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1892.

Sixty-Fifth Legislature.

SENATE. No. 3.

STATE OF MAINE.

AUGUSTA, ME., January 21st, 1891.

To the President of the Senate and Speaker of the House of Representatives:

I have the honor of transmitting herewith the report of the Commissioners, appointed under Resolve of the Legislature entitled, "Resolve in favor of Enlargement of State House," approved March 12th, 1889.

EDWIN C. BURLEIGH.

Report of the Commission on Enlargement of the State House.

To the Honorable Senate and House of Representatives of the State of Maine:

The legislature of 1889 passed the following resolve:

Resolved, That the Governor of the State and four others to be appointed by him, two of whom shall be members of each of the two leading political parties, are hereby constituted a commission, and are directed to take immediate steps to obtain plans and specifications for such an enlargement and alteration of the state house as will provide ample, convenient and fire-proof apartments for the state library, and for the records and documents of the various departments of the state government, and for the use and accommodation of the legislature and its committees; and shall thereupon proceed to contract for, prosecute and superintend the construction and completion of said enlargement and alteration; and that the sum of one hundred and fifty thousand dollars be and hereby is appropriated for said enlargements and alterations, to be expended under the direction of said commission, and for the reasonable expenses of said commission, to be audited by the governor and council.

Provided, That said commission shall not proceed to make any expenditure, or contract therefor, until they shall have first and obtained a contract or contracts from responsible parties, to build and complete the necessary fire-proof additions to the capitol, for a sum not exceeding the amount specified in this resolve, which contract shall be secured by a bond to be approved by a majority of this commission.

Approved March 12, 1889.

APPOINTMENT.

Pursuant to the provisions of the above act the Governor appointed Messrs. George E. Macomber and Edward C. Allen of Augusta, Lewis Barker of Bangor and Henry Ingalls of Wiscasset.

ORGANIZATION.

In obedience to a call from the Governor, the Commissioners met at the Governor's room at the State House, Monday, March 25,

1889, and, having taken oath of office, effected an organization by the election of Hon. E. C. Burleigh as Chairman, and C. S. Hichborn of Augusta, as Secretary.

Before taking definite action it was thought advisable to ask the citizens of the State to co-operate with the Commission in its work, and to this end notice was published by the Associated Press, and inserted in the several daily newspapers of the State, inviting architects and all interested citizens to meet the Commission and make such suggestions and present such plans regarding the proposed enlargement, as should seem to them desirable. In response to this invitation gentlemen from various parts of the State appeared and discussed with the Commission, the question of how best to make the proposed enlargement. Two plans were advocated; the one for a central wing and the other for one or more side wings. Each seemed to present some advantages over the other; but after carefully weighing the question, the Commission unanimously voted to adopt the former. It was further strengthened in its judgment by the fact that the plan submitted to the legislature of 1889 and by the members thereof very generally approved, contemplated the addition of a *central* wing. As the work has progressed and the convenience and accessibility of the building become apparent, the Commission has become more thoroughly convinced of the wisdom of this decision; and it is confidently believed that the structure with which you are now familiar possesses, in a satisfactory degree, the essential qualities of safety, comfort and adaptability to the needs of the State.

ARCHITECT.

The Commission believed that upon the judicious selection of architect largely depended the success of the enterprise.

It was designed that the addition should be a strictly fire-proof building,—built in accordance with the most advanced thought and most approved methods of construction. The best interests of the State, therefore, *demanded* that only such an architect should be employed as was thoroughly acquainted, both by study and actual experience, with the erection of this class of buildings.

After careful inquiry the Commission decided to entrust this important work to Messrs. Brigham and Spofford of Boston, a firm whose reputation is believed to be second to none in New England.

A member of this firm was before the last Legislature, and presented the plan, heretofore alluded to, of which this addition is the

essential embodiment, and upon which, with the estimate then made, the appropriation was, in a large measure, based. The Commission was, therefore, pleased to be able to ratify the implied choice of the Legislature under whose appropriation the work was to be done.

The Commission is of the opinion that no better service could have been obtained, and that to the ability and fidelity of these architects the State is, to a great extent, indebted for the character of this work.

PLANS AND PROPOSALS.

Before fully deciding upon the plan the Commission, accompanied by the architects, visited and inspected the state houses of Massachusetts, New Hampshire and Connecticut, for the purpose of gathering information such as would be useful and a help to the Commission in the discharge of its duties. Many valuable hints were received, and numerous desirable features have thereby been incorporated into this building.

The plans having been adopted, advertisements inviting proposals for executing the work were published in all the daily papers of the State. In reply thereto sixty-four bids were received, a tabulation of which showed the Booth Brothers and Hurricane Isle Granite Company of Rockland to be the lowest bidder for furnishing the stone, and Messrs. M. C. Foster and Son of Waterville, the lowest for doing the balance of the work, excepting the heating and ventilating plant, elevator, mantels, electric light and bell wires and other matters of less importance. The contracts were, therefore, on the day of May, 1889, awarded to those parties, whose two bids combined were more than six thousand dollars less than the next lowest bidder.

