sources of Supply of Air.* *Supply and Discharge of Air.*

Air Channels. How far any difference has been made in the construction of the main air flues of the House of Lords and that portion of the structure which is under witness's orders, to the disadvantage of that portion over which Dr. Reid exercises authority, *Sir C. Barry* 720-723——Evils arising from the difficulty which the air has to pass through the strangulated channels prepared for it, and the twists and turns given to it before it can get to the House, *Gurney* 868——Size of the ventilating channels; they are all accessible to actual

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actual inspection; manner in which, and periods when, these channels are cleaned, *Meeson* 2734-2739.

Great impediments in the way of witness's completing his system of ventilation, from the want of cordial communication with the architectural department; frequency of his channels being injured and destroyed, *Reid* 587-591——None of the air channels should be less than a man can walk into and inspect; in cases where the channels are less, inspection is neglected, *ib.* 3539, 3540——Great difficulty in the way of ventilating the House of Commons from the want of space in the present structure for the admission of air in any unobjectionable place, *ib.* 3543, 3544——Denial of the statement of Mr. Gurney, that there is a want of control over the ingress and egress in the air passages; witness has the means of regulating both the ingress and egress of the air in the present House, *ib.* 3572-3581.

See also *Diffusion of Air. Sources of Supply of Air. Vaults.*

Ancient Buildings. There is no evidence that in ancient buildings any means of ventilation were adopted, not even in times of Sir Christopher Wren or Inigo Jones, *Sir C. Barry* 1424-1430.

Apertures. See *Admission of Air. Air Channels. Egress of Air. Ingress of Air. Vitiated Air.*

Appold, George. (Analysis of his Evidence.)—Civil engineer; has paid great attention to the subject of warming and ventilating buildings, 3599-3602——The present state of the ventilation of the House of Commons is very pleasant and regular; experiments made by witness to ascertain the variation of the temperature of the House, and satisfactory result obtained, 3603-3618——Approval of the mode of lighting the House from the ceiling, 3619-3628——Objections to lighting the House from the outside, 3623, 3624——Preference to be given to the plenum system of ventilation, 3633-3639——The vacuum ventilation is much cheaper than a plenum system, 3639-3642——Ventilation of the theatre of the London Institution by letting in the air under the seats, 3641, 3642——In order to have a plenum, care must be taken that the ingress of air is larger than the egress, otherwise a forcing power must be used to keep up a balance, 3643-3646.

The passage of air over iron pipes heated with steam or warm water is very injurious to the qualities of the air, 3647-3651——Description of witness's self-regulating gas stove, 3648-3652——Remarks relative to witness's register hygrometer, invented for keeping the atmosphere of his house at one regular degree of moisture, 3652-3954——In ventilating the House of Commons witness would regulate the temperature by an aperture at the outlet, 3655-3657——Experiments made by witness to ascertain whether the velocity of a current of air upon a dry bulb thermometer immediately causes the temperature to sink, and result, 3658-3660——Recommendation that the air should be sifted by passing through a wire gauze at the source of supply, 3660-3673. 3905.

[Second Examination.]—Unsatisfactory state of the present ventilation of Merchant Tailors' Hall, 3846-3849——Placing two or three thicknesses of hair cloth over the floor where the members walk would remove all the inconvenience

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Appold, George. (Analysis of his Evidence)—*continued.*

convenience at present felt from the dust, and tend to improve the diffusion of the air, 3850-3876——Witness has inspected the plan of lighting the Philharmonic Concert-room at Liverpool, 3877——Approval of the sun-burner method of lighting as adopted at Liverpool; it would do very well in the House of Commons, 3878-3904——The side lights adopted at Liverpool would not be applicable for the present House of Common, 3878. 3895——Witness prefers the present system of lighting the House of Commons to adopting the sun-burner, 3896.

Architectural Department. Provided complete facilities were given witness in the architectural department, he could bring his system of ventilation entirely into operation in a very weeks, *Reid* 585-586.

Arnott, Neil, M.D. (Analysis of his Evidence.)—Has paid great attention to the subject of warming and ventilating of buildings, 1055, 1056——Has examined the system of ventilation pursued in the two Houses of Parliament, 1057——In any system of warming and ventilating, to be perfect, six given objects must be attained; statement of these objects, 1058——The art of ventilation is very new; remarks on the various attempts made to ventilate the Houses of Parliament during the last eighty years, 1059——Evidence as to the best means of moving through a building uniformly the measured quantity of air that is required, 1059 *et seq.*——The systems of ventilation in operation at the Houses of Parliament are too complex, 1059-1115. 1199-1205——Advantages of the plenum movement; details of the system, 1061-1127——Witness would not advise the double system of plenum and vacuum for ventilation, 1114——Observations as to the best means of distributing the air to the different rooms and compartments, and of properly diffusing the air in each room, 1128 *et seq.*——The present channels are sufficient for the distribution of the air, either by vacuum or plenum, 1129-1131.

Description of the ventilating apparatus at York Hospital, on the self-regulating principle; satisfactory performance and great economy thereof, 1132, 1133. 1141-1143. 1325——Sufficiency of the present means of diffusing the air in the Houses of Parliament, 1134, 1135——Preference to be given to the mode of ventilating from below; the pierced floor of the House of Commons nearly answers this purpose, 1134-1144——The arrangements for the ventilation of the House of Commons are not complete at present; some of the openings being in an unfit state are not as yet used, 1136-1139——Bringing the air in at the ceiling is an unnatural mode; the chief circumstance to be considered with regard to an upward current is the dust; possibility of all difficulty arising from this cause being removed, 1144, 1145. 1155-1158——It is of great consequence that all the air which enters should be sifted by passing through wire gauze to prevent the entrance of dirt, 1159.

The presence of workmen, and the dirt consequent upon their labours about the building, would alone account for a great deal of the inconvenience experienced from dust, 1160-1166——There could be no difficulty in carrying into effect the plan of creating a plenum in the House by having to force the air through the carpet, 1167-1172——Objection to the ventilating current

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Arnott, Neil, M. D. (Analysis of his Evidence)—*continued.*

descending from the roof, 1173-1178——Difficulties in the way of lighting the House in the event of ventilation coming from the roof, 1179—The difficulties arising from the overheating of the upper portion of the House could be better overcome by the ascending system of ventilation than the descending system, 1180.

How far it is possible to fill the House with a plenum so that its general temperature should not be affected by contact with air of a different temperature, 1181-1187——In case of the introduction of warm air from the roof, it is doubtful whether the Members would derive any benefit from it whatever, 1188-1192——Witness does not approve of the system of ventilation in the House of Lords, 1193-1197——Mode witness would propose for discharging the vitiated air where it tends to accumulate, 1198-1209——System at present pursued in the House of Commons for the discharge of the vitiated air, 1199-1205——Witness sees no difficulty in adopting the system of the plenum movement only in the ventilation of the House of Commons, 1210.

With a perfect system of ventilation, there would be no need of pumping or forcing out the vitiated air, 1211-1214——Sufficiency of the discharging apertures for the vitiated air in the House of Commons for the adoption of any system of ventilation, 1215-1218——The greater density of the atmosphere within the House by witness's plenum system, would be very little, not sufficient sensibly to affect the respiration, 1219, 1220——One system of ventilation would answer for the whole of the House of Commons buildings, as well as the House itself, 1221——Necessity for the person charged with the ventilation of the Houses of Parliament having the complete control of the means necessary for accomplishing it, 1222-1225——Objection to the present system of giving to the House the fit degree of temperature by means of steam, 1226-1275.

The distribution of the machinery and pipes for warming the House is good, and might be applied in the carrying out of witness's system, 1242-1245. 1272——Explanation as to the changes and simplification of the system of giving the House a fit degree of temperature, which witness would propose to be carried out, 1246-1249——How far the present means of mixing the air in the Houses of Commons and Lords are sufficient to produce a proper ventilation, 1258-1277——Importance of supplying sufficient moisture to the air of the House; suggestions as to the best mode of effecting this object, 1277-1289.

Unsatisfactory state of the present lighting of the House of Commons, 1290, 1291——Recommendation that the gas-lights should be placed above the ceiling, and the House lighted by means of grass panels, 1291-1303——The gas used in lighting the House is of the ordinary kind, and not the best quality; it gives much heat, and not very much light, 1292, 1293——Side lights might be placed where the painted windows now are, 1298-1304——Witness considers a system of lighting by wax candles exceedingly inferior, for many reasons, to gas-lighting well managed, 1305-1310.

The system of gas-lighting for the House, with a false glass roof and the lights above it, would be sufficient for lighting the House of Commons, 1311-1319——

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Arnott, Neil, M. D. (Analysis of his Evidence)—*continued.*

1319——Even using the very best description of gas in the present lamps of the House of Commons, would not remove the great inconvenience felt; the heat would still be excessive, 1320-1322——The difficulties of ventilating the House of Commons are very great, so as to render it comfortable for a large body of Members, 1324. 1326——Until the late House of Commons existed, there never was in the world a room in which 500 or more persons could sit with comfort for 10 hours in the day, and day after day; it was a perfect novelty in regard to the science of ventilation, 1324——System of ventilation adopted by witness for the Hospital for Consumption, 1325.

Arnott, Dr. See *House of Commons,* IV. 1.

Artificial Temperature. Witness's objection to the temperature of the House of Lords is that it is too artificial, *Lord Redesdale* 669-676.

Artificial Ventilation. There is a great deal of artificial preparation for ventilation in many of the rooms, which is not required, *Gurney* 2787——Witness has never done anything except to overcome the impediments which artificial circumstances throw in the way of ordinary ventilation, *Reid* 3534, 3535.

Atmosphere of the House. See *Dryness of Atmosphere. Heat. Impure Air. Mixture of Air. Temperature.*

Ayliffe, William. (Analysis of his Evidence.)—One of the police doing duty at the House of Commons, 269, 270——Attends in the cloisters, 270, 271——Comes on duty at ten in the morning; opens the doors leading from the cloisters into Westminster Hall; suffocating nature of the atmosphere of the cloisters till the doors are opened, 272 *et seq.*

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Bardwell, Mr. Letter from Mr. W. Bardwell, dated 27 April 1852, *Rep.* ii. *App.* 569.

Barometric Balance. Opinion that under witness's system the barometric or feather balance of the air could be preserved to a great nicety *Gurney* 821-828. 831-849——Witness does not agree with Mr. Gurney that by his system the barometric balance could be preserved to such a nicety that a window might be opened without any rush of cold air being felt, *Daukes* 1844-1847. 1855-1859. 1927-1932.

Barry, Sir *Charles,* R.A. (Analysis of his Evidence.)—Grounds on which witness has declined to furnish Dr. Reid with certain drawings which he states in his report it is necessary he should have access to in order to make his report complete, 707 *et seq.*——The only true method of ascertaining what the arrangements are is to examine the building itself, and Dr. Reid has been offered every facility for this, 707-719——How far any difference has been made in the construction of the main air-flues of the House of Lords and that portion of the structure which is under witness's orders, to the disadvantage of that portion over which Dr. Reid exercises authority, 720-723.

Reports, 1852—*continued.*

Barry, Sir *Charles*, R. A. (Analysis of his Evidence)—*continued.*

Witness has delivered up as finished, to the Crown, all those portions of the building which are at present in occupation, 725——They are not delivered up as complete, they are only delivered up for the purpose of being under the charge and control of the Office of Woods during their occupation, and until the completion of the several rooms can be proceeded with, 725-727——The charge of the ventilation is at the present moment generally under witness's control, but with the assistance of the officers of the Department of Works, 728, 729——Extent to which various works have been performed, such as putting down gas-pipes, and making smoke-flues and other works, without Dr. Reid's knowledge, which have interfered with the ventilation of that portion of the House of Commons under his charge, 731-733——Witness conceives that he has the post-office entirely under his charge, 734-735.

The painting of the perforated iron plates is exactly similar in both Houses of Parliament, 736——Witness is not aware that it affects the air which passes into the House of Peers through the bottom of the House, 737——Reference to the application made by Dr. Reid to the Commissioners of the New Palace, requesting that the paint might be removed; refusal of the Commissioners to comply with this request, 738, 739——When the whole of the ventilating arrangements are complete, the inconveniences which have been complained of as regards the various offices on the ground-floor will be remedied; they were not originally intended for offices, but merely for store-rooms, 740-742. 744.

Witness was not aware that any complaints had been made respecting the foulness of the air in the cloisters; can only attribute it to the incompleteness of the arrangements, 743, 744——Detail of the plan by which the committee-rooms are ventilated; the complaints which are made are also attributable to the present incompleteness of the arrangements, 745-760——Brief general description of witness's whole plan of ventilation, 761-781——Witness's belief is that the radiation of heat from the chandeliers, as they are now placed, is very inconsiderable upon the gallery, 782, 783.

Witness has no doubt the apparatus which he now has would be amply sufficient to supply ventilation to the House of Commons, as well as the House of Lords, if the whole were under his control, 784——Witness would require a larger staff and a more efficient staff than he has at present, 785. 788-792——Number of men now employed on the ventilation of the part of the building under witness's charge; amount of their wages, 786. 788-792——(Dr. *Reid.*) The number employed under witness for the ventilation of the House of Commons has never been arranged, 787——Witness's establishment is in the position in which it was when witness was deprived of his office, and the same parties are with him who were with him in the old Houses, 787——At the present moment there are such various works going on, and so much dust is made from this and the intrusion of labourers through doors that are not locked, that it requires four men to attend to the dusting alone, 787——(Sir *C. Barry.*) It is of the greatest importance that the lighting and warming should be under one superintendence, 793.

[Second

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Barry, Sir *Charles*, R. A. (Analysis of his Evidence)—*continued.*

[Second Examination.]—Description of the mode of warming and ventilating the House of Lords and other portions of the building, under the control of the architect, delivered in and read, 1377.

[Third Examination.]—Explanation generally upon the subject of the paper delivered in by witness, giving an account of his method of ventilation, 1378 *et seq.*——Besides other motive powers referred to by witness, there are certain local rarefactions which cause certain currents; remarks thereon, 1380, 1381——Explanation with respect to the air passing through the channel from the Victoria Tower before it reaches the fan, becoming purified by water, 1382-1388——Each of the apartments has a separate warming apparatus in the basement for its special use; the effect has been perfectly successful, 1389-1394——Great advantage would result from the double glazing of the windows in the east front, 1395, 1396.

There is a complete similarity of operation under witness's system of ventilation throughout the entire building, namely, a downward admission of tempered air, and an upward discharge of vitiated air, 1397-1401——Evidence as to the force and direction of the attempered air which descends through the ceiling, reversing the ordinary current of the air, 1402-1422——Necessity for the double process of purification of the air, as adopted in witness's system of ventilation, 1423——There is no evidence that in ancient building any means of ventilation were adopted, not even in times of Sir Christopher Wren or Inigo Jones, 1424-1430.

The subjects of warming and ventilation form no part necessarily of the profession of an architect, but questions with which most architects are to some extent familiar, 1441-1450——Cause of the oppression which is felt from what is commonly called overheated air; the want of a due proportion of moisture is another cause, 1461-1463——The structural arrangements required by Dr. Reid for warming and ventilating were carried into effect under witness's direction, 1468——Any requirements of Dr. Reid were attended to during the progress of the work, 1469-1478——The mode adopted for lighting the House is too complicated, and is attended with many inconveniences; the present mode was adopted so as not to interfere with the ventilation of the House, under the direction of Dr. Reid, 1479——The removal of the panels from the ceiling of the House would be attended with much difficulty, and expense, 1480-1491——The ventilation of the urinals and closets is wholly and entirely under the control of Dr. Reid, 1492, 1493.

The suggestions of Dr. Reid for improving the lighting of the House being experimental, it would be necessary, before any alterations are made, that those suggestions should be more accurately explained in detail, 1494, 1495——Detail of the mode at present adopted for lighting the House of Commons; the system adopted in the House of Lords is more easily managed; 1496-1506——The whole of the structural arrangements with regard to the ventilation of the entire New Palace at Westminster were contrived by Dr. Reid and executed by witness up to the period of Dr. Reid's dismissal, 1507——Modifications made in Dr. Reid's system of ventilation, under witness's direction, 1507-1520——The mode of warming and ventilating the House of Lords, as effected by witness, is by the downward current, 1515. 1572-1587——Witness is not

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Barry, Sir *Charles*, R.A. (Analysis of his Evidence)—*continued.*

aware that the system of lighting adopted in the House of Commons has prevented Dr. Reid from employing the downward current, 1521, 1522.

Witness proposed to improve the lighting of the House by an arrangement, by means of which the radiating light should be a little below the ceiling; it would not be necessary to remove more than a very few panels to effect this object, 1523, 1524. 1602, 1603——If the ceiling of the House were full of apertures, for the purposes of lighting, and the upward current were adopted, it would greatly affect the acoustic properties of the House, 1525, 1526—— Witness is not aware of any suggestion by which the acoustic properties of the House of Commons might be improved, 1527-1542——Approval of the principle of lighting from above, and of the interposition of glass as a means of preventing the radiation of heat, as suggested by Dr. Arnott, 1543-1547.

Opinion that it is quite practicable to attain a uniform velocity, and perhaps more uniformity, by the fan than by the pump, 1548-1551——At present witness's ventilation staff only consists of seven persons; the abandonment of the steam-engine would result in a larger staff being required, 1552-1560—— Number of steam jets employed about the House for the purposes of ventilation; when completed, no noise will proceed therefrom, 1561-1563——The present engine-power would not be sufficient, supposing the ventilation of the whole Palace were placed under one superintendence, 1564-1571. 1648-1657.

There would be no difficulty whatever in discharging the vitiated air wholly from the floor, but it might be inconvenient, 1580-1583. 1644-1647——The air should be both supplied and discharged from the ceiling, 1581——Objection to the upward-current ventilation, 1586——The employment of the fan or the pump would not affect the principle of ventilation; they are merely a means to obtain the ventilation, totally irrespective of the principle to be employed, 1588-1590. 1639-1643——Course pursued upon the discovery of defects in the ventilation; reports made to witness upon the subject, 1591-1601. 1620, 1621. 1628——Evidence as to the new system of lighting, called the "sun light" or "rose light," in use at Liverpool; how far applicable to the lighting of the House of Commons, 1604-1619.

It is intended to make a perfect system of ventilation in the cloisters; the defect exists simply because the arrangements are not yet completed, 1628-1635——No alteration will be necessary in the foul-air shafts for the discharge of smoke, 1636——It is intended to make use of the Central Tower; the building of this tower was suggested by Dr. Reid, 1637, 1638——It is more easy to maintain a plenum in the House by the double column than by making the egress entirely through the floor, 1647——Reasons for witness preferring the double system of discharging the vitiated air, the descending and ascending currents, 1658-1677——Cause of witness adopting the two sources of motive power, the steam jet and the fan, both in the supply and the discharge of the air, 1675.

Barry's System. Detail of the system adopted by Sir Charles Barry to ventilate those portions of the New Palace under his superintendence, *Rep.* ii. *p.* iv, v——Brief general description of witness's whole plan of ventilation, *Sir C. Barry* 761-781——With the additional assistance which other portions

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Barry's System—continued.

portions of the building offer, witness has no doubt that the apparatus which he now has would be amply sufficient to supply ventilation to the House of Commons as well as the House of Lords, if the whole were under his control, *Sir C. Barry* 784——Witness would require a larger staff, and a more efficient staff, than he has at present, *ib.* 785. 788-792——There is a complete similarity in operation by witness's system of ventilation throughout the entire building, namely, a downward admission of tempered air, and an upward discharge of vitiated air, *ib.* 1397-1422——Sir C. Barry's system is tolerably perfect in its application, and may be taken as a fair sample in the House of Lords and the adjacent portions, *Meeson* 2542-2544———Description of the mode of warming and ventilating the House of Lords and other portions of the New Palace at Westminster, amounting to about four-fifths of the entire building, under the control of Sir Charles Barry, *Rep.* ii. *App.* 599.

See also *Control.* *Gurney's System.* *House of Lords.* *Lighting*, 1. *Purification of Air.*

Basement. See *Sources of Supply of Air.* *Vaults.*

Berwick Prison. Introduction of the descending current of ventilation into the prison at Berwick; this prison was erected under the management of the English Board of Commissioners, *Brown* 3691-3704.

Blackman, Thomas. (Analysis of his Evidence.)—One of the servants of The House; doing duty in the cloak room; suffocating nature of the atmosphere of the lobby of the House in the morning when witness goes through it to the cloak room, 294-304——It has been much better since the doors have been put up in the cloisters, 305-315.

Board of Works. Witness has delivered up as finished, to the Crown, all those portions of the building which are at pressnt in occupation, *Sir C. Barry* 725——They are not delivered up as complete, they are only delivered up for the purpose of being under the charge and control of the Office of Woods during their occupation, and until the completion of the several rooms can be proceeded with, *ib.* 725. 727.

Witness delivers in a coloured plan, showing the portions of the New Palace of Westminster in charge of the Board of Works; formal method in which these portions have been delivered over by the architect to the Office of Works, *Phipps* 3377-3385——An officer had been already appointed to take charge of those portions of the building delivered over to the Office of Works; it is the same officer who had charge of the old Houses of Parliament, *ib.* 3386——The appointment is not in the Board of Works, *ib.* 3387——The Board of Works pay all the accounts for repairs, *ib.* 3388-3390.

No expense can be incurred for any alteration in the system of warming and ventilation without the sanction of the Board of Works; this applies also to any purpose connected with the fabric; witness believes no alterations have been made without such application, *Phipps* 3408-3424. 3426-3428. 3447-3454——The whole of those parts of the buildings which have been handed over by Sir C. Barry to the Commissioners of Works were not finished at the time, and they have been finished under the direction of Sir C. Barry, *ib.* 3429-

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Board of Works—continued.

3431——In certain portions of the building Sir Charles Barry's men are performing certain unfinished works, and the men of the Board of Works employed on the repairs are in some instances working together; no inconvenience arises from this, *ib.* 3432-3441. 3454.

The Board of Works exercises some supervision over every portion of the building during the progress, *Phipps* 3457-3463——Witness considers the entire fabric of the building under the charge of the Board of Works, *ib.* 3467——Witness does not consider the warming and ventilation of the House, nor the lighting, to be under his charge, *ib.* 3468-3474.

See also *Control.*

Bowles, Major-general Sir *George,* K. C. B. (Analysis of his Evidence.)—Was formerly Master of the Household to the Queen; is, generally speaking, well acquainted with the state of the ventilation of Windsor Castle, 1818, 1819——Imperfect ventilation of the apartments up to the year 1847; improvement therein since it has been under the superintendence of Mr. Price and Mr. Turnbull, 1820-1834.

Brown, Thomas. (Analysis of his Evidence.)—Architect, at Edinburgh, 3674——Has erected several public buildings; almost all the prisons erected or enlarged in Scotland for the last twelve years have passed through witness's hands, 3675-3677——Suggestions made by Dr. Reid to witness on the subject of ventilation; adoption of the suggestions of Dr. Reid, and successful operation of the system, 3683-3690. 3782-3793. 3808-3812——Introduction of the descending current of ventilation into the prison at Berwick; this prison was erected under the management of the English Board of Commissioners, 3691-3704——Witness prefers the ascending current to the descending, 3698——Comfortable state of the ventilation of the House of Commons, 3705-3724——Good quality of the air supplied to the House, 3711——Comfortable state of the warming and ventilation in the corridors, 3714-3718.

The arrangements for warming, and for the escape of air, are very nearly perfection, if they were properly managed, 3722——Possibility of carrying out a system of ventilation without making use of the windows as a means of ingress, 3725-3737——Witness has no objection to the supply of air for the House being taken from the vaults, provided they are kept clean and absolutely dry, 3738-3748——Mechanical power need not be used for forcing the air in, as quite sufficient air could be obtained without it, 3749-3752——The furnace in the shaft witness considers to be a very manageable power, and preferable to the jet or fan, 3753-3756. 3805-3807——There does not appear to be any unnecessary apparatus used in the warming and ventilation of the House, 3757——The lights very much assist the ventilation of the House, 3758-3760——In bringing air in at the roof, and carrying it out at the roof, witness doubts whether it would go down to the floor, 3766.

Difficulty of working a system of ventilation where the floor was made both the ingress and egress of the air, 3767-3770——Witness never found that heating the air by means of hot-water pipes had any effect on the quality of the air, 3771-3775——Witness would prefer heating the whole quantity of air

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Brown, Thomas. (Analysis of his Evidence)—*continued.*

air required to warming a portion above the required temperature, and then mixing it with cold air until the required temperature was obtained, 3776-3778——Remarks relative to the use of glazed stoneware pipes, 3779-3781——Witness is not aware of any means by which the inconvenience arising from the dust, from the air being admitted through the carpet, could be remedied; using perforated lead for the flooring would be liable to the same objection, 3794-3804——Necessity for some provision being made to prevent currents; suggestion that double and treble or four doors should be tried, 3812-3814——Great advantage would result from the ventilation of the whole building being in the hands of one directing authority, 3815-3817——Statement as to the variations of temperature in the House of Commons on the night of the 3d May 1852; from the slight difference observable, witness considers the present system to be very perfect in its operation, 3818-3822.

Bude Light. Witness decidedly considers the introduction of lights inside the House objectionable; witness's first proposal was to light the old House of Commons by oil and oxygen, called the Oxygen Bude Light; it was tried for nearly two years, *Gurney* 3065-3069——It was abandoned partly on account of the expense of the oxygen, and partly on account of witness's discovery of being able to produce the same quantity and quality of light by a more simple process, *ib.* 3070-3072——Witness would propose the "Atmospheric Bude Light," with concentric burners, as used in the old House, *ib.* 3315-3323.

Bull, James B. (Analysis of his Evidence).—Clerk to the Public Petitions Committee, 143——Defective state of the ventilation of the office, 144-151——Witness has no special complaint to make of the lighting, 148.

C.

Carpet. The admission of fresh air is stifled by the perforated floor being covered with a carpet; there would be plenty of fresh air passing through if the carpet were removed, *Daukes* 1734. 1876-1878——Witness is not aware of any means by which the inconvenience arising from the dust, from the air being admitted through the carpet, could be remedied; using perforated lead for the flooring would be liable to the same objection, *Brown* 3794-3804.——*See* also *Dust.* *Floor of the House,* 1.

Caustic Air. Witness would call the air in the lobbies, large halls, and corridors, "caustic;" explanation of this term, and way in which witness supposes this state of atmosphere to arise, *Gurney* 2879-2881.

Ceiling of The House. The system of gas lighting for the House, with a false glass roof, and the lights above it, would be sufficient for lighting the House of Commons, *Arnott* 1291-1303. 1311-1319——Such a system of lighting would not interfere with any mode of ventilation which might be adopted, *ib.* 1313, 1314——The removal of the panels from the ceiling of the House would

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would be attended with much difficulty and expense, *Sir C. Barry* 1480-1491——Approval of the principle of lighting from above, and of the interposition of glass as a means of preventing the radiation of heat, as suggested by Dr. Arnott, *ib.* 1543-1547——Witness has seen the contrivance adopted in the House of Commons at present for lighting; no advantage would be gained by having ground glass beneath the lights, *King* 2253-2257. 2327, 2328.

Grounds on which witness comes to the conclusion that to effect a perfect system of lighting in the House, it is desirable to take away all the panels in the roof, *Leslie* 3183. 3190-3193——Suggestions that there should be a gas supply all round the edge of the panels, with perfectly fixed and secure lights inside of each opening; no assistance of external lighting would be required, and the House would be splendidly lighted for about half a crown an hour, *ib.* 3199-3210——No obstruction of glass should be placed in the panels, as it would take a great per-centage from the light, *ib.* 3211.

Witness proposes to illuminate the whole of the panels in the central part of the roof, *Gurney* 3293-3302. 3306-3314——Pleasing effect which would be produced by having the surface, that is, the roof and the ceiling of the House, of an agreeable reflecting colour, *ib.* 3296-3299. 3301, 3302——Evidence in favour of putting a small light in every panel of the roof of the House in preference to a larger light in a smaller number of panels; how far witness concurs in the opinion of Mr. Gurney as to the desirableness of the diffusion of light, *Reid* 3483-3489.

See also *Acoustic Properties of the House. Cornice Lights. Downward Current Ventilation. Floor of the House,* 1. *Reflected Light. Roof Lights. Vitiated Air.*

Central Tower. Opinion that the Central Tower may be made to act most efficiently upon numerous causes of evil at present existing, *Reid* 210——It is intended to make use of the Central Tower for the purposes of ventilation; the building of this tower was suggested by Dr. Reid, *Sir C. Barry* 1637, 1638.——*See* also *Clock Tower.*

Chalmers, Robert. (Analysis of his Evidence.)—Head of the Committee Clerks' office, 1——Satisfactory state of the ventilation of the office, 2-7——Great inconvenience arising from the chimnies smoking, particularly when the wind blows from the east or north-east quarter, 3. 6-12——Also from draughts from the windows not being sufficiently tight, 5. 9, 10.

Chandeliers. Improvement of the lighting since the chandeliers have been raised; still it is not now perfect or convenient, *Thornton* 32-36——Witness's belief is that the radiation of the heat from the chandeliers, as they are now placed, is very inconsiderable upon the gallery, *Sir C. Barry* 782-783.

Clark, William. (Analysis of his Evidence.)—Civil Engineer, 1327, 1328——Has been practically engaged in ventilating and warming several buildings, 1329-1331——Evidence relative to the ventilation of the court at Hull, under witness's superintendence; adoption of Mr. Gurney's system of ventilation, 1330-1363——

Reports, 1852—*continued.*

Clark, William. (Analysis of his Evidence)—*continued.*

1330-1363——Grounds on which witness prefers the downward ventilation to any other system, 1359——Witness has been engaged in the ventilation of the assize courts at York; adoption of the downward system, and satisfactory result, 1364-1367——The cost of effecting the improvements in the ventilation of the court at Hull was very small indeed, 1368——Witness attributes the complaints made of the ventilation of the House of Commons and the committee-rooms to the adoption of the upward principle of ventilation, 1369-1376.

Clifford, Sir *Augustus W.,* Bart. (Analysis of his Evidence.)—Usher of the Black Rod, 532-534——General satisfactory state of the ventilation of the House of Lords; complaints are occasionally made by the Peers of draughts; means which have been taken to obviate them, 535-556.

Clock Tower. Witness's original plan was to have drawn the supply of air from the Clock Tower and the Victoria Tower, and to have discharged it from the Central Tower; way in which this arrangement has been interfered with, *Reid* 454-464——Witness would prefer the Clock Tower as the source from which to draw his supply of air, *Gurney* 956-962.

Cloisters. Witness comes on duty at ten in the morning; opens the doors leading from the cloisters to Westminster Hall; suffocating nature of the atmosphere of the cloisters till the doors are opened, *Ayliffe* 272 *et seq.*—— It is intended to make a perfect system of ventilation in the cloisters; the defect exists simply because the arrangements are not yet completed, *Sir C. Barry* 734. 744. 1628-1635——Inquiry instituted into the cause of the policeman's complaints in respect of the ventilation of the cloisters, and result, *ib.* 1464-1467. 1591-1601.——*See* also *Lobby.*

Coals. Large quantity of coals consumed in the committee-rooms; one quarter of the coals would be quite sufficient upon witness's system of warming, *Leslie* 3156.

Cold Air. The mode adopted by Dr. Reid to diffuse the cold and fresh air is quite inadequate to its purpose, *Daukes* 1875-1886. 1917, 1918.

See also *Currents of Air. Draughts. Mixing Air. Variations of Temperature. Windows.*

Colney Hatch Lunatic Asylum. Witness designed and carried into execution the building of the Colney Hatch Lunatic Asylum; successful ventilation of the building, *Daukes* 1684-1692——The system of ventilation in the Colney Hatch Asylum is by the vacuum principle, and performs satisfactorily, *ib.* 1715-1725——Necessity for seven apparatuses for the ventilation of the Colney Hatch Asylum from the enormous extent of the building, *ib.* 1919-1926——Satisfactory results of the system adopted by witness at the Colney Hatch Asylum, *Price* 2450-2457——Papers relating to Colney Hatch Lunatic Asylum, *Rep.* ii, *App.* 572.

Coloured Light. The present light is rather too white; light a little coloured is far more agreeable than pure white; this can be carried out when it is reflected through glass, *Gurney* 3020. 3022-3032.

Combination

Reports, 1852—*continued.*

Combination of Systems. Opinion that the Houses of Parliament, committee-rooms, &c. could be much better warmed and ventilated separately than by one combined system, *Leslie* 3154.

Committee Clerks' Office. Satisfactory state of the ventilation of the Committee Clerks' Office, *Chalmers* 2–7——Draughts, from the windows not being sufficiently tight, *ib.* 5. 9, 10.

Committee Rooms. Observations of the Committee on the defective state of the ventilation of the committee-rooms, *Rep.* ii., *p.* vii——The ventilation of the committee-rooms is very defective, and the rooms consequently extremely disagreeable, *Legh* 79, 80; *Patten* 111, 112. 116——Evidence in detail as to the plan by which the committee-rooms are ventilated; the complaints which are made are attributable to the present incompleteness of the arrangements, *Sir C. Barry* 745–760; *Meeson* 2655–2734.

Suggestion for curing the defects in the warming of the committee-rooms, arising from the cooling process of the large surface of windows, *Gurney* 2787–2825. 2871–2878. 3016——The result of the present means adopted for supplying air, and carrying off the vitiated atmosphere of the committee-rooms, is very unsatisfactory, *Leslie* 3156. 3184——Great advantage would result from the committee-rooms being warmed and ventilated separately, *ib.* 3156–3182——Way in which this might be effected, *ib.*——All the arrangements are entirely subverted in the practical effects they produce, from the manner in which the flues for ingress and egress are used, *Reid* 3563——Complaint of the Committee on the Nene Navigation, dated 10 May 1852, *Rep.* ii. *App.* 573.

Continent, The. Grounds on which witness forms the opinion that elaborate systems of ventilation are now being carried out on the Continent, *Reid* 433, 434.

Control. Opinion of the Committee, that much of the inconvenience in regard to ventilation has arisen from the want of a proper understanding between Sir C. Barry and Dr. Reid, to whom the superintendence of different parts of the building has been confided, *Rep.* ii., *p.* v——Recommendation of the Committee, that for the future divided responsibility should be avoided, and that the ventilation of the Houses of Parliament should be placed in the charge of one person only, *ib.* v, vi——Grounds on which the Committee form the opinion, that until the whole building is placed under the absolute control and vigilant supervision of the Board of Works, it is vain to expect good service or economy, *ib.* ix——Opinion also, that all attempts at inquiry will be baffled by the allegation of divided responsibility, *ib.*——Recommendation of the Committee, therefore, that as regards future management, the entire responsibility of ventilating and lighting the House and its appendages should be confided to one competent person, under the direction and supervision of the Board of Works, *ib.*——Recommendation of the Committee, that with a view to secure attention to any complaints that may hereafter arise, a committee should be named to confer with the Board of Works upon the measures necessary to remove such complaints, *ib.*

Certain

Reports, 1852—*continued.*

Control—continued.

Certain portions of rooms which ought to be under witness's control are actually being ventilated both by Sir Charles Barry and himself, *Reid* 179-181——The charge of the ventilation is at the present moment generally under witness's control, but with the assistance of the officers of the department of Works, *Sir C. Barry* 728, 729——Extent to which various works have been performed, such as putting down gas-pipes and making smoke-flues and other works, without Dr. Reid's knowledge, which have interfered with the ventilation of that portion of the House of Commons under his charge, *ib.* 731-733——Great advantage would result from the ventilation of the whole building being in the hands of one directing authority, *Sir C. Barry* 793; *Brown* 3817.——*See* also *Board of Works.*

Cornice Lights. Witness would light the House of Commons on the principle of cornice lights, by carrying a light round the lower part of the inclined portion of the ceiling, *King* 2310——A system of burners might be arranged round the lower part of the sloped roof of the House so as to be sightly; witness would have no apprehension from any danger that might arise to the roof, although it is of timber, *ib.* 2318-2326. 2333-2336——The same system of lighting might be adopted in the cornice in the square part of the House, *ib.* 2330-2332——Cost at which this system of lighting might be adapted to the present House of Commons, *ib.* 2347, 2348. 2357, 2358.

Opinion that the cornice light would be inapplicable to the House of Commons; it would be brought down to too low a level; witness also considers the sun-lights as applied in the Philharmonic room at Liverpool an objectionable mode of lighting the House, *Stephenson* 3907-3911——But if sixty-four of these clusters were diffused over the flat part of the ceiling of the House of Commons, the effect would be extremely good, *ib.* 3907-3909. 3927-3932.

See also *Liverpool Philharmonic Hall.* *Sun-Burners.*

Corridors. Comfortable state of the warming and ventilation of the corridors of the House of Commons, *Brown* 3714-3718.

Currents of Air. Under witness's system, supposing the temperature of the House to be fifty or sixty degrees, and the external temperature to be 320, if either doors or windows were opened there would be no current of air; the disturbance would be so small it would be scarcely perceptible, *Gurney* 830-841. 846-855——Witness's opinion with respect to the complaints of the current of cold air which comes into the building on the opening of the doors is, that it arises from the state of exhaustion of the House itself; the House itself being in a state of exhaustion or *minus* pressure, *ib.* 856. 861-865. 868——Evidence showing that if this state of vacuum did not exist, the air within the building might be kept at sixty-five degrees without any scarcely perceptible current of air on the opening of the doors, *ib.* 857-864. 866.

See also *Doors.* *Downward Current Ventilation.* *Draughts.* *Fan and Pump Apparatus.* *Velocity of Currents.*

Reports, 1852—*continued.*

D.

Daukes, Samuel Whitfield. (Analysis of his Evidence.)—Architect; has been eighteen years engaged in the profession, 1678, 1679——Has been a competitor for several works of magnitude, 1680-1683——Witness designed and carried into execution the building of the Colney Hatch Lunatic Asylum; successful ventilation of the building, 1684-1692——Construction of the Small Pox Hospital by witness, and ventilation thereof upon his principle, 1693——Objections to the principle of ventilation adopted by Sir Charles Barry in the House of Lords and the committee-rooms, and to the manner in which it is developed, 1694-1698.

Detail of witness's system of ventilation, as successfully carried out in the buildings committed to his care, 1699-1711 ——Witness considers the natural upward passage of the vitiated and hotter air to be adequate to produce a sufficient and constantly recurring supply of fresh air into the building to be ventilated, 1710——Impossibility of successfully applying a forced ventilation to the Houses of Parliament, 1712-1714——The system of ventilation in the Colney Hatch Asylum is by the vacuum principle, and performs satisfactorily, 1715-1725——The principle of ventilation adopted in the House of Commons is at present incomplete; the supply of fresh air is not adequate to the requirements of the House, and consequently there is not an escape of the vitiated air, 1726-1728. 1730-1737.

Causes of the variety of temperature felt in the House, 1729——The admission of fresh air is stifled by the perforated floor being covered with a carpet; there would be plenty of fresh air passing through if the carpet were removed, 1734. 1785-1804——Witness does not consider that when the works are completed, and the whole principle in force, that the ventilation will be satisfactory, 1738-1740——The gas-lamps would have no prejudicial effect in an upward-current ventilation, 1741——The ventilation of Exeter Hall is natural ventilation, and acts successfully, 1742-1744.