On the third day of June, A. D. 1889, the first blow was struck, and on the first day of January, 1891, the building was formally turned over to the State by the contractors.

HEATING AND VENTILATING.

The question of ventilation engaged the serious attention of the Board. No pains have been spared to obtain the best advice in this very important matter. The State Board of Health was consulted, and the views of gentlemen interested in this branch of work in various parts of the State were sought. It was a complex and difficult problem and one which demanded the best skill and judg-

ment obtainable. This duty was, therefore, assigned to Prof. S. H. Woodbridge of the Massachusetts Institute of Technology, a gentleman who has made this subject a special study and whom we believe to have no superior, if an equal, in his line in New England. Under his plan and direction there has been placed in this building a system of ventilating and heating which we believe will be attended by the very best results.

The fan located in the basement of the addition forces a volume of pure air into every room in the new building and to the Halls of the Senate and House of Representatives, while ample vent-flues provide exit for the impure air through the roof ventilator. The air ducts are under the control of the engineer, and to each and every room is being sent, every minute, such an amount of pure air as the occupants of the several rooms require.

The steam boilers have always been located in the basement of the old building. To the Commission it seemed a serious mistake to continue them there and thus subject the occupants of the building to danger of possible explosion, and the State to unnecessary risks from fire. Accordingly, following the advice of experienced engineers and of the Governor and Council of this State, it was decided to erect an underground boiler-house removed from the main building, and place new and larger boilers therein; and for this purpose the Governor and Council appropriated a special sum of five thousand dollars. We hope and believe this action will meet the approval of every thoughtful citizen.

The entire steam-heating and ventilating plant was put in by Mr. A. D. Ward of Augusta, he being the lowest bidder for doing this work.

ELEVATORS.

The elevator was furnished under contract by the Whittier Machine Company of Boston. It is operated by hydraulic power, the water being taken direct from the pipes of the Augusta Water Company. It is capable of raising two thousand pounds two hundred feet per minute.

HOUSE OF REPRESENTATIVES.

Although the appropriation at the disposal of the Commission was small and in spite of the fact that it was not intended that it be spent upon the old building, nevertheless much has been done in this Hall. The old floor has been removed and alterations made

beneath to perfect the arrangements for ventilation. The walls have been entirely re-plastered, a new floor has been laid, the room enlarged by the addition of a recess at the west side to accommodate the Speaker and Clerk and Official Reporters, the room handsomely decorated and finally, new desks and chairs have been furnished throughout. Towards the furnishing of this Hall a special appropriation was made from the sum appropriated by the last legislature for furniture and repairs, of twenty-five hundred dollars.

THE WORK.

It will, doubtless, be of interest to know what parties have done this work, and we herewith submit the names of the various firms who have had part therein.

It is a matter of interest and gratification to the Commission that nearly all the material entering into the construction of this addition has been furnished by residents of our own State.

Granite, Booth Brothers and Hurricane Isle, Granite Company, of Rockland.

General Contractors, M. C. Foster & Son of Waterville.

Heating and Ventilating, A. D. Ward of Augusta.

Mantels, Walter Corey & Company of Portland.

Treasurer's counter, Walter Corey & Company of Portland.

Desks for Speaker and Clerk and for the members of the House of Representatives, Walter Corey & Company of Portland.

Chairs for members, House of Representatives, West Paris Manufacturing Company, West Paris.

Decorating House of Representatives, Major J. W. Berry of Gardiner.

Elevator, Whittier Machine Company of Boston.

Electric wires and speaking tubes, Kendall & Slade of Boston, Sub-contractors under Messrs. Foster & Son.

Iron work, Megquier & Jones of Portland.

Asphalt, L. W. Tibbetts of Portland.

Painting, C. Beale & Company of Augusta.

Sash, doors and glazing, Webber & Gage of Augusta.

Copper work, piping and plumbing, Chas. Greenwood of Lewiston.

Marble work, C. E. Hall & Company of Boston.

Pointing exterior walls, by the day, by mechanics from Portland.

Hard pine flooring, Deering, Winslow & Company of Portland.

Oak stair work, R. C. Pingree & Company of Lewiston.

Brick, H. Purinton & Company of Waterville.
Lime and cement, I. H. Cunningham of Augusta.
Slate came from Brownville.

OBITUARY.

In the death of Mr. Barker, which occurred Oct. 10th, 1890, the Commission lost a member wise in counsel and constant in interest, and the State a tried and faithful son. The Commission attended his funeral in a body.