The artificial system of ventilation adopted by witness, which has been found successful in the several buildings in which employed, is exceedingly simple in construction, and easy of regulation; it is what is called Mr. Price's plan, 1745-1749——Manner in which the air is diffused under witness's system; it is under complete control, 1750-1761——Witness prefers the tractive power of ventilation only, to the forcing power, or the union of the two, 1762——The present apparatus for the ventilation of the House of Commons is not applicable to what witness considers a complete system; alterations necessary for adapting the apparatus to witness's system, 1763-1781. 1808-1817.

Opinion that where there is a current of air passing through a vault a very disagreeable close smell will be discoverable in the air, 1782-1784——Detail of the mode which witness would adopt for improving the warming and ventilation of the House, 1804-1807.

[Second Examination.]—The system of warming proposed by witness would be perfectly under command, so that it could be raised or lowered at pleasure, 1835-1843——Witness does not agree with Mr. Gurney that by his system the barometric balance could be preserved to such a nicety that a window might

Reports, 1852—*continued.*

Daukes, Samuel Whitfield. (Analysis of his Evidence)—*continued.*

might be opened without any rush of cold air being felt, 1844–1847. 1855–1859. 1927–1932——Witness never heard any complaints of the system of warming and ventilating advocated by him (Price's system), 1848–1854——Objections to the present air channels of the House of Commons, as they pass through subterranean vaults, 1860–1867.

Mode proposed by witness for moistening the air, 1869–1874——The mode adopted by Dr. Reid to diffuse the cold and fresh air is quite inadequate to its purpose, 1875, 1876. 1917, 1918. 1933——At present the air is stifled in its very first discharge by the carpet covering the whole of the orifices in the floor, 1876–1878——Advantage of confining the uprise of tempered air to certain portions of the House, instead of making the entire floor a channel for the uprise of fresh air, 1879-1903. 1917, 1918——Placing ventilators for the admission of air on the risers of the steps in the gangways to the seats, would be the best position, as there would be little or no inconvenience felt therefrom, 1888–1901. 1912–1917. 1934–1936. 1950, 1951.

The centre of the House would be a very good position for the admission of moderately warmed air, 1902, 1903. 1952–1955——The present lighting of the House is not injurious to any contrivance for ventilation on the ascending principle, 1904——Mode in which witness proposes to regulate the temperature of the House; witness would admit the air at a temperature a few degrees lower than that at which it would be desirable to maintain it in the House, 1907–1911——Necessity for seven apparatuses for the ventilation of the Colney Hatch Asylum from the enormous extent of the building, 1919–1926.

Witness does not give Exeter Hall as at all a perfect specimen of the application of his principle, but merely to show what little assistance to natural ventilation is required, 1937–1942——The double system of letting the air enter the floor and drawing it out at the floor must operate very much against the ventilation, 1943. 1957–1959——There are no channels now existing from the roof of the House of Commons to conduct the vitiated air into the upper air shaft, 1944–1946——Witness sees no great objection to the admission of air above the heads of the persons occupying the building, if it were necessary, 1947–1949.

Witness is in favour of ventilating the House of Commons, or any building of the kind, from or near the floor, relying upon natural means of ventilation, with the assistance of an extracting shaft, with a rarefier in it in case of need, 1956——Opinion that the paint upon the floor would not interfere with the ventilation of the House of Commons, 1960, 1961.

Daukes, Mr. See *House of Commons,* IV. 2.

Dawes, Edward, M. P. (Analysis of his Evidence.)—Great inconvenience experianced in the House from the ventilation, but more particularly from the excessive glare and smell of the gas used in the lighting, 245–252——Unhealthy state of the galleries from the disagreeable smell of gas, and the bad state of the atmosphere, 247, 248.

Deadness of the Air. Witness has heard complaints of the deadness of the air, but does not think this can be avoided, *Lord De Ros* 689. 692. 694, 695.

Reports, 1852—*continued.*

De Ros, Lord. (Analysis of his Evidence.)—Is in the habit of attending the House of Lords pretty regularly, 686, 687——Has had opportunities of witnessing the effects of ventilation in barracks and various places allotted to a number of people, and in military hospitals also, 688——Witness would say that, generally speaking, the atmosphere of the House of Lords is good, 689, 690. 692-695——Has heard complaints of the deadness of the air, but does not think this can be avoided, 689. 692. 694, 695——The most perfect ventilation witness ever saw is at the Great Marine Hospital at Chatham, 691——Witness does not know whether this system could be applied to the House of Lords, 691——It is ventilated under the direction of Sir William Burnett, 696-698.

Descending System of Ventilation. See *Downward Current Ventilation.*

Diffusion of Air. Observations as to the best means of distributing the air to the different rooms and compartments, and of properly diffusing the air in each room, *Arnott* 1128 *et seq.*——The present mode of distribution is by hand regulation, as it may be called; advantage of something of self-regulation being introduced instead of having a valve to open and shut by hand, *ib.* 1128, 1129——The present channels are sufficient for the distribution of the air either by vacuum or plenum, *ib.* 1129-1131——Sufficiency of the present means of diffusing the air in the Houses of Parliament, *ib.* 1134, 1135.

Discharge of Air. See *Egress of Air. Downward Current Ventilation. Steam Jet. Supply and Discharge of Air. Vitiated Air.*

Doors. Difficulties experienced in the ventilation of the House of Commons from the cross currents arising from the doors, *Reid* 3549-3562——From the want of double doors the equalization on the floors does not act with the full beneficial effect that it otherwise would do, *ib.* 3571——Necessity for some provision being made to prevent currents; suggestion that double and treble or four doors should be tried, *Brown* 3812-3814.

See also *Currents of Air. Draughts.*

Dorrington, John Edward. (Analysis of his Evidence.)—Annoyances experienced in the Public Bills and Fees Office from the ventilation; complaints thereof, and improvements made therein, 160-165.

Double Windows. Great advantage would result from the double glazing of the windows in the east front, *Sir C. Barry* 1395, 1396; *Reid* 3563-3566.

Downward Current Ventilation:

1. *Opinions in favour of employing the Downward Current for the purpose of Ventilation.*
2. *Objections thereto.*
3. *How far the Lighting of the House interferes with the carrying out of the Downward Current satisfactorily.*

1. *Opinions in favour of employing the Downward Current for the purpose of Ventilation:*

The power of driving down a current of fresh air from above at times is an almost necessary incident to witness's system of ventilation as applied to the House,

Reports, 1852—*continued.*

Downward Current Ventilation—continued.

1. *Opinions in favour of employing, &c.*—continued.

House, *Reid* 358——Means resorted to to force the air down, *ib.* 363-369——Grounds for preferring the downward ventilation to any other system, *Reid* 606. 612-614; *Clark* 1359; *Sir C. Barry* 1515. 1572-1587; *Gurney* 2940-2965. 2971-3004——The air should be both supplied and discharged from the ceiling, *Sir C. Barry* 1581——Opinion that the air, when it enters the House from the roof, descends to the floor of the House before it seeks for its exit; experiment made in the House of Lords with a view of ascertaining this fact, *Meeson* 2578-2627. 2638-2654. 2760-2778——In bringing air in at the roof, and carrying it out at the roof, witness doubts whether it would go down to the floor, *Brown* 3766.

2. *Objections thereto:*

Grounds for objecting to the ventilating current descending from the roof, *Arnott* 1140. 1173-1178; *Leslie* 3183——In case of the introduction of warm air from the roof, it is very doubtful whether the Members could derive any benefit from it whatever, *Arnott* 1188-1192.

3. *How far the Lighting of the House interferes with the carrying out of the Downward Currents satisfactorily:*

The entire supplies of air from the roof are arrested by the intense heat from the burners, *Reid* 345-357. 362 *et seq.*——The gas tubes, under any circumstances, will become so hot as to interfere materially with the ventilation of the House, *ib.* 349-353. 595——The light which comes from the burners is very small in proportion to the heat which is produced by them, *Reid* 354-356; *Arnott* 1292, 1293——Impossibility at the present time of putting in operation the downward movement, from the state of the lighting and the leakage from the gas, *Reid* 583, 584. 596-598. 610-620.

Difficulties in the way of lighting the House in the event of ventilation coming from the roof, *Arnott* 1179——The difficulties arising from the overheating of the upper portion of the House could be better overcome by the ascending system of ventilation than the descending system, *ib.* 1180——Witness is not aware the system of lighting adopted in the House of Commons has prevented Dr. Reid from employing the downward current, *Sir C. Barry* 1521, 1522——Witness's system of ventilating would not interfere with the lighting of the present House of Commons, that is, as regards the down draught, *Gurney* 2966-2970.

See also *Berwick Prison. Gas. Upward Current Ventilation.*

Drainage. So far as witness is acquainted with the plan and arrangements for drainage, he would say they are most unaccountable; way in which they interfere with the ventilation, *Reid* 412-432.——*See* also *Sewage Drains.*

Draughts. Objectionable state of the ventilation of the House; prevalence of constant draughts, accompanied by considerable alterations of temperature, *Legh* 70-78. 81; *Patten* 108-110; *Romilly* 117-123; *Sir D. Le Marchant* 124-127; *Sir D. J. Norreys* 153-159——With respect to the evidence which

Reports, 1852—*continued.*

Draughts—continued.

has been given by several witnesses that they have been much incommoded by the inequality of the temperature, and by strong currents of air, witness believes that the remedies which he has suggested in his report will abate these evils, *Reid* 345——Till the system of ventilation can be introduced in full, there can be no diminution of these currents to the extent which is desirable, *ib.*——The ventilation is only partially in operation at present, *ib.* 346.

It is utterly impossible for witness to carry out a perfect system of ventilation whilst he is liable to have it deranged by violent cold currents, *Reid* 378 —— Opinion that the atmosphere of the Houses, in its mechanical condition, is in a state of considerable disturbance, a state of pneural commotion; way in which the present system of ventilation gives rise to those currents which have been complained of, *Gurney* 817 *et seq.*——When the two doors going into the House of Commons are opened, there is more air passes than is sufficient to ventilate five such houses, *ib.* 882–884——The sudden and unwholesome sensations of heat and cold and unpleasant draughts in the House might be completely guarded against, *Price* 2389——Way in which fresh air might be supplied without creating annoyance and draught, *ib.* 2405–2413.

See also *Currents of Air.* *Doors.* *Fan and Pump Apparatus.* *House of Lords.* *Libraries.* *Lobby.* *Reporters' Gallery.* *Velocity of Currents.* *Windows.*

Drawings and Plans. Impossibility of witness suggesting remedies for the existing evils in the ventilation without inspecting the drawings; refusal of Sir C. Barry to allow witness to see such drawings, *Reid* 211–215. 529–531. 567–579——Grounds on which witness has declined to furnish Dr. Reid with certain drawings which he states in his report it is necessary he should have access to, *Sir C. Barry* 707 *et seq.*——The only true method of ascertaining what the arrangements are, is to examine the building itself, and Dr. Reid has been offered every facility for doing this, *ib.* 707–719.

Dryness of Atmosphere. Complaints made by Members of there being something in the air which causes a tendency to cough, and considerable irritation in the chest and throat, *Sir D. Le Marchant,* 138——Inconvenience experienced from heat and cold, and from currents of air, and also from the peculiar sensations caused by the dryness of the atmosphere, *Right Hon. the Speaker* 316, 317——With respect to the air having at times been complained of as being dry, witness cannot imagine it to be the case that it is attributable to the dust from the floor-cloth, to any appreciable extent, *Reid* 359–361——Explanation as to the facility with which moisture may be introduced into the air, *ib.* 361.

Dust. The presence of workmen, and the dirt consequent upon their labours about the building, would alone account for a great deal of the inconvenience experienced from dust, *Reid* 787. 3545; *Arnott* 1160–1166; *Meeson* 3836–3838—— A portion of the air now enters the House through the hair-cloth carpet; this very much hinders its ingress into the house, and must have the effect of carrying with it particles of dust, *Gurney* 966–974——Way in which the annoyance of the dust which is now complained of might be met, *Price* 2391–2395.

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Reports, 1852—*continued.*

Dust—continued.

The entrance of the air through the carpet is by no means the general cause of the dust complained of; the principal cause is the uninterrupted passage of workmen, and the works in progress on the roof of the House, *Reid* 3545——Advantage of converting a portion of the floor into an exit for the air, as it carries with it a great portion of dust, *ib.* 3582–3590——Placing two or three thicknesses of hair-cloth over the floor where the Members walk would remove all the inconvenience at present felt from the dust, *Appold* 3850-3876

See also *Carpet. Mats. Sifted Air. Upward Current Ventilation.*

E.

Earthenware Pipes. Opinion of the Committee that glass or glazed earthenware would be a more appropriate material for heating the air than metal surfaces, *Rep.* ii. *p.* vi, vii——Suggestions for supplying a copious supply of fresh air through glazed earthenware pipes of large diameter, *Leslie* 3154, 3155. 3184-3186.

Egress of Air. The present means of egress of the vitiated air from the House is most objectionable, *Leslie* 3147–3153——In ventilating the House of Commons, witness would regulate the temperature by an aperture at the outlet, *Appold* 3655–3657——The arrangements for warming and for escape of air are very nearly perfection, if properly managed, *Brown* 3722.

See also *Clock Tower. Floor of the House. Ingress of Air. Plenum System. Supply and Discharge of Air. Vitiated Air.*

Engine Power. The present engine power would not be sufficient, supposing the ventilation of the whole Palace were placed under one superintendence, Sir *C. Barry* 1564-1571. 1648–1657.

Escape of Gas. Great inconvenience resulting from the escape of gas from pipes not under witness's control; this is one cause of the deterioration of the air in the House, *Reid* 3555–3560.——*See* also *Gas.*

Estimates. Evidence on witness's estimate of the probable cost of works in his report, *Reid* 469 *et seq.*——From what has been already expended on the improvements of the ventilation and the lighting, witness has no reason to suppose that his original estimate of 2,800 *l.* will be exceeded, *ib.* 2011–2062. 2120, 2121——Amount expended in reference to the works executed since the meeting of the Committee before the recess; the gross amount is 1,100 *l.*; witness's estimate was 2,800 *l.*; the whole of these works have not been executed, but could be completed for that amount, *ib.* 2486 *et seq.*—— Mr. Edge's account for gas-fittings has not been delivered, but witness believes it will amount to about 500 *l.*, *ib.* 2489–2496. 2506. 2520–2527—— The estimated expense of placing side-lights all round the House was 800 *l.*; by the omission of the side-lights that expense is avoided, *ib.* 2507–2509—— Nature of the works executed in the vaults, and practical result obtained

Reports, 1852—*continued.*

Estimates—continued.

from those works; the amount expended, 163 *l.* 15 *s.* 8 *d.*, is only a portion of that which witness originally contemplated for 400 *l.*, *Reid* 2510-2519.

See also *Lighting*, 3.

Exchequer, Court of. The Court of Exchequer was placed under Mr. Gurney's superintendence in the vacation of 1850, *Pollock* 797——Up to this time there had been very considerable complaints of the state of ventilation of the court, *ib.*——Admirable manner in which the temperature was regulated under Mr. Gurney's plan, *ib.* 797. 799, 800——Witness has seen the apparatus; it is very simple and very beautiful in its scientific bearings; witness believes the ventilation was under the superintendence of Dr. Reid before Mr. Gurney had it, *ib.* 798.

Evidence showing that witness never had the ventilation of the Court of Exchequer under circumstances under which he could execute it properly; was never empowered to ventilate the courts of law in the way which he desired, *Reid* 801——It is far more desirable to ventilate by the single action, as adopted in the Court of Exchequer, but it is one that cannot now be well introduced into the House of Commons under the present condition of the building, *Gurney* 2837-2839——Letter from Baron Parke, dated 3d April 1852, in answer to a communication addressed to him containing certain queries in reference to the ventilation of the Court of Exchequer and the law courts at Liverpool, *Ev. p.* 259.

Exeter Hall. The ventilation of Exeter Hall is natural ventilation, and acts successfully, *Daukes* 1742-1744. 1937-1942.

Exhalations. Observations on the difference of gases in all rooms inhabited by living creatures, the process of respiration constantly altering the composition of the air, *Gurney* 869——The laws of difference of gases soon produce an equal division of any effluvium that may happen to be floating in a room, *ib.*——But in the present condition of mechanical disturbance of the House, there is no disturbance of the laws of diffusion, *ib.*

Expenditure. See *Estimates.*

Expense of Lighting. The present mode of lighting is very expensive, *Leslie* 3189——The expense of carrying out the whole of witness's plan would be very inconsiderable; about 200 *l.* or 300 *l.*, in addition to the facilities which already exist in the House, *Gurney* 3328, 3329.

Experiments. Advantages which witness considers would result from his being allowed to fit up a single room in the building, on the model of the room which was the original cause of his being called in 1835 to the House of Commons, *Reid* 517-524——Evidence upon the subject of Mr. Gurney's experiments in the House of Commons; deficiencies in these experiments; Mr. Gurney has taken a very unfair advantage of witness in making those experiments, *ib.* 3568-3571. 3598.

External Air. Witness has always taken his supply of air, at all seasons, from the external atmosphere when pure, and it is only when the external air is in

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Reports, 1852—*continued.*

External Air—continued.

an impure state that he has made the vaults his source of supply, *Reid* 3536-3538——Inferior quality of the external air round the Houses of Parliament; by taking a supply from the towers an advantage is gained, *ib.* 3567.

F.

Fan and Pump Apparatus. Reasons for witness objecting to the use of the fan as creating currents, *Gurney* 885. 915, 916. 925-930——The employment of the fan and the pump would not affect the principle of ventilation; they are merely a means to obtain the ventilation, totally irrespective of the principle to be employed, *Sir C. Barry* 1588-1590——Necessity for some such mechanical aid as the pump and the fan-wheel for carrying out the present system of ventilation, *ib.* 1639-1643.

See also *Shaft.* *Steam Jet.*

Feather Balance. See *Barometric Balance.*

Fees Office. Annoyances experienced in the Public Bills and Fees Office from the ventilation; complaints made and improvements which have been effected therein, *Dorrington* 160-165.

Fire. Witness considers the alterations made in the lighting of the House during the recess to be of the most dangerous character; great danger of the roof taking fire, *Leslie* 3188, 3189. 3248-3259.——*See* also *Cornice Lights.*

Fireplaces. Proposal for warming and ventilating the House of Commons by means of open fireplaces in the house, *Leslie* 3183-3187.

FLOOR OF THE HOUSE:

1. *How far the Floor of the House is adapted to the Ventilating of the House from below.*
2. *Evil Effects resulting from the Oil Paint on the Floor of the House.*

1. *How far the Floor of the House is adapted to the Ventilating of the House from below:*

Observations of the Committee that one of the causes of the defective ventilation in the House of Commons is the want of a sufficient area of openings at the floor of the House; suggestions for remedying this defect, *Rep.* ii. *p.* vii ——Preference to be given to the mode of ventilating from below; the pierced floor of the House of Commons nearly answers this purpose, *Arnott* 1134-1144——Sufficiency of the present area of the House for admitting the required supply of air for the consumption of the House, if not impeded by the carpet, *Daukes* 1785-1804——Witness does not consider the method adopted by Dr. Reid for admitting the air into the House by the perforated floor a good one, *ib.* 1933. 1943. 1957-1959——The paint of the floor would not interfere with the ventilation of the House of Commons, *ib.* 1960, 1961——Objections to making the roof the means of ingress and the floor the means of egress; it is better if the air is put in at the ceiling, to let it go out again at the ceiling, *Meeson* 2779-2784.

Reports, 1852—*continued.*

Floor of the House—continued.

2. *Evil Effects resulting from the Oil Paint on the Floor of the House:*

Evidence showing the evil effects of the oil paint on the floor of the House; necessity for its removal as a measure of improving the ventilation, *Reid* 197–205. 236–238——The expense would not exceed 100 *l.*, *ib.* 206——The painting of the perforated iron plates is exactly similar in both Houses of Parliament, *Sir C. Barry* 736——Witness is not aware that it affects the air which passes into the House of Peers, *ib.* 737——Application made by Dr. Reid to the Commissioners of the New Palace, requesting that the paint might be removed; refusal of the Commissioners to comply with this request, *ib.* 738, 739——A very large portion of the oil paint has been removed from the floor, *Reid* 1999, 2000.

See also *Admission of Air. Carpet. Dust. Ingress of Air. Plenum System. Tempered Air. Vitiated Air.*

Flues. Manner in which the flues of the kitchen and refreshment-rooms interfere with witness's ventilation of the House, *Reid* 207–209——Importance of a more thorough examination of fire flues in the walls of the House, and the stoppage of all leakage from that source, *ib.* 215. 240–244.

Forced Ventilation. Objection to forced ventilation, as contradistinguished from natural ventilation, *Gurney* 885, 886. 915, 916——Impossibility of successfully applying a forced ventilation to the Houses of Parliament, *Daukes* 1712–1714——Witness does not consider it advisable that mechanical power should be used for forcing the air in, as quite sufficient air could be obtained without it, *Brown* 3749–3752.

Foul Air Shafts. No alterations will be necessary in the foul air-shafts in the House of Lords, for the discharge of smoke, *Sir C. Barry* 1636.

Fresh Air. See *Cold Air. Natural Ventilation.*

G.

Galleries. Unhealthy state of the galleries, from the disagreeable smell of gas, and the bad state of atmosphere, *Dawes* 247, 248——Means by which the rooms above the division lobbies are warmed; how far, when these rooms are not warmed, the cold air from them rushes into the gallery of the House. *Reid* 380–388.

See also *Chandeliers. Lighting*, 4. *Roof Lights. Subdued Light.*

Gas. Great inconvenience witness has experienced in the House from the ventilation, but more particularly from the excessive glare, and from the smell of the gas used in the lighting of the House, *Dawes* 245–252——Great attention which witness has paid to the lighting of the House since it has been under his direction; still the lighting is anything but satisfactory, and there is a great leakage of gas, *Reid* 592–594——Even using the very best description of gas in the present lamps of the House of Commons would not remove the great inconvenience felt; the heat would still be excessive, *Arnott* 1320–1322——The

Reports, 1852—*continued.*

Gas—continued.

——The gas lamps would have no prejudicial effect in an upward-current ventilation, *Daukes* 1741——The lighting of the gas-lights during the time The House is sitting is a great inconvenience, *Leslie* 3199.

See also *Downward Current Ventilation*, 3. *Escapes of Gas. Galleries. Lighting.*

Gas Meters. Considerable annoyances to the ventilation arising from the gas meters, *Reid* 467, 468.

Grey, Earl. (Analysis of his Evidence.)—Has been constantly in the habit of attending the House of Lords for the last six years, 699, 700——Does not think the ventilation of the House of Lords bad, but at the same time is of opinion that it is very inferior indeed to that of the late House of Commons, 701——The currents of air are very objectionable, 702, 703——The lighting of the House of Lords is not at all disagreeable, 704, 705.

Ground Floor Offices. When the whole of the ventilating arrangements are complete, the inconveniences which have been complained of as regards the various offices on the ground floor will be remedied; they were not originally intended for offices, but merely for store rooms, *Sir C. Barry* 740–742. 744.

Gudge, James. (Analysis of his Evidence.)—Clerk in the Journal Office, 50——Situation of the Journal Office; the rooms were not intended to have been inhabited, and are very uncomfortable, 51–53. 59–62——The ventilation of the Journal Office is anything but satisfactory; nature of the ventilation and warming apparatus, 54–57. 62–69.

Gurney, Goldsworthy. (Analysis of his Evidence.)—Has paid great attention to the subject of ventilation, 82——In consequence of the Order of The House, witness has been lately inspecting the method of ventilation adopted by Dr. Reid, 83–85——Witness delivers in his First Report on the Ventilation of the New House of Commons, 86.

[Second Examination.]—Since 1822 witness has, as a matter of taste, pursued the study and investigation of lighting, warming, and ventilation, with other branches of mechanics and pneumatics and chemistry, 802–807——In 1830 witness's attention was first practically called to lighting by the Trinity House, for lighthouses, 806——Was engaged experimentally on light so long ago as 1816, and then constructed what was afterwards called the "Drummond Light," 806——Has been examined several times before Committees of both Houses of Parliament on the subject of lighting and ventilating the Houses, as well as the ventilation of mines and collieries, 808——Witness's recommendations have been adopted in many cases, 809——As regards the ventilation of the Houses of Parliament, the recommendations given by witness before the Committees of 1846 have only been partially adopted; nature of these recommendations, 809, 810——The system recommended has been adopted in the law courts, and in the courts at Hull, York, &c., and appears to succeed and work well, 810.

In consequence of an order, dated the 12th March 1852, witness proceeded to investigate the arrangements of warming, ventilating, and lighting the New

Reports, 1852—*continued.*

Gurney, Goldsworthy. (Analysis of his Evidence)—*continued.*

House of Commons, 811——Addressed a letter to the Speaker, making a sort of first report, as the result of his investigation on 25th March, 812, 813——Explanation relative to the statement made by witness in this report, that he had been interrupted in making his investigations in the House so fully and completely as he could have wished, 814-816——Still witness considers he has seen and learnt sufficient to satisfy his mind upon the causes of the existing evils, 814-816.

Grounds on which witness forms the opinion that the atmosphere of the House, in its mechanical condition, is in a state of considerable disturbance; way in which the present system of ventilation gives rise to those currents which have been complained of, 817 *et seq.*——The principle of ventilation which witness has laid down is, that a sufficient quantity of air should be extracted, under control, for the requirements of the House, and arrangements so made that that quantity shall be supplied by an insensible movement under nature's law, 822-849——Under this plan the same simple system of drawing in the air from the roof of the building, and admitting it at the floor, might be made to afford a perfect ventilation, even if the air is prepared and warmed before it is permitted to enter, 830-848 *et seq.*——Under witness's system, supposing the temperature of the House to be fifty or sixty degrees, and the external temperature to be thirty-two degrees, if either doors or windows were opened there would be no current of air; the disturbance would be so small it would be scarcely perceptible, 830-841. 846-855. 857-864.

The current of cold air which comes into the building on the opening of the doors arises from the state of exhaustion of the House itself; the House itself being in a state of partial exhaustion, or *minus* pressure, 856. 861-865. 868——One of the radical evils is, that the accesses of air in the present House of Commons are too small, 867——Evils arising from the difficulty which the air has to pass through the strangulated channels prepared for it, and the twists and turns given to it before it can get to the House, 868——Observations on the diffusion of gases in all rooms inhabited by living creatures, the process of respiration constantly altering the composition of the air, 869——The laws of diffusion of gases soon produce an equal division of any effluvium that may happen to be floating in a room, 869——But in the present condition of mechanical disturbance of the House, there is no disturbance from the laws of diffusion, 869.

Observations relative to the chemical condition of the air itself, 870——Evidence showing that it is partially decomposed, one of its conditions being that of air overheated, heated above ninety degrees, 870-879. 881——Air is so vitiated by overheating as to have a great effect upon the animal constitution, 870-879. 881——Another cause of the unpleasant condition of the air is, that by the partially exhausted state of the House, it is vitiated from foreign and unprepared sources, 870-875——A further cause arises from the wet iron surface over which the air is made to pass over the floors having been previously overheated by dry iron cockles, 870-879——Recommendation that the air should never be heated up to a high degree in order to be pulled down again, 880——When the two doors going into the House of Commons are opened, there is more air passes than is sufficient to ventilate five such houses, 882-884——

Reports, 1852—*continued.*

Gurney, Goldsworthy. (Analysis of his Evidence)—*continued.*

882-884——The smell from the urinals and other objectionable sources is, in consequence of this rush of air, brought into the House, 883——Objection to the use of the fan; it is a useless appendage, doing mischief, 885. 915, 916. 925-930——Objection to forced ventilation as contradistinguished from natural ventilation, 886——Ventilation should be as simple as possible; the vitiated air should be simply drawn off, nature will do the rest, 886.

Witness has had the Court of Common Pleas and the Court of Exchequer under his control for the purposes of ventilation; statement of witness's method of ventilating these courts, 887-912. 931-944. 978-991. 1036-1038——Statement of the difference in principle between witness's system and that adopted by Dr. Reid, and also partially by Sir Charles Barry, 913-916——The present mode of lighting the House tends to make the air oppressive; this was not the case in the old House, as the lamps were insulated, 919-924——Witness's plan might be applied to the House of Commons for less than 100*l.*; witness would pledge himself to remove in a week all the material evils, 945-955.

Opinion that the present areas for the access of air to the House of Commons are not sufficient, 950-956. 965-967——Witness would prefer the Clock Tower as the source from which to draw his supply of air, 956-962——It is not a part of witness's plan to reject the vaults as a means of obtaining air, 964——A portion of the air now enters the House through the hair-cloth carpet; this very much hinders its ingress into the House, and must have the effect of carrying with it particles of dust, 966-974——Alleged interruption which witness met with from Dr. Reid in the course of his investigation of the subject of the ventilation of the House, 975, 976, 977——(Dr. *Reid.*)—Explanation relative to these allegations, 977——(Mr. *Gurney.*) Way in which witness disconnects the warming from the ventilation; objection to the present complicated system of warming the House; description of the system adopted, 996-1035. 1046-1051——Witness is not aware of any chemical process by which air can be cured of its impurities, 1039-1045.

[Third Examination.]—Witness has seen sufficient of the ventilation of the House to warrant him in stating in his report, that he perceived in what the evils consist, and that if the House were placed under the control of the Office of Works for a week, he would pledge himself to do away with the material evils, 1985-1990.

[Fourth Examination.]—How far witness has made an examination into the system of warming and ventilating those parts of the building occupied by Members of the House of Commons, such as the committee-rooms, refreshment rooms, library, &c., 2785, 2786——Generally speaking, there are in the arrangements the foundation of everything that can be required except for crowded committee-rooms on special occasions, 2787——Otherwise the arrangements, with very little modifications, are sufficient for the requirements, 2787——There is a great deal of artificial preparation for ventilation in many of the rooms which is not required, 2787——There is an evil in the whole of the committee-rooms arising from the very great extent of the glass surface, the glass cooling the air coming in contact with it very rapidly;

Reports, 1852—*continued.*

Gurney, Goldsworthy. (Analysis of his Evidence)—*continued.*

rapidly; suggestions for remedying this evil; the coil of pipe placed beneath the windows to counteract the effect of the windows has not been successful under a low temperature, 2787–2825. 2871–2878.

Evidence in detail as to the mode in which the committee-rooms, library, and refreshment-rooms are warmed, 2795–2798. 2826 *et seq.*——As regards the special coil, placing the pipes vertically is a far better arrangement than placing them horizontally, 2827, 2828——All the inlets and outlets appear to be under proper regulation, though they are not exactly upon the system witness would have recommended; witness's plan would have been to extract from below, and allow the air to come in from the upper parts of the windows, 2829–2837. 2839–2847. 2849–2866——It is far more desirable to ventilate by the single action, as adopted in the Court of Exchequer, but it is one which cannot well be now introduced into the House of Commons, 2837–2839——Opinion that it is not worth while to upset the present system of ventilation, and go to a great expense to upset the building, 2848——Witness would be content to introduce the means which appear to him self-evident would get rid of the evils which temporarily obtain, 2848.

The libraries are comfortable, with the exception of the cold windows, 2866. 2875–2878——Evidence relative to the ventilation of the refreshment-rooms; in the smoking-room there is very effective ventilation, 2867–2870——Witness would call the air in the lobbies, large halls, and corridors, "caustic;" explanation of this term, and way in which witness supposes this state of the atmosphere to arise, 2879–2881——The great defect of the air of the House of Commons compared with that of the libraries, committee-rooms, and lobbies, may be attributed to its being partially overheated, and partially to impurities being drawn into the House from sources which are contaminated, 2884, 2885——Remarks on the ventilation of the House of Lords; way in which it differs from that of the House of Commons, 2886–2892——Further evidence showing that the apertures for the ingress of air in the House of Commons are deficient, 2895–2918.

The system witness would adopt for ventilating the House of Commons with a view to getting rid of the impurities of which he complains, would involve a change of the present locality of the warming chambers, and witness would also advise a change in their construction; the expense would not be much, 2920–2939——Detail of witness's reasons for preferring the downward current, 2940–2965. 2971–3004——Witness's system of ventilating would not interfere with the lighting of the House, 2966–2970——There is an existing condition about the House under which it is impossible to ventilate it perfectly until it be changed; reasons for witness objecting to state this condition publicly, 3005–3014——The alterations made during the Easter recess have partially changed the condition of the House, 3015.

[Fifth Examination.]—Further evidence on witness's suggestion for curing the defect arising in the warming of the committee-rooms, in consequence of the cooling process of the large surface of windows, 3016——The present mode of lighting the House is in principle the same as that of the late House, and which was first recommended by witness, 3017–3022——Witness sees no objection to the present system of lighting the House, but prefers its being reflected

Reports, 1852—*continued.*

Gurney, Goldsworthy. (Analysis of his Evidence)—*continued.*

reflected through glass; reasons for this preference, 3022-3032——Opinion that some provisions are required for lighting under the galleries and under the roof; suggestions as to the mode in which this might be carried out, 3019, 3020. 3033-3060——The present light is rather too white; light a little coloured is far more agreeable than pure white; this can be carried out when it is reflected through glass, 3020. 3022-3032.

With regard to the present lights materially aiding the ventilation of the House, the ventilation is too important a condition to depend on lighting, though there is no doubt the up-current is assisted when the lamps are lit, 3061——The introduction of lights inside the House is objectionable, 3062-3064——Witness's first proposal was to light the old House of Commons by oil and oxygen, called the Oxygen Bude Light; it was tried for nearly two years, 3065-3069——Reasons why it was abandoned, 3070-3072——Gradual steps which have been taken with a view to the better lighting of the new Houses; various plans which have been tried, 3072-3076——Reflection from a metallic surface, and transmitting that light through glass into the House, is the best mode, 3077-3084——Evidence showing that there is very little loss of light under this system, 3084-3110——Witness considers the system of reflection adopted in the old House a better and more economical one than that adopted at present in the new House, 3111, 3112——The present system of lighting the House, with certain modifications, is the best system that could be adopted, 3114.

[Sixth Examination.]—Delivers in a sketch showing the mode of illuminating the roof of the House of Commons, and under the galleries, so as to destroy the blank shadows arising from the mouldings; explanation of this sketch, and the mode of carrying out this object, 3267-3277——Reasons why witness would have more lights in the roof than there now are, 3278——The expense of a smaller number of large or a greater number of small lights would be very nearly the same, 3279-3282——Proposal that a small mask catoptric light should hang from each of the present pendents, of which there are ten, and that the roof should also be lighted on the present system, with certain modifications, 3283 *et seq.*——Witness conceives it possible, by increasing the amount of light, to get a sufficient amount of illumination for the House generally, by making the ceiling a reflector; but there would then be more light in the galleries than in the body of the House; this would have an unpleasant appearance, 3293-3302——Pleasing effect which would be produced by having the surface, that is, the roof and ceiling of the House, of an agreeable reflecting colour, 3296-3299. 3301-3302.

There is nothing to prevent the present House being lighted perfectly well, exactly as the old House was lighted, by adding to the present light in the roof a couple of chandeliers fitted with catoptric masks; this would light those portions of the roof which are now in shadow, 3303-3305. 3368-3371——According to witness's plan, he proposes to illuminate the whole of the panels in the central part of the roof, 3306-3314——Witness would propose the "Atmospheric Bude Light," with concentric burners, as used in the old House, 3315-3323——Way in which witness proposes to light under the galleries, 3323-3325——Way in which he proposes to light the galleries, 3326, 3327——

Reports, 1852—*continued.*

Gurney, Goldsworthy. (Analysis of his Evidence)—*continued.*

3326, 3327——The expense of carrying out the whole of witness's plan would be very inconsiderable; about 200*l.* or 300*l.*, in addition to the facilities which already exist in the House, 3328-3329.

Taking out the present panels and substituting glass would in no way affect the hearing; which would be the case if the panels were left open, 3332-3335——Result of experiments which witness has made with respect to the colour most suitable for the reflection of light; silver reflectors are the best reflectors, 3336-3359——The same number of lights which witness proposes, placed in a continuous line round the upper part of a screen at the foot of the sloping roof, or round the House, would not give the same amount of light as under witness's plan, 3360-3367——Probable expense of high pressure steam for a steam jet to sustain a proper rate of ventilation of the House of Commons, 3372-3376.

Gurney's System. The principle of ventilation which witness has laid down is, that a sufficient quantity of air should be extracted, under control, for the requirements of the House, and arrangements so made that that quantity shall be supplied by an insensible movement under nature's laws, *Gurney* 822-849——Difference of principle between witness's system and that adopted by Dr. Reid, and also partially by Sir Charles Barry, *ib.* 913-916——Witness's plan might be applied to the House for less than 100*l*; witness would pledge himself to remove in a a week all the material evils, *ib.* 945-955. 1985-1990.

See also *Exchequer,* Court of. *Experiments. House of Commons,* IV. 3. *Law Courts.*

H.

Heat. When there is a full House the heat is very oppressive, *Right Hon. the Speaker* 328, 329——Witness has heard numerous complaints from the Members as to the atmosphere of the House being hot and overpowering, *Lord C. Russell* 258.

See also *Gas. Lighting,* 2. *Variations of Temperature.*

High Pressure. See *Hot Water Apparatus.*

Hospital for Consumption. System of ventilation adopted by witness for the Hospital for Consumption, *Arnott* 1325.

Hot Water Apparatus. Opinion that the low-pressure hot water disturbs the balance of the air, much less than the higher pressure, *Price* 2379-2381——Way in which the air breathed into the House is injured by the temperature of the hot water, *ib.* 2390—— Preference given to hot-water apparatus over any other kind of apparatus for heating the air going into the House, *Reid* 3591-3595——Witness never found that heating the air by means of hot-water pipes had any effect on the quality of the air, *Brown* 3771-3775.

See also *Price's System. Steam Pipes.*

Reports, 1852—*continued.*

HOUSE OF COMMONS:

I. *Unsatisfactory State of the Ventilation at the beginning of the Session; Improvements therein.*

II. *Approval of the present State of the Ventilation.*

III. *Existing Difficulties in the way of a perfect System of Ventilation; how far insuperable.*

IV. *Suggestions of various Parties as to the best System of Ventilation:*

1. Dr. Arnott.
2. Mr. Daukes.
3. Mr. Gurney.
4. Mr. Leslie.
5. Mr. Price.

V. *Perfect Ventilation of the Old House of Commons.*

VI. *Papers laid before the Committee.*

I. *Unsatisfactory State of the Ventilation at the beginning of the Session; Improvements therein:*

Opinion of the Committee that the condition of the ventilation of the House of Commons and its appendages is still unsatisfactory, notwithstanding the improvement which has been effected in the House itself, since the period when the Committee were appointed, *Rep.* ii. *p.* v——Opinion of the Committee that the present system of ventilating the House of Commons is a complicated system, and one which they are not prepared to approve, *ib.* vi.——Improvements in the ventilation since the beginning of the Session, *Lord C. Russell* 259——Since the Members have taken possession of the New House the ventilation has been very imperfect, *The Right Hon. the Speaker* 316——So far as witness has found it practicable within the time allowed him, he has made the alterations in the lighting and ventilation of the House authorized by the Committee, *Reid* 1991——Nature of the principal alterations which have been made, *ib.* 1992-1998——Witness has every reason to believe that, so far as the alterations have been carried out, they have been satisfactory, *ib.* 2063, 2064——The arrangements are not yet completed; the external lighting is not yet completed, and this affects the ventilation very much, *ib.* 2067——The alterations made during the Easter recess have partially changed the condition of the House, *Gurney* 3015.

II. *Approval of the present State of the Ventilation:*

Witness sees no reason to find fault with ventilation of the House generally, *Thompson* 16-18. 24, 25——The present state of ventilation of the House of Commons is very pleasant and regular; experiments made by witness to ascertain the variation of the temperature of the House, and satisfactory results obtained, *Appold* 3603-3618——Comfortable state of the ventilation of the House of Commons, *Brown* 3705-3724.

III. *Existing*

Reports, 1852—*continued.*

HOUSE OF COMMONS—continued.

III. *Existing Difficulties in the way of a perfect System of Ventilation; how far insuperable:*

If authority be given to witness, he knows of no insuperable obstacle to his providing a remedy for the evils now complained of in the House of Commons, *Reid* 525-529——Obstruction which now exists, and which witness assigns as the causes of the evils which are complained of, *ib.* 529-531——The difficulties of ventilating the House of Commons are very great, so as to render it comfortable for a large body of Members, *Arnott* 1324. 1326——The standing difficulty in warming and ventilating the House is, that there is such a vast disproportion between the area of the House and the number of persons that at times occupy it, *Price* 2402-2404. 2458 *et seq.*——Difficulties which have been thrown in witness's way from the mode in which business has been conducted in the execution of his works in the New House of Commons, *Reid* 3522.

IV. *Suggestions of various Parties as to the best System of Ventilation:*

1. Dr. Arnott:

In any system of warming and ventilating, to be perfect, six given objects must be obtained; statement of these objects, which witness considers absolutely necessary, *Arnott* 1058——Witness sees no difficulty in adopting the system of the plenum movement only in the ventilation of the House of Commons, so as to make a perfect ventilation of the House, *ib.* 1210——The greater density of the atmosphere within the House by witness's plenum system would be very little, not sufficient sensibly to affect the respiration, *ib.* 1219, 1220——One system of ventilation would answer for the whole of the House of Commons buildings as well as the House itself, *ib.* 1221.

2. Mr. Daukes:

Witness does not consider that when the works are completed, and the whole principle in force, that the ventilation will be satisfactory, *Daukes* 1738-1740——Manner in which the air is diffused under witness's system; it is under complete control, *ib.* 1750-1761——Mode which witness would adopt for improving the warming and ventilation of the House of Commons, *ib.* 1804-1807.

3. Mr. Gurney:

Although witness met with interruptions in making his investigations into the system of warming, ventilating, and lighting the House of Commons, still he considers he has seen and learnt sufficient to satisfy his mind upon the causes of the existing evils, and to give the Committee and the House such information as is necessary for their guidance, *Gurney* 86. 811-816——Alleged interruption which witness met with from Dr. Reid in the course of his investigation, *ib.* 975, 976, 977——Explanation relative to these allegations, *Reid* 977.

Opinion that it is not worth while to upset the present system of ventilation, and go to a great expense to upset the building, *Gurney* 2848——Witness would be content to introduce the means which appear to him self-evident would get rid of the evils which temporarily obtain, *ib.*——As a principle, witness is in favour of a simpler mode of ventilation, drawing from the roof and

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House of Commons—continued.

IV. *Suggestions of various Parties as to the best System, &c.*—continued.

3. Mr. Gurney—*continued.*

and taking the exhaustion from the floor, *Gurney* 2849-2866——There is an existing condition about the House, under which it is impossible to ventilate it perfectly until it be changed; reasons for witness's objecting to state this condition publicly, *ib.* 3005-3014.

4. Mr. Leslie:

Statement of the leading principles of the system witness would propose for the House of Commons; the flooring of the House should be constantly and uniformly warm, *Leslie* 3183, 3184——The supply of air should be self-regulating, *ib.* 3184——And the removal of the vitiated atmosphere should pass quietly away, and with the least possible frictional interruption, *ib.*

5. Mr. Price:

Description of the method witness would recommend for warming and ventilating the House of Commons, *Price* 2371 *et seq.*——It is witness's honest opinion that the present system of ventilating the House is altogether unsatisfactory and bad; if witness had the ventilation there is no part of the present plan which he would adopt; the alterations would be material, *ib.* 2440-2449 ——Witness has no doubt that under his system he could meet all the variations of temperature which must be produced by the difference in the number of Members within the building at different times, *ib.* 2458-2467.

V. *Perfect Ventilation of the Old House of Commons:*

Until the late House of Commons existed there never was in the world a room in which 500 or more persons could sit with comfort for ten hours in the day, and day after day; it was a perfect novelty in regard to the science of ventilation, *Arnott* 1324.

VI. *Papers laid before the Committee:*

Statement explanatory of the arrangements for warming and ventilating the New House of Commons, abbreviated in unison with the instructions given at the Committee, *Rep.* ii. *App.* 545——First report of Mr. Goldsworthy Gurney on the ventilation of the New House of Commons, *ib.* 586——Second Report of Mr. Gurney, *ib.* 587——Third Report of Mr. Gurney, *ib.* 592.

See also *Ceiling of the House.* *Floor of the House.* *House of Lords.* *Lighting.* *Old House of Commons.*

House of Lords. General satisfactory state of the ventilation of the House of Lords; complaints are occasionally made by the Peers of draughts; means which have been taken to obviate them, *Sir A. Clifford* 535-556——Their Lordships have been in possession of the present House about five years; during that time the ventilation has varied a good deal; it was bad at first, but is now improved, *Lord Redesdale* 667-671——Generally speaking, the atmosphere of the House of Lords is good, *Lord de Ros* 689, 690. 692-695 The ventilation of the House of Lords is not bad, but at the same time it is very

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House of Lords—continued.

very inferior indeed to that of the late House of Commons, *Earl Grey* 701-703.

Witness does not approve of the system of ventilation in the House of Lords; one of its difficulties is, that there is so delicate a balance of specific gravities, that it is very likely, unless carefully watched, to fall into confusion, *Arnott* 1193-1197——Description of the mode of warming and ventilating the House of Lords, and other portions of the New Palace, under the control of the architect, *Sir C. Barry* 1377 *et seq.*——Objections to the principle of ventilation adopted by Sir Charles Barry in the House of Lords and the committee-rooms, and to the manner in which it is developed, *Daukes* 1694-1698——System of ventilation of the House of Lords, *Meeson* 2545-2551. 2577——Remarks on the ventilation of the House of Lords; way in which it differs from the House of Commons, *Gurney* 2886-2892——Comparing the ventilation of the House of Commons and that of the House of Lords, there is a great difference, not exactly in the ventilation, but in the means which are requisite, in consequence of the difference of structure; detail in illustration of this point, *Reid* 2522-2530.

See also *Air Channels.* *Artificial Temperature.* *Lighting*, 3.

Hull Courthouse. Evidence relative to the ventilation of the court at Hull under witness's superintendence; adoption of Mr. Gurney's system of ventilation, *Clark* 1330-1363——The cost of effecting the improvements was very small indeed, *ib.* 1368.

I.

Impure Air. The air of the House of Commons is not agreeable to breathe; grounds on which witness asserts that it gets mixed up with all sorts of impurities; suggestions for obviating the evils, *Price* 2382-2386.

See also *Escapes of Gas.* *External Air.* *Galleries.* *Offensive Smells.* *Sources of Supply of Air.* *Vaults.*

Ingress of Air. The present areas for the access of air to the House of Commons are not sufficient, *Gurney* 867. 950-956. 965-967——Placing ventilators for the admission of air on the risers of the steps in the gangways to the seats would be the best position, as there would be little or no inconvenience felt therefrom, *Daukes* 1888-1901. 1912-1917. 1934-1936. 1950, 1951——The centre of the House would be a very good position for the admission of moderately warmed air, *ib.* 1902, 1903. 1952-1955——It would be difficult to work a system of ventilation where the floor was made both the ingress and egress of the air, *Brown* 3767-3770——Observations as to which witness considers to be the present defects in the system of ventilating the House of Commons and the committee-rooms, with suggestions for remedying these defects, *Stephenson* 3934, 3935. 3937-3944.

See also *Admission of Air.* *Carpet.* *Dust.* *Floor of the House*, 1. *Plenum System.* *Supply and Discharge of Air.* *Velocity of Currents.* *Vitiated Air.* *Windows.*

Iron

Reports, 1852—*continued.*

Iron Pipes. Opinion that the system of warming the air adopted by witness, by means of iron pipes, is not injurious to the quality of the air, *Reid* 3546, 3547 ——The passage of air over iron pipes heated with steam or warm water is very injurious to the qualities of the air thus warmed, *Appold* 3647-3651.

See also *Hot-Water Apparatus.* *Overheated Air.*

J.

Journal Office. Comfortable state of the ventilation of the room in which Mr. Rowland and witness perform their duties; the Clerks' Office is not quite so comfortable, *Postlethwaite* 41-49——Situation of the Journal Office; the rooms were not intended to be inhabited, and are very uncomfortable, *Gudge* 51-53. 59-62——The ventilation is anything but satisfactory; nature of the ventilation and warming apparatus; there are no fireplaces or chimneys, *ib.* 54-57. 62-69.

K.

King, Alfred. (Analysis of his Evidence.)—Engineer; resident in Liverpool, 2169, 2170——Has been employed in lighting large buildings, 2171——The most important building which witness has been employed in lighting is the Philharmonic Hall at Liverpool; size of this room; it is lighted simply by a row of jets; the ceiling is coved, 2172-2174——Mr. Cunningham was the architect of the room; a good deal of attention was given to the construction of the room, in order that it should be properly ventilated, 2175-2177—— Witness believes that the natural currents are resorted to for the ventilation of the room, and, he believes, successfully; he has never heard any complaints, 2178-2180.

Detail of the method adopted, under witness's superintendence, for lighting the room; with the exception of a cluster of 170 very small burners over the orchestra, the whole room is lighted by a continuous row of small burners, numbering about 1,000, round the cornice; the whole of the burners are naked burners; the flame is a horizontal flame; arrangements made for carrying off the products of combustion, 2181-2252. 2258-2308——Witness has seen the contrivance adopted in the House of Commons at present for lighting; opinion that no advantage would be gained by having ground glass placed beneath the lights, 2253-2257——There is no doubt that great advantage is derived in the lighting of a room from the colour of the wall; white is the best for economizing the light, 2268-2273.

Opinion that the lights might be so arranged in the present House of Commons that there should be no offensive shadow, 2281——The House of Commons might be lighted very differently from what it is; witness's principal objection to it is its inefficiency, and it is also unsightly, 2309-2317 ——Witness would light it on the principle of cornice lights, by carrying a light round the lower part of the inclined portion of the ceiling, 2310——A system of burners might be arranged round the lower part of the sloped roof of the House, so as to be sightly: witness would have no apprehension from any danger that might arise to the roof, although it is of timber, 2318-2326.

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King, Alfred. (Analysis of his Evidence)—*continued.*

2333–2346——It is always desirable that the light should be placed as much as possible above the line of vision, 2327, 2328——The same system of lighting might be adopted in the cornice in the square part of the House, 2330–2332——Cost at which this system of lighting might be adapted to the present House of Commons, 2347, 2348. 2357, 2358——It might be lighted by a combination of sun-burners and lights round the cornice, 2349——Witness does not contemplate that there would be any flickering in the light, 2350–2356.

L.

Law Courts. Witness has had the Court of Common Pleas and the Court of Exchequer under his control for the purposes of ventilation; statement of witness's method of ventilating those courts, *Gurney* 887–912. 931–944. 978–991. 1036–1038. 1046–1051——Letter from Baron Parke, dated 3 April 1852, n answer to a communication addressed to him containing certain queries in reference to the ventilation of the Court of Exchequer and the Law Courts at Liverpool, *Ev. p.* 259.——*See* also *Exchequer*, Court of.

Legh, George Cornwall, M. P. (Analysis of his Evidence.)—Objectionable nature of the ventilation of the House, 70–78. 81——The ventilation of the committee-rooms is very defective, and the rooms extremely disagreeable, 79, 80.

Le Marchant, Sir *Denis,* Bart. (Analysis of his Evidence.)—Disagreeable state of the ventilation of the House, 124. 127——The lighting of the House is very tolerable, 126——Frequency of the prevalence of very unpleasant smells in the House, 128–137——Complaints made by Members of there being something in the air which causes a tendency to cough, and considerable irritation in the chest and throat, 138.

Leslie, John. (Analysis of his Evidence.)—Has devoted considerable attention to the subject of warming and ventilation, 3122–3131——The processes by which the ventilation of the House of Commons is effected create an unhealthy atmosphere in the House, 3132–3136——Defective state of the sources and channels of supply, 3136——Objections to the manner in which air is at present forced into the House, 3136–3146——The present means of egress of the vitiated air from the House is most objectionable, 3147–3153——The Houses of Parliament, committee-rooms, &c. could be much better warmed and ventilated separately than by any one combined system, 3154. 3156–3182.

Suggestion for supplying a copious supply of fresh air through glazed earthenware pipes of large diameter, 3154, 3155——The results of the present means of supplying air and carrying off the vitiated atmosphere of the committee-rooms are very unsatisfactory, 3156——Large quantity of coals consumed in the committee-rooms; one quarter of the coals would be quite sufficient upon witness's system, 3156——Manner in which the committee-rooms

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Leslie, John. (Analysis of his Evidence)—*continued.*

rooms might be warmed and ventilated separately, 3156-3182——Witness looks upon all descending currents of air as most dangerous to health, 3183.

Proposal for warming and ventilating the House of Commons by means of open fireplaces in the House, 3183-3187——The whole of the centre framing and panels of the ceiling of the House should be removed, 3183——Statement of the leading principles of the system witness would propose for warming and ventilating the House of Commons, 3183, 3184——Suggestion for supplying the House with fresh air from the exterior by means of glazed earthenware pipes, 3184-3186——Witness considers the alterations made in the lighting of the House during the recess to be of the most dangerous character; great danger of the roof taking fire, 3188, 3189. 3248-3259——The present mode of lighting is very expensive, 3189.

To effect a perfect system of lighting in the House, it is desirable to take away all the panels in the roof, 3190-3193——System of lighting in operation in the Post-office; successful effect and great economy of the system, 3193-3198. 3236——The lighting of gas-lights during the time The House is sitting is a great inconvenience, 3199——Suspended lights from the roof are very dangerous, 3199——Suggestions that there should be a gas supply all round the edge of the panels, with perfectly fixed and secure lights inside of that opening; the House would be splendidly lighted for about half-a-crown an hour, 3199-3210——Witness would not place any obstruction of glass in the panels, as that would take a great per-centage from the light, 3211.

Removing the panels from the ceiling would not affect the hearing in the House, 3212-3215——The failure of the ventilation has chiefly arisen from there not being sufficient means of escape for the vitiated air, 3215. 3260-3264——Experiments made by witness for improving the ventilation of the Merchant Tailors' Hall, and successful results thereof, 3216-3232——Expense of lighting the establishment of the Merchant Tailors' Company, 3232-3236——The removal of the panels, as suggested by witness, would not be detrimental to the architectural beauty of the present ceiling, 3237. 3265, 3266.

Detail of the principles of witness's gas-burner, showing its importance and advantages over all other burners, 3237-3247——Objections to adopting the system of lighting in operation at the large reading-rooms at Liverpool, 3255-3257.

Leslie, Mr. See *House of Commons,* IV. 4.

Libraries. Comfortable state of the ventilation of the libraries; equality of the temperature, *Vardon* 89-103; *Gurney* 2875-2878. 2886——Facility with which the temperature can be regulated, *Vardon* 90——Complaints have been made of temporary draughts of cold air from the windows, *Vardon* 96, 97; *Gurney* 2886.

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LIGHTING:

1. *Opinions in favour of the present System of Lighting the House of Commons.*
2. *Objections to the present Mode of Lighting the House.*
3. *Suggestions for remedying the Evils resulting from the present System of Lighting.*
4. *Necessity for some Provision for Lighting under the Galleries; Suggestions on the Subject.*
5. *Lighting an important Element in the Ventilation of the House.*

1. *Opinions in favour of the present System of Lighting the House of Commons:*

Inconveniences resulting from system of lighting the House adopted by Sir Charles Barry, *Rep.* ii. *p.* vi——Opinion of the Committee that the alterations which have been made in the lighting have been successful, and that the principle upon which they have been made is capable of still further and more satisfactory developement, *ib.* viii.

The lighting of the House is very tolerable, *Sir D. Le Marchant* 126—— The present system of lighting the House, with certain modifications, is the best system that could be adopted, *Gurney* 3114.

2. *Objections to the present Mode of Lighting the House:*

Objections to the present system of lighting the House of Commons, *Reid* 216–232; *Arnott* 1290, 1291; *King* 2309–2317——The present mode of lighting the House tends to make the air oppressive; this was not the case in the old House, as the lamps were insulated, *Gurney* 919–924——The mode adopted for lighting the House is too complicated, and is attended with many inconveniences, *Sir C. Barry* 1479.

3. *Suggestions for remedying the Evils resulting from the present System of Lighting:*

Proposal for remedying the existing evils, and improving the lighting, *Reid* 216–232——The expense of making the alterations necessary for carrying out witness's suggestions would not exceed 3,000*l.*; experiments might be made at a trifling expense, *ib.* 233–235——The arrangements necessary for lighting the House, as proposed by witness, would not occupy more than five weeks; it would be easy to carry on the work during the sitting of the House, *ib.* 611. 1494, 1495——Detail of the mode at present adopted for lighting the House of Commons; the system adopted in the House of Lords is more easily managed; improvements suggested in the mode of lighting the House, *Sir C. Barry* 1496–1506. 1523, 1524. 1602, 1603.

The present mode of lighting the House is, in principle, the same as that of the late House, and which was first recommended by witness, *Gurney* 3017–3022——There is nothing to prevent the present House being lighted perfectly well, exactly as the old House was lighted, *ib.* 3017–3022. 3303–3305 ——Alteration which witness has made during the Easter recess with respect to the lighting of the House, *Reid* 2002–2011.

Detail

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3. *Suggestions for remedying the Evils resulting from, &c.*—continued.

Detail of the gradual steps which have been taken with a view to the better lighting of the new Houses, *Gurney* 3072-3076——Witness would have more lights in the roof than there now are, for two reasons; one is, that it would be more agreeable in appearance, and the other is, that that which is now produced by intensity might be made up in quantity of illuminated surface, *ib.* 3278——It is witness's proposition that a small mask catoptric light should hang from each of the present pendents, of which there are ten, and that the roof should also be lighted on the present system, with certain modifications, *ib.* 3283 *et seq.*——Witness dissents entirely from Mr. Gurney's statement, that witness borrowed all his present system of lighting from him; witness has documents in proof of this assertion, *Reid* 3512, 3513.

4. *Necessity for some Provision for Lighting under the Galleries; Suggestions on the Subject:*

The lights might be so arranged in the present House of Commons that there should be no offensive shadow, *King* 2281——Some provisions are required for lighting under the galleries and under the roof; suggestions as to the mode in which this might be carried out, *Gurney* 3019, 3020. 3033-3060——Witness delivers in a sketch, showing the mode illuminating the roof of the House of Commons and under the galleries, so as to destroy the black shadows arising from the mouldings; explanation of this sketch, and the mode of carrying out this object, *ib.* 3267-3277. 3326, 3327——Way in which witness proposes to obviate the difficulties with regard to the shadows in the roof, and the want of a sufficient amount of light underneath the galleries, *Reid* 3490-3505.

5. *Lighting an important Element in the Ventilation of the House:*

The present mode of lighting was adopted so as not to interfere with the ventilation of the House under the direction of Dr. Reid, *Sir C. Barry* 1479——The mode of lighting the House is a very important ingredient in the plan of warming and ventilation, *Price* 2433-2435——With regard to the present lights materially aiding the ventilation of the House, the ventilation is too important a condition to depend on lighting, though there is no doubt the up current is assisted when the lamps are lit, *Gurney* 3061——The lights very much assist the ventilation of the House, *Brown* 3758-3760.

See also *Bude Light. Ceiling of the House. Chandeliers. Coloured Lights. Cornice Lights. Downward Current Ventilation,* 3. *Expense of Lighting. Fire. Gas. House of Commons,* I. *Liverpool Philharmonic Hall. Outside Light. Post Office. Reflected Light. Roof Lights. Subdued Light. Sun-burners. Suspended Lights. Upward Current Ventilation. Wax Candles.*

Liverpool Philharmonic Hall. Evidence as to the new system of lighting, called the sun light or rose light, in use at Liverpool; how far applicable to the lighting of the House of Commons, *Sir C. Barry* 1604-1619——The plan adopted for lighting the Liverpool Philharmonic Hall is spoken very highly of, *Daukes* 1905, 1906. 1938——The most important building which witness has

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Liverpool Philharmonic Hall—continued.

has been employed in lighting is the Philharmonic Hall at Liverpool; size of this room; it is lighted simply by a row of jets; the ceiling is coved, *King* 2172-2174——Detail on the method adopted, under witness's superintendence, for lighting the room, *ib.* 2181-2225. 2258-2308.

The side light adopted at Liverpool would not be applicable to the present House of Commons, *Leslie* 3255-3257; *Appold* 3878-3895; *Stephenson* 3907-3911——Witness has been to Liverpool to look at the lights in the Philharmonic concert-room, *Stephenson* 3906——The chief feature which struck witness on entering the room was the great advantage of the extreme diffusion of light, *ib.* 3907——The effect is very much the same as the effect of Dr. Reid's lights in the hollow pyramids, *ib.*

Lobby. Suffocating nature of the atmosphere of the lobby of the House in the morning, *Blackman* 294-305——The atmosphere has been better in the lobby since the doors have been put up in the cloisters, *ib.* 305-315——Witness has frequently had to complain of a violent cold draught rushing through the doors into the Commons lobby, *Reid* 375-379.

London Institution. Ventilation of the theatre of the London Institution by letting in the air under the seats; satisfactory operation of the system, *Appold* 3641, 3642.

Lonsdale, Earl. (Analysis of his Evidence.)—Has attended the House of Lords frequently during the last and the present Session, 677, 678——The ventilation is very disagreeable; great variation therein, 679, 680——Difference in the system of ventilating the Post-office from that adopted in the House of Lords; the system applied to the Post-office has answered well; nature of this system, 681-685——How far this system would answer in the House of Lords, 684.

M.

Machinery and Pipes. The distribution of the machinery and pipes for warming the House is good, and might be applied in the carrying out of witness's system, *Arnott* 1242-1245. 1272——The present apparatus for the ventilation of the House of Commons is not applicable to what witness considers a complete system; alterations necessary for adopting the apparatus to witness's system, *Daukes* 1763-1781.——*See* also *Fan and Pump Apparatus.*

Marine Hospital (Chatham). The most perfect ventilation witness ever saw was at the great Marine Hospital at Chatham, *Lord de Ros* 691——Witness does not know whether that system could be applied to the House of Lords, *ib.* ——It is ventilated under the direction of Sir William Burnett, *ib.* 696-698.

Mats. With all the arrangements witness has been able to secure, in the present House of Commons there is not anything approximating to what there was in the old House for cleaning the feet unconsciously; this is a great inconvenience, *Reid* 3582.

Measurement

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Measurement of Air. Measurement of the quantity of air which is made use of in the House of Lords by means of an anemometer; self-regulating meters would not answer for such a building, *Meeson* 2554-2556.

Meeson, Alfred. (Analysis of his Evidence.)—Civil engineer, 2540——The ventilation of the Houses of Parliament, with the exception of that portion under Dr. Reid's superintendence, is in witness's charge, 2541——The system in its application is tolerably perfect, and may be taken as a fair sample in the House of Lords and the adjacent portions, 2542-2544——The object of the system of ventilation of the House of Lords is to obtain a plenum, which object is attained by the present plan, 2545-2551——Ventilation of the smoking-room by means of a vacuum ventilation, 2551-2553.

Measurement of the quantity of air which is made use of in the supply and discharge by means of an anemometer; self-regulating meters would not answer for such a building, 2554-2556——The pipes being heated by steam does not act on the air prejudicially, 2557-2563——The temperature of the air could be reduced several degrees in a few minutes, 2564-2567——Means existing for mixing the tempered air with the warmed air when this mixture is required, 2568-2576—— In the House of Lords the ingress of air is downward principally, upward subordinately, 2577.

Grounds on which witness comes to the conclusion that the air when it enters the House from the roof descends to the floor of the House before it seeks for its exit; remarks on the experiment made in the House of Lords with a view of ascertaining this fact, 2578-2627——Explanation relative to the velocity of the air at the point of ingress, and in the House itself, 2628-2637——There are other means for the access of air to the House of Lords besides the roof; the area of those accesses would be sufficiently large for the ventilation of the House, supposing the system of ventilation not by means of the roof, but by means of the floor, were adopted, 2638-2654.

Mode of ventilating and warming the committee-rooms; the works necessary for completing the ventilation arrangements would take but a short time to execute, 2655-2734——Size of the ventilation channels; they are all accessible to actual inspection; manner in which, and periods when, those channels are cleaned, 2734-2739——Velocity of the vitiated air; experiments which witness has tried with a view of ascertaining this velocity in its escape from the House of Lords, 2740-3753——It is desirable to have the means both in the floor of the House and in the roof for the access of air and for the exit of air at the same time; it is perfectly feasible to carry that out with effect, 2760-2778—— Objections to making the roof the means of ingress and the floor the means of egress, 2779-2784.

[Second Examination.]—The inconveniences complained of with regard to dust arise from the air channels having been but recently finished and completed; the workmen have been constantly employed in the channels, 3836-3838——Witness is not aware of any complaint of heat having been made; witness considers it quite under control, 3839——Existence of steam coils of pipe under the windows in all the committee-rooms for the purpose of counteracting the cooling down of the air by the large surface of glass; sufficiency of those pipes for the purpose of regulating the heat, 3840-3845.

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Merchant Tailors' Hall. Experiments made by witness for improving the ventilation of the Merchant Tailors' Hall, and successful results thereof, *Leslie* 3216-3232——Expense of lighting the establishment of the Merchant Tailors' Company, *ib.* 3232-3236——Unsatisfactory state of the present ventilation of Merchant Tailors' Hall, *Appold* 3846-3849.

Mixing Air. Objections to the present practice of heating a certain portion of the air beyond the ultimately required temperature, and then cooling it down by the admixture of cold air, *Rep.* ii. *p.* vii; *Brown* 3776-3778——How far the present means of mixing the air in the Houses of Commons and Lords are sufficient to produce a proper ventilation, *Arnott* 1258-1277.

See also *Tempered Air.*

Moisture of Air. Importance of supplying sufficient moisture to the air of the House; suggestions as to the best mode of effecting this object, *Arnott* 1277-1285——Any machinery necessary for the purpose of giving moisture to the air might at any time be applied at very inconsiderable expense, *ib.* 1286-1289——Mode proposed by witness for moistening the air to be supplied under Price's system, *Daukes* 1869-1874——Remarks relative to witness's register hygrometer, invented for keeping the atmosphere at one regular degree of moisture, *Appold* 3652-3654.

See also *Dryness of Atmosphere.* *Overheated Air.*

Morning Sittings. There is very little difference in the state of the air between the morning and evening sittings, *Right Hon. the Speaker* 318-319.

Mulhenkamp, Herman. (Analysis of his Evidence.)—Has been employed in the Reporters' Gallery of the House of Lords ever since the Peers first began to sit in the present House, 557-559——Comfortable state of the ventilation of the House of Lords; improvements which have been made in the Reporters' Gallery, 560-566.

N.

Natural Ventilation. Witness considers the natural upward passage of the vitiated and hotter air to be adequate to produce a sufficient and constant recurring supply of fresh air into the building to be ventilated, *Daukes* 1710——Witness would say that his system of ventilation may be called a natural system, with artificial additions to meet the peculiarities by which the natural operation of ventilation is obstructed, *Reid* 3534, 3535.

See also *Admission of Air.* *Exeter Hall.* *Forced Ventilation.* *Gurney's System.* *Windows.*

Norreys, Sir *Denham Jephson,* Bart., M.P. (Analysis of his Evidence.)—Has regularly attended the House from the commencement of the Session, 152——Inconvenience arising from the present mode of ventilation of the House; great inequalities of the temperature, 153-159.

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O.

Offensive Smells. Frequency of the prevalence of very unpleasant smells in the House, *Patten* 109. 113-115; *Sir D. Le Marchant* 128-137——Causes to which the bad smells in the House may be attributed, *Reid* 331-344. 389-391. 397-400; *Price* 2436-2439——Obstructions which are placed in witness's way in remedying the defect of bad smells, *Reid* 391——Witness is not aware of any bad smells in the House of Peers, *Lord Redesdale* 672.

See also *Galleries. Urinals.*

Old House of Commons. The ventilation of the old House was very much better than the ventilation of the present House, *Right Hon. the Speaker* 321-324——The old House appeared to be infinitely more under the control of Dr. Reid than the present, *Lord C. Russell*, 255——The system of ventilation in operation in the present House is not the same upon which the old House of Commons was ventilated; material changes made in the system, *Reid* 580, 581. 642.——*See* also *House of Commons*, V.

Outlets. See Discharge of Air. Egress of Air. Vitiated Air.

Outside Light. Objections to lighting the House from the outside, *Appold* 3623-3624——*See* also *Roof Lights.*

Overheated Air. Inconveniences arising from the air being at times deteriorated by overheating, *Rep.* ii. *p.* vi——Evidence showing that the air in the House is partially decomposed, one of its conditions being that of air overheated, heated above ninety degrees, *Gurney* 870-879. 881——Air is so vitiated by overheating as to have a great effect upon the animal constitution, *ib.*——One cause arises from the wet iron surface over which the air is made to pass over the floors having been previously over-heated by dry iron cockles, *ib.* 870-879——Witness would recommend that the air should never be heated up to a high degree in order to be pulled down again, *ib.* 880——Cause of the oppression which is felt from what is commonly called overheated air; the want of a due proportion of moisture is another cause, *Sir C. Barry* 1461-1463.

P.

Paint. See Floor of the House 1. 2.

Panels. See *Ceiling of the House.*

Parliament, Houses of. As regards the ventilation of the Houses of Parliament, the recommendations given by witness before the Committees of 1846 have only been partially adopted; nature of these recommendations, *Gurney* 808-810.

Passages. Impossibility of such a building as the House of Commons being perfectly ventilated unless the person in charge of the ventilation has the control over the passages which lead from the external air, or the large halls in the building, *Brown* 3815-3817.

Patten,

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Patten, John Wilson, M. P. (Analysis of his Evidence.)—Chairman of the Standing Orders' Committee and of the Committee of Selection, 106, 107—— Objectionable state of the ventilation of the House; prevalence of constant draughts, 108–110——Witness has perceived bad smells in the House on one or two occasions, but not lately, 109. 113–115——Imperfect state of the ventilation of the committee-rooms, 111, 112. 116.

Phipps, John. (Analysis of his Evidence.)—An officer belonging to the Board of Works; delivers in a coloured plan, showing the portions of the New Palace of Westminster in charge of the Board of Works; formal method in which these portions have been delivered over by the architect to the Office of Works, 3377–3385——An officer had been already appointed to take charge of those portions of the building delivered over to the Office of Works; it is the same officer who had charge of the old Houses of Parliament, 3386——The appointment is not in the Board of Works, 3387——The Board of Works pay all the accounts for repairs, 3388–3390.

The lighting of the House of Lords is under the control of the Board of Works, 3391——The warming and ventilating is still in charge of Sir Charles Barry, 3394–3396——The ventilation and warming of those portions of the building belonging to the House of Commons is partly under the charge of Dr. Reid and partly under the charge of Sir Charles Barry, 3397–3405—— The tradesman who was employed by Sir Charles Barry still continues to look after the lighting; he is paid by the Office of Works, 3406, 3407——No expense can be incurred for any alteration in the system of warming and ventilation without the sanction of the Board of Works; this applies also to any purpose connected with the fabric; witness believes no alterations have been made without such application, 3408–3424. 3426–3428. 3447–3454.

The whole of those parts of the buildings which have been handed over by Sir C. Barry to the Commissioners of Works were not finished at the time, and they have been finished under the direction of Sir C. Barry, 3429–3431 ——In point of fact, in certain portions of the building Sir Charles Barry's men are performing certain unfinished works, and the men of the Board of Works employed on the repairs are, in some instances, working together; no inconvenience arises from this, 3432–3441. 3454——Way in which the expenses governed or directed by Sir Charles Barry and those undertaken by the Commissioners of Works are distinguished, 3432. 3439–3441. 3454—— The average amount of expenditure for repairs is about 25*l.* per week, exclusive of the general superintendence, 3442–3446.

The Board of Works exercises some supervision over every portion of the building during its progress, 3457–3463—— Witness considers the entire fabric of the building under the charge of the Board of Works, 3467—— Witness does not consider the warming and ventilation of the House, nor the lighting, to be under his charge, 3466. 3468–3474——Remarks relative to the putting up and removal of a steam-engine at the House of Commons, 3475–3482.

Plans. See *Drawings and Plans.*

Playfair, Dr. Copy of Dr. Lyon Playfair's Report, dated 11 June 1850, *Rep.* ii. *App.* 561.

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Plenum System. Advantages of the plenum movement; details of the system, *Arnott* 1061-1127——Witness would not advise the double system of plenum and vacuum for ventilation, *ib.* 1114——There would be no difficulty in carrying into effect the plan of creating a plenum in the House by having to force the air through the carpet, *ib.* 1167-1172——How far it is possible to fill the House with a plenum, so that its general temperature should not be affected by contact with air of a different temperature; reference to the Montgolfier balloon in illustration of this principle, *ib.* 1181-1187.

It is more easy to obtain a plenum in the House by the double column than by making the egress entirely through the floor, *Sir C. Barry* 1647——Preference given to the plenum system, *Appold* 3633-3639——The vacuum ventilation is much cheaper than a plenum system, *ib.* 3639-3642——In order to have a plenum, care must be taken that the ingress of air is larger than the egress, otherwise a forcing power must be used to keep up a balance, *ib.* 3643-3646.——*See* also *Diffusion of Air.* *House of Commons,* IV. 1.

Pollock, William Frederick. (Analysis of his Evidence.)—One of the Masters of the Court of Exchequer; part of his duty compels him to sit in court at Westminster; has held the office since 1846; 794-796——The court was placed under Mr. Gurney's superintendence in the vacation of 1850; 797——Up to this time there had been very considerable complaints of the state of ventilation of the court, 797——In consequence of these complaints the Lord Chief Baron wrote to the Office of Works in April 1850, and the matter was placed in Mr. Gurney's hands by the Office of Works, 797.

Admirable manner in which the temperature was regulated under Mr. Gurney's plan, 797——Witness has seen the apparatus; it is very simple and very beautiful in its scientific bearings, and witness would imagine it is not expensive, 797——Witness believes the ventilation was under the superintendence of Dr. Reid before Mr. Gurney had it, 798——Witness would say that the air is always very pure, 799, 800——(Dr. *Reid.*) Evidence showing that witness never had the ventilation of the Court of Exchequer under circumstances under which he could execute it properly; was never empowered to ventilate the courts of law in the way in which he desired, 801.

Postlethwaite, Joseph Legg. (Analysis of his Evidence.)—Employed in the Votes and Proceedings Office, 40——Comfortable state of the ventilation of the room in which Mr. Rowland and witness perform their duties; the Clerks' Office is not quite so comfortable, 41-49.

Post Office. Difference in the system of ventilating the Post Office from that adopted in the House of Lords; the system applied to the Post Office has answered well; nature of that system, *Earl Lonsdale* 681-685——How far the Post Office system would answer in the House of Lords, *ib.* 684——System of lighting in operation in the Post Office; successful effect, and great economy of the system, *Leslie* 3193-3198. 3236.

Price, Henry Cruger. (Analysis of his Evidence.)—Civil Engineer; has for upwards of twenty years been engaged in warming and ventilating buildings, 2359, 2360——Witness took out a patent more than twenty years ago for a new kind of hot-water apparatus, 2361——Witness's system has been applied to

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to some important buildings, 2362——It has been applied at Windsor Castle and at the Colney Hatch Lunatic Asylum, and also to many other large lunatic asylums and county prisons; the system has also been extensively applied to private houses, 2363-2367.

The hot-water coil, as an extracting power, is decidedly preferable to the furnace, 2367, 2368——It may be the case that in some places where witness's system has been adopted it may have been removed and another substituted for it, 2369——With respect to warming and ventilation, there may be peculiarities in the House of Commons, but they do not present, to witness's mind, any insuperable difficulties, 2370——Description of the method witness would recommend for warming and ventilating it, 2371 *et seq.*——Witness always adopts the ascending or natural movement of air currents; nature of witness's objections to the descending movement, 2374-2379.

Opinion that the low-pressure hot water disturbs the balance of the air much less than the higher pressure, 2379-2381——The air in the House of Commons is not agreeable to breathe; grounds on which witness asserts that it gets mixed up with all sorts of impurities; suggestions for obviating the evils, 2382-2388——Opinion that sudden and unwholesome sensations of heat and cold, and unpleasant draughts in the House, might be completely guarded against, 2389——Way in which the air breathed in the House is injured by the temperature of the hot water, 2390.

Way in which the annoyance of dust, which is now complained of, might be met, 2391-2395——The only difference between the systems of ventilating the House of Lords and the House of Commons is, that in the one steam power is used and in the other hot water; the air passages are both tainted the same, 2398-2401——Witness would admit the fresh air, warm and cold, from as few apertures as may be practicable; but in the House of Commons they must necessarily be numerous, 2402——The standing difficulty in warming and ventilating the House is, that there is such a vast disproportion between the area of the House and the number of persons that at times occupy it, 2402-2404. 2458 *et seq.*

Way in which witness considers fresh air might be supplied without creating annoyance and draught, 2405-2413——The velocity is the main thing to manage; it is of no consequence how large the body of air is, 2414-2420. 2423-2425——Witness would prefer a few openings at the ceiling of the House of Commons, for drawing off the vitiated air, to any large number, 2421——Witness's aim would be to keep the temperature about sixty-five degrees, 2422——It is most important, in the scheme of ventilating and warming the House, that all the adjoining corridors and other apartments should be incorporated, 2426——The cooling effect of the windows must form an element in the calculation, as there is a fixed law of cooling, which results from windows, 2427-2432.

Evidence showing that the mode of lighting the House is a very important ingredient in the plan of warming and ventilation, 2433-2435——Way in which witness accounts for the bad smells complained of in the House, 2436-2439——The present system of ventilating the House is altogether unsatisfactory

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tory and bad, 2440–2449——Satisfactory results of the system adopted by witness at the Colney Hatch Asylum, 2450–2457.

Witness has no doubt that under his system he could meet all the variations of temperature which must be produced by the difference in the number of Members within the building at different times, 2458–2467——Detailed description of witness's system of warming, and the mode of applying it under the various circumstances which may arise, 2468–2485.

Price's System. Detail of witness's system of ventilation, as successfully carried out in the buildings committed to his care; it is what is called Mr. Price's system, *Daukes* 1699–1711. 1745–1749——It is exceedingly simple in construction, and easy of regulation, *ib.* 1745–1749——Witness has never heard of any complaint of this system, *ib.* 1848–1854.

Witness took out a patent more than twenty years ago for a new kind of hot-water apparatus, *Price* 2361——The system has been applied to some important buildings, *ib.* 2362——It has been applied at Windsor Castle and at Colney Hatch Lunatic Asylum, and also to many other large lunatic asylums and country prisons; the system has also been extensively applied to private houses, *ib.* 2363–2367——Witness's system is by low-pressure hot water, fixing the maximum temperature at 170°; opinion that atmospheric air cannot be brought in contact with the surface at 212°, without impairing its healthy qualities, *ib.* 2373——Detailed description of witness's system of warming, and the mode of applying it under the various circumstances that may arise, *ib.* 2468–2485——Statement of public buildings warmed and ventilated by Mr. H. C. Price, *Rep.* ii. *App.* 572.

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Prisons (Scotland). Manner in which the vacuum system of ventilation adopted by witness has been carried out in the prisons erected under his management in Scotland, *Brown* 3782–3793.

Proceedings of the Committee. *Resumé* of the proceedings of the Committee, *de die in diem*, *Rep.* i. *p.* ii; *Rep.* ii. *p.* x–xxi.

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Public Petitions Office. Defective state of the ventilation of the Public Petitions Committee Office, *Bull* 144–151——Witness has no special complaint to make of the lighting, *ib.* 148.

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Redesdale, Lord. (Analysis of his Evidence.)—Chairman of Committees in the House of Lords, 664, 665——Has attended Parliament almost constantly, during a great many years, in all the Houses in which Parliament has sat during that time, 666——Their Lordships have been in possession of the present House about five years, 667——During that time the ventilation has varied a good deal; it was very bad at first, but it is improved now, 668——The complaints that were made at first were both of the alteration of temperature and of the currents; to a certain degree the complaints still continue, 669-671——What witness objects to in the temperature of the House is that it is too artificial, 669-676——Witness is not aware of any bad smells in the House, 672——The same complaint with regard to the alternation of hot and cold air existed in the Old House, 672.

Reflected Light. Proposal for lighting the House by means of a reflected light instead of a direct light, *Reid* 599-605. 615-619. 623-641——It would greatly facilitate the arrangements for lighting to have a certain additional power from the ceiling, *ib.* 600——How far any experiment might be made with a view of ascertaining the effect of witness's proposed mode of lighting the House by means of a reflected light, *ib.* 646-663——Side lights might be placed where the painted windows now are; if ground glass were used a direct light would be desirable; otherwise reflection would be best, *Arnott* 1298-1304.

Witness sees no objection to the present system of lighting the House, but would prefer its being reflected through glass; reasons for this preference, *Gurney* 3022-3032. 3077-3084. 3111, 3112——There is very little loss of light under this system, *ib.* 3084-3110——Result of experiments which witness has made with respect to the colour most suitable for the reflection of light; silver reflectors are the best reflectors, *ib.* 3336-3359——The same number of lights which witness proposes, placed in a continuous line round the upper part of a screen at the foot of the sloping roof, or round the House, would not give the same amount of light as under witness's plan, *ib.* 3360-3367.

Refreshment Rooms. Evidence relative to the ventilation of the refreshment-rooms; in the smoking-room there is very effectual ventilation, *Gurney*, 2867-2870.

Reid, David Boswell, M. D. (Analysis of his Evidence.)—Statement as to the portions of the New Houses of Parliament under witness's superintendence, as to ventilation and lighting, 166-183——From the want of effective communication, certain portions of rooms which ought to be under witness's control are actually being ventilated both by Sir Charles Barry and witness, 179-181——In consequence of many Members complaining of the bad ventilation of the House, an order was issued to witness, on the 11th February, to report upon some measures for the health and comfort of the House, 184——Report made by witness in accordance with that order, which was printed and distributed on the 16th March, 185——Impossibility of rendering the ventilation of the House satisfactory unless the vaults are paved and cemented,

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as those of the House of Peers, so as to prevent the infiltration of bad water from the exterior, 186-193. 236-239——Objections to the present supply of water; importance of certain alterations being made in the supply, 194-196.

Evidence showing the evil effects of the oil paint on the floor of the House; necessity for its removal as a means of improving the ventilation, 197-205. 236-238——The expense of removing it would not exceed 100 *l.*; 206——Manner in which the flues of the kitchen and refreshment-rooms interfere with witness's ventilation of the House; these rooms are not under witness's superintendence, 207-209——The Central Tower might be made to act most efficiently upon numerous existing causes of evil, 210——Impossibility of witness suggesting remedies for the existing evils in the ventilation without inspecting the drawings; refusal of Sir Charles Barry to allow witness to see the drawings, 211-215.

Importance of a more thorough examination of the fire-flues in the walls of the House, and the stoppage of all leakage from that source, 215. 240-244——Objections to the present system of lighting the House; proposal for remedying the evils, 216-232——The expense of making the alterations necessary for carrying out witness's suggestions for improving the lighting would not exceed 3,000 *l.*; experiments might be made at a very trifling expense, 233-235.

[Second Examination.]—Numerous sources of the bad smells in the House, 331-344. 389-391——With respect to the evidence which has been given by several witnesses, that besides suffering from the effect of the gas-lights, they have been much incommoded by the inequality of the temperature, and by strong currents of air, witness believes that the remedies which he has suggested in his report will abate these evils, 345——But till the system of ventilation can be introduced in full, there can be no diminution of these currents to the extent which is desirable, except more air is sent through the House than witness would wish, 345——The ventilation is only partially in operation at present, 345, 346——The entire supplies of air from the roof are arrested by the intense heat from the burners, 345-357. 362 *et seq.*——Independently of the burners themselves, the iron-work connected with the lamps gets exceedingly heated, 349-353——The light which comes from the burners is very small in proportion to the heat which is produced by them, 354-356.

The power of driving down a current of fresh air from above at times is an almost necessary incident to witness's system of ventilation, as applied to the House, 358——With respect to the air having been at times complained of as being dry, witness cannot imagine it to be the case that it is attributable to the dust from the floor-cloth, to any appreciable extent, 359-361——Explanation as to the facility with which moisture may be introduced into the air, 361——Means resorted to to force the air down, 363-369——Sources from which witness would prefer taking his supply of air, 370-374——Bad smell witness has perceived coming from the cloisters, 370, 371——Witness has repeatedly had to complain of a violent cold draught rushing through the doors into the Commons' lobby, 375-379——It is utterly impossible

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sible for witness to carry out a perfect system of ventilation whilst he is liable to have it deranged by violent cold currents, 378.

Means by which the rooms above the division lobbies are warmed; how far, when these rooms are not warmed, the cold air from them rushes into the gallery of the House, 380–388——Reason why witness would prefer having two sources from which to draw his supply of fresh air, viz. the Clock Tower and the Central Tower, instead of one source, 392–396. 501–516——Detail of the different sources of the present supply; objection to a supply from the basement, if it can be avoided, 392. 396. 401–409——Noxious exhalations from the river, and from St. Margaret's churchyard, 397–400.

Witness has not been made acquainted with the drainage arrangements since 1846, except what he has seen incidentally; drawings and every other information have been withheld from him, 410–412. 423–432——So far as witness is acquainted with the plan and arrangements for the drainage, he would say they are most unaccountable; way in which they interfere with the ventilation, 413–432——Cause of the strong current of air in the Reporters' Gallery; witness has no control over the corridors below this gallery, from which these draughts come, 435–439——Complaints of the air in the House being too dry have not reached witness, 440, 441——Evidence in detail showing the way in which the working of witness's system is impeded by the discharges of vitiated air interfering with his arrangements, 442–453.

Witness's original plan was to have drawn the supply of air from the Clock Tower and the Victoria Tower, and to have discharged it from the Central Tower; way in which this arrangement has been interfered with, 454–464. 501–516——Considerable annoyances to the ventilation arising from the gas-meters, 467, 468——Evidence on witness's estimate of the probable cost of works, as stated in his report, 469 *et seq.*——Advantages which witness considers would result from his being allowed to fit up a single room in the building on the model of the room which was the original cause of his being called to the House of Commons in 1835; 517——Opinion that this will do more, by the example it will give of what is practicable, to save unnecessary expenditure, as well as to add to the health of the members, than any other plan that witness can suggest, 517–524——If authority be given to witness, he knows of no insuperable obstable to his providing a remedy for the evils now complained of by the House of Commons, 525–529——Statement of the obstacles which now exist which witness assigns as the causes of the evils which are complained of, 528, 529——Witness has not the whole of the plans which he requires, 529–531.

[Third Examination.]—Further evidence relative to witness's application to Sir Charles Barry for leave to inspect the drawings, with a view of reporting to The House, in compliance with the instruction of the 11th February, 567–579——Reason why witness allowed a month to elapse between the receipt of that instruction and the application to inspect the drawings, 569–579——The system of ventilation in operation in the present House is not the same as that upon which the old House of Commons was ventilated; material changes made in the system, 580, 581. 642——For the purpose of putting witness's plan into perfect operation, it is desirable to have the power of introducing both

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both a downward and an upward movement, 582——At present it is impossible to put in operation the downward movement, from the statement of the lighting and the leakage from the gas, 583, 584.

Great impediments in the way of witness's completing his system of ventilation, from the want of communication with the architectural department; frequency of his channels being injured and destroyed, 585-591——Attention which witness has paid to the lighting of the House since it has been under his direction; still the lighting is anything but satisfactory; great leakage of gas, 592-594——The gas tubes, under any circumstances, will become so hot as to interfere materially with the ventilation, 595.

There would be great difficulty in managing the ventilation so that there should be a certain stratum of pure air extending to a given depth below the ceiling, which should by its own gravity continually descend and mix with the lower and warmer stratum of air, 596-598——Proposal for lighting the House by means of a reflected light instead of a direct light, 599-605. 615-619. 633——It would greatly facilitate the arrangements for lighting to have a certain additional power from the ceiling, 600——By carrying out the downward draught, for the purpose of ventilating the House, any inconvenience produced by the dust would be remedied, 606-609.

The only existing obstacle to the introduction of the downward current is the state of the lamps in the House; intensity of the temperature above the lamps, 610-620——The arrangement necessary for lighting the House as proposed by witness would not occupy more than five weeks; it would be easy to carry on the work during the sitting of The House, 611——The ventilation of the House would be very much improved by the introduction of the downward current, 612-614——The light which witness proposes to produce at the ceiling of the House is to be as nearly as practicable a reflected light, 616-619. 623-641.

Numerous arrangements necessary to bring into operation witness's complete system of ventilation, 620-622. 642——Lighting the House from the ceiling would make very little difference in the power of hearing in the House, 637, 638. 644, 645——Arrangements made in the present House for giving in some of the contiguous places different temperatures, 642——Frequency of witness's operations being greatly embarrassed by the ingress of smoke from parts of the building not under witness's control, 643——How far any experiment might be made with a view of ascertaining the effect of witness's proposed mode of lighting the House by means of a reflected light, 646-663.

[Fourth Examination.]—So far as witness has found it practicable within the time allowed him, he has made the alterations in the lighting and ventilation of the House authorized by this Committee, 1991——The principal alterations which have been made with respect to the ventilation, have been the purification of the vaults, and the arrangement of the supply of fresh air at the ceiling by the lateral panels, instead of the central panels, 1992-1998——A very large portion of the oil paint has also been removed from the floor, 1999, 2000.

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Witness is prepared to show models of doors which ought to form a very important item of consideration, 2001——Nature of the principal alteration which witness has made during the Easter recess, with respect to the lighting of the House, 2002–2011——Evidence showing, that from what has been already expended on the improvements of the ventilation and lighting, witness has no reason to suppose that his original estimate of 2,800 *l.* will be exceeded, 2011–2062. 2120, 2121——Witness has every reason to believe that the alterations that have been carried out so far, with regard to the ventilation, have been satisfactory, 2063, 2064.

The cause of the unpleasant low temperature of the House on the first night of The House meeting after the Easter recess, was the exceptional case arising from a large door towards the east end of the building having been left either inadvertently or purposely open, 2063–2066. 2069–2073. 2075–2079. 2088–2092. 2094 *et seq.*——The sources from which witness derived his supply of air after this door was shut were from the central vault, and the air also came in from certain leakages, the works not having been quite completed, 2063. 2074. 2080–2087. 2093. 2099–2119.

Witness's arrangements with respect to the ventilation are not yet completed; the external lighting is not yet completed, and this affects the ventilation very much, 2067——Great inconvenience arising to the ventilation from the chimneys that are smoking at the door of the House, the post-office, for instance; difficulties thrown in the way of witness's remedying this, 2067, 2068——Evidence in detail on the feasibility of making the vaults perfectly dry; the vaults to the House of Lords are beautifully dry; the stones are laid quite solid upon concrete, 2125–2163.

[Fifth Examination.]—Amount expended in reference to the works executed since the meeting of the Committee before the recess; the gross amount is 1,100 *l.*; witness's estimate was 2,800 *l.*; the whole of these works have not been executed, but could be completed for that amount, 2486 *et seq.*——Mr. Edge's account for gas fittings has not been delivered, but witness believes it will amount to about 500 *l.*; 2489–2496. 2506. 2520–2529——The estimated expense of placing side-lights all round the House was 800 *l.*; by the omission of the side-lights that expense is avoided, 2507–2509——Nature of the works executed in the vaults, and result: the amount expended, 163 *l.* 15 *s.* 8 *d.*, is only a portion of that which witness originally contemplated for 400 *l.*; 2510–2519——Observations as to the expense of lighting the House of Commons with gas; the cost of lighting, within the House, of the reflectors is about 4 *s.* 6 *d.* per hour; the expense of external lighting would be from about 12 *s.* to one guinea per hour, 2528–2539.

[Sixth Examination.]—Further evidence in favour of witness's plan of putting a small light in every panel of the roof of the House, in preference to a larger light in a smaller number of panels; how far witness remains in the opinion of Mr. Gurney as to the desirableness of the diffusion of light, 3483–3489——Way in which witness proposes to obviate the difficulties with regard to the shadows in the roof, and the want of a sufficient amount of light underneath the galleries, 3490–3505——The expense of witness's present plan

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plan would be much less than that of having the outside lights, as first proposed by witness, 3506-3511.

Witness does not acquiesce in Mr. Gurney's claim to be the inventor of the system of lighting now employed in the House of Commons, 3512——Mr. Gurney came into the House of Commons under circumstances that stopped the application of that system which he now advocates, 3512——Witness dissents entirely from Mr. Gurney's statement, that witness borrowed all his present system of lighting from him; witness has documents in proof of this assertion, 3512, 3513——Numerous classes of buildings in which witness's experiments and observations have been made, in respect of warming, ventilating, and lighting, 3514.

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Comparing the ventilation of the House of Commons and that of the House of Lords, there is a great difference, not exactly in the ventilation, but in the means which are requisite in consequence of the differences of structure; detail in illustration of this point, 3522-3530——It may not perhaps be necessary under all circumstances to have both an ascending and a descending movement to produce a perfect system of ventilation, but witness considers it convenient and very desirable, 3524-3533.

Witness would say that his system of ventilation may be called a natural system, with artificial additions to meet those peculiarities by which the natural operation of ventilation is obstructed, 3534, 3535——Witness has never done anything except to overcome the impediments which artificial circumstances throw in the way of ordinary ventilation, 3534, 3535——Witness has always taken his supply of air at all seasons from the external atmosphere, when pure, and it is only when the external air is in an impure state that he has made the vaults his source of supply; further expression of the opinion that the vaults might be made a desirable source of supply, 3536-3538.

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The entrance of the air through the carpet is by no means the general cause of the dust complained of; the principal cause of the dust is in the uninterrupted passage of workmen, and the works in progress on the roof of the House, 3545——Witness is not aware that the system of warming the air by means of iron pipes, is injurious to the quality of the air, 3546, 3547——Observations with respect to the delicacy of movement of air, and currents and eddies in the House from the opening of the doors, 3549——The discharge from the ceiling of the House is under the most absolute and perfect control, 3550.

Unfinished state of the closets and sewage drains; impossibility of perfecting the ventilation until these are completed, 3551-3554——Great inconvenience resulting from the escape of gas; this is one cause of the deterioration of the air in the House of Commons, 3555-3560——Regulation of the temperature of the air to be supplied to the House in the tempering or equalizing chamber, 3561——Difficulties experienced in the ventilation of the house of Commons from the cross currents arising from the doors, 3562.

In reference to the committee-rooms, all arrangements there are entirely subverted in the practical effects they produce, from the manner in which the flues for ingress and egress are used, and from the manner in which the air is introduced, as well as the state of the fireplace that is connected with these rooms, 3563——It is very desirable that there should be double windows to the committee-rooms, 3563-3566——Inferior quality of the external air round the Houses of Parliament; by taking the supply from the towers an advantage is gained, 3567.

Evidence upon the subject of Mr. Gurney's experiments in the House of Commons; deficiencies in these experiments; opinion that Mr. Gurney has taken a very unfair advantage of witness in making those experiments, 3568-3571. 3598——From the want of double doors, the equalization on the floors does not act with the full beneficial effect that it otherwise would do, 3571——Denial of the statement of Mr. Gurney, that there is a want of control over the ingress and egress in the air passages; witness has the means of regulating both the ingress and egress of air in the present House, 3572-3581.

Advantage of converting a portion of the floor into an exit for the air, as it carries with it a great portion of dust, 3582-3590——With all the arrangements witness has been able to secure in the present House of Commons, there is not anything approximating to what there was in the old for cleaning the feet unconsciously; this is a great inconvenience, 3582——Preference given to hot water apparatus over any other kind of apparatus for heating the air going into the House, 3591-3595——Possibility of rapidly changing the temperature of the House of Commons with the existing apparatus, 3595-3598.

Reid, Dr. Recommendation of the Committee that, during the recess, Dr. Reid be allowed to effect the alterations described in his Report, under the supervision of the First Commissioner of Works, and two Members of the Committee, Mr. Stephenson and Mr. Locke, *Rep.* i. *p.* iii——Observations on the plan adopted by Dr. Reid for ventilating the House of Commons, *Rep.* ii. *p.* v.——Opinion of the Committee that the failure of the ventilation of the House of

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of Commons at the commencement of the session cannot fairly be imputed to any radical defect in Dr. Reid's system; grounds for forming this opinion, *ib.* viii.

Portions of the New Houses of Parliament under witness's superintendence as to ventilation and lighting, *Reid* 166–183——Numerous arrangements necessary to bring into operation witness's complete system of ventilation, *ib.* 620–622——Numerous classes of buildings in which witness's experiments and observations have been made, in respect of warming, ventilating, and lighting, *ib.* 3514——Great difficulties witness has had to contend with in the application of his plan to various works; facility with which those difficulties have been overcome, *ib.* 3516——Suggestions made by Dr. Reid to witness on the subject of ventilation; adoption of the suggestions of Dr. Reid, and successful operation of the system, *Brown* 3679, 3680. 3683–3690. 3808–3812——Papers delivered in by Dr. Reid, 23 April 1852, *Rep.* ii. *App.* 553——Statement as to the date and terms of the engagement of Dr. Reid, as ventilator of the New Palace at Westminster, *ib.* 573.

See also *Air Channels. Central Tower. Control. Gurney's System. Lighting.*

Reporters' Gallery. Great inconvenience experienced in the Reporters' Gallery from the present ventilation; want of uniformity of temperature, *Thornton* 28–31. 38, 39——Cause of the strong currentof air in the Reporters' Gallery; witness has no control over the corridors below that gallery, from which these draughts come, there being several direct communications with the external air, *Reid* 435–439——Comfortable state of the ventilation of the House of Peers; improvements which have been made in the Reporters' Gallery since the sittings began in the present House, *Mulhenkamp* 560–566.

Romilly, Colonel *Frederick*, M.P. (Analysis of his Evidence.)—Witness has suffered great inconvenience from the present state of the ventilation of the House; considerable draughts coming in near the Speakers's chair, 117–123.

Roof Lights. Witness is in favour of adopting the roof lights to a certain extent, and pendent lights to a certain extent, and a sufficient number of other lights for lighting the galleries; this would be the most agreeable, practical, and economical mode, *Gurney* 3368–3371——The expense of witness's present plan would be much less than that of having the outside lights, as first proposed by witness, *Reid* 3506–3511——Approval of the mode of lighting the House from the ceiling; the present lights cannot be improved, *Appold* 3619–3628——Dr. Reid's opinion as to lighting of the House appears to correspond with witness's, as Dr. Reid at first proposed to put a separate light in each panel, *Stephenson* 3912——Witness objected to this mode in the beginning to save expense; but thinks Dr. Reid was perfectly right, *ib.*——At present the light is so contrived as to have a very material and beneficial effect on the ventilation; placing there sixty-four dun lights in the panels would not interfere with the ventilation, but would rather improve it, *ib.* 3913–3916.

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Russell, Lord Charles. (Analysis of his Evidence.)—Serjeant-at-Arms of the House of Commons, 253——Witness's duties require him to be in his place almost continually during the sitting of The House, 254——As regards the ventilation of the House during the present year, witness can say that his own feeling has been one of suffering; way in which witness has suffered, 255–257——In the early part of the session witness suffered from a very high temperature, which Dr. Reid was unable to control, 255–257——The old House appeared to be infinitely more under the control of Dr. Reid than the present, 255——Witness has heard numerous complaints from the Members of the atmosphere of the House being hot and overpowering, 258——Improvement in the ventilation since the beginning of the session, 259.

S.

Sewage Drains. Unfinished state of the closets and sewage drains; impossibility of perfecting the ventilation until these are completed, *Reid* 3551–3554.

Shaft. The furnace in the shaft witness considers to be a very manageable power, and preferable to the jet or fan, *Brown* 3753–3756. 3805–3807.
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Sifted Air. It is of great consequence that all the air which enters should be sifted by passing through wire gauze to prevent the entrance of dirt, *Arnott* 1159——Recommendation that the air should be sifted by passing through a wire gauze at the source of the supply, *Appold* 3660–3673. 3905.

Simplification of Systems. Explanation as to the changes and simplification of the system of giving the House a fit degree of temperature which witness would propose to be carried out, *Arnott* 1246–1249.

Small Pox Hospital. Construction of the Small Pox Hospital by witness, and ventilation thereof, upon his principle, *Daukes* 1693.

Smoke. Great inconvenience arising, in the Committee Clerks' Office, from the chimneys smoking, particularly when the wind blows from the east or north-east quarters, *Chalmers* 3. 6–12——Frequency of witness's operations being greatly embarrassed by the ingress of smoke from parts of the building not under his control, *Reid* 643. 2067, 2068.

Smoking Room. Ventilation of the smoking-room by means of a vacuum ventilation, *Meeson* 2551–2553.

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nated, *Gurney* 2884, 2885——Defective state of the sources and channels of supply, *Leslie* 3136.

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Speaker, Right Honourable The. (Analysis of his Evidence.)—Since the Members have taken possession of the New House the ventilation has been very imperfect, 316——Witness suffers inconvenience from heat and cold, and from currents of air, and also from the peculiar sensations caused by the dryness of the atmosphere, 316, 317——Once or twice since the commencement of the Session the ventilation has appeared to be much improved, but this has been only temporary, 318——There is not much difference in the state of the air between the morning and evening sittings, 319-325——Has not perceived any bad smells in the House, 320——The ventilation of the Old House was very much better than the ventilation of the present House, 321–324——When there is a full House the heat is very oppressive, 328, 329.

Staff. Number of men now employed on the ventilation of the part of the building under witness's charge; amount of their wages, *Sir C. Barry* 786. 788–792——The number employed under witness for the ventilation of the House of Commons has never been arranged, *Reid* 787——Witness's establishment is in the position in which it was when he was deprived of his office, and the same parties are with him who were with him in the Old Houses, *ib.* ——At present witness's ventilating staff only consists of seven persons; the abandonment of the steam-engine would result in a larger staff being required, *Sir C. Barry* 1552–1560.

Steam Engine. Remarks relative to the putting up and removal of a steam-engine at the House of Commons, *Phipps* 3475–3482.

Steam Jets. Number of steam jets employed about the House for the purpose of ventilation; when completed, no noise will proceed therefrom, *Sir C. Barry* 1561–1563——Cause of witness adopting the two sources of motive power, the steam jet and the fan, both in the supply and the discharge of the air, *ib.* 1675——Probable expense of high-pressure steam for a steam jet to sustain a proper rate of ventilation of the House of Commons, *Gurney* 3372–3376.

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Steam Pipes. Grounds on which witness objects to the present system of giving to the House the fit degree of temperature by means of steam, *Arnott* 1226–1275——The only difference between the systems of ventilating the House of Lords and the House of Commons is, that in the one steam power is used and in the other hot water; the air passages are both tainted the same, *Price* 2398–2401——Opinion that the pipes being heated by steam does not act on the air prejudicially, *Meeson* 2557–2563——As regards the special coil, placing the pipes vertically is a far better arrangement than placing them horizontally, *Gurney* 2827, 2828.

Stephenson, Robert, M. P. (Analysis of his Evidence.)—Has been down to Liverpool to look at the lights in the Philharmonic concert-room, 3906——The chief feature was the great advantage of the extreme diffusion of light, 3907——The diffu-

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Stephenson, Robert, M. P. (Analysis of his Evidence)—*continued.*

sion was almost as uniform as the light of day, and not unpleasant, excepting under the sun-burner, which is simply for lighting the orchestra, 3907.

The cornice light would be inapplicable to the House of Commons, it would be brought down to too low a level; witness also considers the sunlights, as applied in the Philharmonic room, would be an objectionable mode of lighting the House, 3907–3911——But if 64 of these clusters were diffused over the flat part of the ceiling of the House of Commons, the effect would be extremely good, 3907–3909. 3927–3932——The effect of the light in the Philharmonic room at Liverpool is very much the same as the effect of Dr. Reid's lights in the hollow pyramids, 3907.

Dr. Reid's opinion as to the lighting of the House appears to correspond with witness's, as Dr. Reid first of all proposed to put a separate light in each panel, 3912——Witness objected to this in the beginning to save expense, but thinks Dr. Reid was perfectly right, 3912——The hollow pyramids are not very sightly, but might easily be made so, 3912. 3914. 3918——At present the lighting is so contrived as to have a very material and beneficial effect on the ventilation; placing there 64 sun-lights in the panels would not interfere with the ventilation, but would rather improve it, 3913–3916.

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Stone, George. (Analysis of his Evidence.)—Clerk in the Vote and Proceedings Office, 139——One of the rooms of the office is very comfortable as to its ventilation, but the other is very unpleasant, 140–142.

[Second Examination.]—Further evidence as to the unsatisfactory state of the ventilation of the Votes and Proceedings Office, 3823–3835.

Structural Arrangements. Sufficiency of the present structural arrangements for ventilation and warming; opinion that they are susceptible of easy adaptation, at a moderate outlay, to any other system that may be considered preferable, *Rep.* ii. *p.* vii——The structural arrangement required by Dr. Reid for warming and ventilating, were carried into effect under witness's direction, *Sir C. Barry* 1468–1478——The whole of the arrangements were contrived by Dr. Reid, and executed by witness up to the period of Dr. Reid's dismissal, *ib.* 1507——Modifications made in Dr. Reid's system of ventilation under witness's direction; witness considers his alterations of an essential character, *ib.* 1507–1520.

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Structural Arrangements—continued.

Statement relative to the structural arrangements made by Dr. Reid with reference to the warming and ventilating of the House of Lords, prior to his removal from the work in the year 1846, and the use made of such arrangements by the architect in the system now in use for warming and ventilating that chamber, *Rep.* ii. *App.* 550——Reply by Dr. Reid to the statement made by Sir Charles Barry, "relative to the structural arrangements made by Dr. Reid with reference to the warming and ventilating of the House of Lords," *ib.* 551.

See also *Ceiling of the House.*

Subdued Light. Witness does not object to the shadow beneath the galleries; opinion that it is desirable that there should be some portions of the House on which the eye may rest without being affected by the large amount of light necessary for business purposes; a mitigated light might easily be thrown under the galleries, *Stephenson*, 3922–3926.

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Sun Burners. The House of Commons might be lighted by a continuation of sun-burners and lights round the cornice, *King* 2349——Witness does not contemplate that there would be any flickering in the light, *ib.* 2350–2356——Approval of the sun-burner method of lighting as adopted at Liverpool; it would do very well at the House of Commons, *Appold* 3878–3904——But witness prefers the present system of lighting the House of Commons to adopting the sun-burner, as it takes the products of combustion off so well, *ib.* 3896——The system of sun-lights is to be recommended in an economical point of view, *Stephenson* 3920, 3921.

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Superintendence. See *Control.*

Supply and Discharge of Air. All the inlets and outlets appear to be under proper regulation, though they are not exactly upon the system witness would recommend; witness's plan would have been to extract from below, and allow the air to come in from the upper parts of the windows, *Gurney* 2829. 2837. 2839–2847. 2849–2866——The supply of air should be self regulating, *Leslie* 3184.

See also *Downward Current Ventilation.* *Earthenware Pipes.* *External Air.* *Floor of the House*, 1. *Ingress of Air.* *Sources of Supply of Air.* *Steam Jets.*

Suspended Lights. Opinion that suspended lights from the roof are very dangerous, *Leslie* 3199.

T.

Temperature of the House. Causes of the variety of temperatures felt in the House of Commons, *Daukes* 1729——Mode in which witness proposes to regulate the temperature of the House, *ib.* 1907–1911——Cause of the unpleasantly low temperature of the House on the first night of meeting after the Easter recess; this was an exceptional case, *Reid* 2066. 2069–2073. 2075–2079.

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2079. 2088–2092. 2094 *et seq.*——Witness's aim would be to keep the temperature about 65°, *Price* 2422——From experiments which have been made it has been found that the temperature of the air could be reduced several degrees in a few minutes, *Meeson* 2564–2567——Statement as to the variations of temperature in the House of Commons on the night of 3 May 1852; from the slight difference observable witness considers the present system to be very perfect in its operation, *Brown* 3818–3822.

Copy of the order given to the engineer in chief as to temperature delivered in by Sir C. Barry, *Rep.* ii. *App.* 550——Statement of the temperatures at the House of Commons, taken by the messenger appointed by the Serjeant-at-arms, on the twelve days on which the House sat immediately preceding the Easter recess, and on the first twelve days on which the House sat immediately after the Easter recess, 1852; *ib.* 580.

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Tempered Air. Advantage of confining the uprise of tempered air to certain portions of the House, instead of making the entire floor a channel for it; portions of the House which might be used for the purpose, *Daukes* 1879–1903. 1917–1918——Means existing for mixing the tempered air with the warmed air when this mixture is required, *Meeson* 2568–2576.

Tempering Chamber. Regulation of the temperature of the air to be supplied to the House in the tempering and equalizing chambers, *Reid* 3561.

Thompson, Lieutenant-Colonel *T. Perronet*, M. P. (Analysis of his Evidence.)—Constant attendant at the House of Commons, 14, 15——Witness sees no reason to find fault with the ventilation of the House generally, 16–18. 24, 25——Unpleasant smells occasionally experienced in the House, which witness attributes to the urinatories, 18–23.

Thornton, Thomas. (Analysis of his Evidence.)—Constantly sits in the Reporters' Gallery, 26, 27——Great inconvenience experienced in the Reporters' Gallery from the present ventilation; want of uniformity of temperature, 28–31. 37–39——Improvement of the lighting since the chandeliers have been raised, still it is not now perfect or convenient, 32–36.

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Turnbull, John. (Analysis of his Evidence.)—Has held the office of clerk of the works at Windsor six years, 1964, 1965——An alteration has been made in the system of warming and ventilating the whole of the north front on the principal floor since witness has held his office, 1966–1969——It has been placed under the system of Mr. Price, under witness's superintendence, 1970–1972——Witness considers the success of the experiment has been most successful, 1973–1975——Witness does not think that for such an object it is at all an expensive plan, 1976–1979——On one or two crowded occasions complaints have been made of the temperature, but on no other occasions, 1980–1984.

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U.

Unhealthy Atmosphere. Opinion that the processes by which the ventilation of the House of Commons is effected create an unhealthy atmosphere in the House, most injurious to the health and comfort of those compelled to breathe it, *Leslie* 3132-3136.

Uniform Velocity of Air. It is quite practicable to attain a uniform velocity, and perhaps more uniformity by the fan than by the pump, *Sir C. Barry* 1548-1551.

Upward Current Ventilation. For the purpose of putting witness's plan into perfect operation, it is desirable to have the power of introducing both a downward and an upward movement, *Reid* 582——The chief circumstance to be considered with regard to an upward current is the dust; possibility of all difficulty arising from this cause being removed, *Arnott* 1144, 1145. 1155-1158——Objections to the upward current ventilation, *Clark* 1369-1376; *Sir C. Barry* 1586——The present lighting of the House is not injurious to any contrivance for ventilation on the ascending principle, *Daukes* 1904——Preference given to the ascending current over the descending, *Price* 2374-2379; *Brown* 3698——It may not perhaps be necessary under all circumstances to have both an ascending and a descending movement to produce a perfect system of ventilation, but witness considers it convenient and very desirable, *Reid* 3524-3533.

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Urinals. Unpleasant smells occasionally experienced in the House, which witness attributes to the urinatories, *Thompson* 18-23——The smell from the urinals and other objectionable sources is in consequence of the rush of air brought into the House, *Gurney* 883——The ventilation of the urinals and closets is wholly and entirely under the control of Dr. Reid, *Sir C. Barry* 1492, 1493.

V.

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Vaults. Opinion that in their present state the vaults ought not to be used as air channels for transmitting the air to the House of Commons, *Rep.* ii. *p.* vi ——Impossibility of rendering the ventilation of the House satisfactory, unless the vaults are paved and cemented, as those of the House of Peers, so as to prevent the infiltration of bad water from the exterior, *Reid* 186–193. 236–239. 2125–2163——It is not a part of witness's plan to reject the vaults as a means of obtaining air, *Gurney* 964——Objection to the present air channels of the House of Commons, as they pass through subterraneous vaults, *Daukes* 1782–1784. 1860–1867——Although the air is very pure when it enters the towers, it becomes impure in its passage through the vaults and other channels previously to its arrival at the House, *Price* 2387, 2388—— Witness has no objection to the supply of air for the House being taken from the vaults, provided they are kept clean and absolutely dry, *Brown* 3738–3748.——*See* also *External Air.*

Velocity of Currents. Evidence as to the best means of moving through a building uniformly the measured quantity of air that is required, *Arnott* 1059 *et seq.*——The velocity is the main thing to manage; it is of no consequence how large the body of air is, *Price* 2414–2420. 2423–2425——Velocity of the air at the point of ingress and in the House of Lords itself, *Meeson* 2628–2637——Velocity of the vitiated air; experiments which witness has tried with a view of ascertaining this velocity in its escape from the House of Lords, *ib.* 2740–2753——Objections to the manner in which air is at present forced into the House; the velocity of the current causes the sensation of cold so much complained of, *Leslie* 3136–3146——Experiments made by witness to ascertain whether the velocity of a current of air upon a dry bulb thermometer immediately causes the temperature to sink, and result, *Appold* 3658–3660.

Ventilation. The art of ventilation is very new; remarks on the various attempts made to ventilate the Houses of Parliament during the last 80 years, *Arnott* 1059——The systems of ventilation in operation at the Houses of Parliament are too complex, *ib.* 1059–1115——Generally speaking, witness would say that there are in the ventilating arrangements the foundation of everything that can be required, except for crowded committee-rooms on special occasions, *Gurney* 2785–2787——Otherwise the arrangements, with very little modifications are sufficient for the requirements, *ib.* 2787——Report on the warming and ventilation of the Houses of Parliament, addressed to the Select Committee of the House of Commons on Ventilation and Lighting, and prepared at their request, *Rep.* ii. *App.* 564.——*See* also *Lighting*, 5.

Victoria Tower. Explanation with respect to the air passing through the channel from the Victoria Tower, before it reaches the fan, becoming purified, *Sir C. Barry* 1382–1388.——*See* also *Clock Tower.*

Vitiated Air. Way in which the working of witness's system is impeded by the discharges of vitiated air interfering with his arrangements, *Reid* 442–453————The apertures for the egress of air in the House of Commons are deficient; witness would regulate the extraction, but would allow the intake always to be as free as possible, *Gurney* 870–875. 2895–2918——Mode witness would propose for discharging the vitiated air where it tends to accumulate, *Arnott* 1198–1209. 1211–1214——System at present pursued in the House of Commons

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mons for the discharge of the vitiated air, *Arnott* 1199-1205——Sufficiency of the discharging apertures for the vitiated air in the House of Commons for the adoption of any system of ventilation, *ib.* 1215-1218.

There would be no difficulty whatever in discharging the vitiated air wholly from the floor, but it might be inconvenient, *Sir C. Barry* 1580-1583. 1644-1647. 1658-1677——The failure of the ventilation chiefly arises from there not being sufficient means of escape for the vitiated air, *Daukes* 1726-1728. 1730-1736. 1944-1946; *Leslie* 3215. 3260-3264——Witness would prefer a few openings at the ceiling of the House of Commons for drawing off the vitiated air to any large number, *Price* 2421——The discharge from the ceiling of the House is under the most absolute and perfect control, *Reid* 3550.

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Vote and Proceedings Office. Unsatisfactory state of the ventilation of the Vote and Proceedings Office; disagreeable state of the atmosphere from the dusty particles in the air, *Stone* 140-142. 3823-3835.

W.

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Water. Objections to the present supply of water; importance of certain alterations being made in the supply, *Reid* 194-196.

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Wax Candles. Witness considers a system of lighting by wax candles exceedingly inferior, for many reasons, to gas-lighting well managed, *Arnott* 1305-1310.

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Wilts County Asylum. In the Asylum just completed for the county of Wilts the warming power is hot water, and the ventilating power is hot water also, *Price* 2367——In witness's judgment and experience this is the right combination; the hot-water coil, as an extracting power, is decidedly preferable to the furnace, *ib.* 2367, 2368.

Windows. The cooling effect of the windows must form an element in the calculation, as there is a fixed law of cooling which results from windows, *Price* 2427–2432——Possibility of carrying out a system of ventilation without making use of the windows as a means of ingress; such a system is quite practicable to be carried out in the present building, *Brown* 3725–3737——Existence of steam coils of pipe under the windows in all the committee-rooms for the purpose of counteracting the cooling down of the air by the large surface of glass; sufficiency of those pipes for the purpose of regulating the heat, *Meeson* 3840–3845.

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Windsor Castle. Imperfect ventilation of the apartments of Windsor Castle up to the year 1847; improvements therein since it has been under the superintendence of Mr. Price and Mr. Turnbull, *Bowles* 1820–1834——An alteration has been made in the system of warming and ventilating the whole of the north front on the principal floor, since witness has held his office, *Turnbull* 1966–1969——It has been placed under the system of Mr. Price, under witness's superintendence, *ib.* 1970–1972——The success of the experiment has been most successful, *ib.* 1973–1975——Witness does not think that for such an object it is at all an expensive plan, *ib.* 1976–1979.

Y.

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York Hospital. Description of the ventilating apparatus at York Hospital, on the self-regulating principle; satisfactory performance and great economy thereof, *Arnott* 1132, 1133. 1141–1143. 1325.

London May 24 1853

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