At the next regular meeting the following resolutions were passed, and the same placed upon the records of this Commission:

WHEREAS, By a decree of Providence, whose wisdom cannot be questioned, and yet whose dispensations we cannot comprehend, our beloved friend and faithful associate, Lewis Barker, has been called from this life, therefore be it resolved,

That, This Commission desires to record its appreciation of his worth as a man and of his services as a member of this Board. From the beginning of its work he has labored with an earnestness and zeal characteristic of his every effort. Constant in his attendance upon its meetings, painstaking and just in his dealings, he considered only what was for the best interests of our State, and bore, in a conspicuous degree, the duties and responsibilities of this Commission. His work in connection with this building, now nearly completed, is not the least of his services in behalf of the State he loved and so faithfully served.

And it is further ordered and resolved,

That these resolutions be spread upon the records of this Commission, and a copy forwarded to the family of our deceased associate.

CONCLUSION.

In closing this report, we can but refer in complimentary terms to all those who have participated in the carrying out of this work. The desire to do whatever was right, the general interest manifested in the work, and the courtesy and respect always accorded to the Commission, are matters which the Board remembers with a good deal of pleasure.

Detailed reports from the architects and Prof. Woodbridge, are appended hereto, which will be read with much interest.

An account of the expenditure of the legislative appropriation is herewith submitted.

RECEIPTS.

Legislative Appropriation	$150,000 00
Received from the Contingent Fund of the Governor and Council on account of Expenditures made necessary by outside boiler-house	5,000 00
Received from Superintendent of Public Buildings, from the appropriation for furniture and repairs for expenditures in Hall of House of Representatives	2,500 00
Total	$157,500 00

EXPENDITURES.

J. R. Milliken, fee as dedimus justice	$ 5 00
Expenses, trip to Hartford, Concord and Boston	236 86
James N. Wade, labor	5 00
S. H. Woodbridge, services	63 50
S. H. Woodbridge, "	222 50
Advertising and incidental expenses	96 47
Lewis Barker, travelling expenses	177 33
Henry Ingalls, "	106 89
A. D. Ward, bill rendered	15 12
C. W. Trask, wood	124 50
Lewis Barker, travelling expenses	102 50
Henry Ingalls, "	57 30
Kennebec Light and Heat Company, bill rendered	59 50
Charles Milliken, wood	6 00
E. Stone, coal	116 88
Kennebec Light and Heat Company, bill rendered	57 00
Lewis Barker, travelling expenses	95 50
Henry Ingalls, "	39 65
A. D. Ward, stoves, etc	200 00
A. D. Ward, for heating	150 00
Edwin C. Burleigh, salary for year 1889	800 00
George E. Macomber, " "	800 00
Edward C. Allen, " "	800 00
Lewis Barker, " "	800 00
Henry Ingalls, " "	800 00
C. S. Hichborn, " "	500 00
Henry Ingalls, travelling expenses	42 52
Expense attending Mr. Barker's funeral	24 15
M. C. Foster & Son, contractors	92,737 00
Booth Bros. and Hurricane Isle Granite Co., granite	30,499 63
A. D. Ward, steam heating and ventilating	8,098 00
West Paris Chair Company, chairs	1,694 00

Kendall & Slade, electric work	$1,000 00
Whittier Machine Company, elevator	1,990 00
Craig & Tucker, vault doors	120 00
Tuttle & Bailey, registers	62 44
Doe, Hunnewell & Company, mantel	75 00
Boston Terra Cotta Company, panel	84 00
Walter Corey & Company, desks, mantles, etc	1,377 50
John W. Berry, decorating	691 20
I. E. Loud, register borders	18 59
G. A. & H. Cony, bill rendered	7 50
Henry Ingalls, travelling expenses	17 13
Lewis Barker, "	37 30
Brigham & Spofford, special expenses	178 62
S. H. Woodbridge, services	225 00
Brigham & Spofford, fees as architects	7,007 80
Edwin C. Burleigh, salary for year 1890	800 00
George E. Macomber, " "	800 00
Edward C. Allen " "	800 00
Lewis Barker, " "	800 00
Henry Ingalls, " "	800 00
C. S. Hichborn, " "	500 00
S. D. Hicks & Son, ventilator	112 00
B. F. Sturtevant & Co., bill rendered	110 08
Brigham & Spofford, fee on furniture	213 58
Due Kendall & Slade, on completion of work	235 00
Balance covered into State Treasury	4 46
	$157,500 00

IN COUNCIL, January 20, 1891.

The report of the Commission on Enlargement of State House was this day presented and referred to a committee of the whole.

Chairman of Council reported that accounts submitted with said report had been examined and found to be correctly cast and properly vouched.

J. F. BRACKETT, *Chairman.*

This Commission has found its duties oftentimes laborious—the sessions frequently lasting into the small hours of the morning—and yet full of interest. It hopes its stewardship will be thought wise and faithful.

The two years' work has brought this Commission into intimate knowledge of the construction of the parent edifice; and, while not a part of the legitimate business of this Commission, we venture, as citizens of our good State, with an eye single to its welfare, to call the attention of your Honorable Body to the advisability of making substantial alterations in the old building. It is known to you all that its entire interior is of inflammable material. Modern skill and ingenuity have produced such *fire-proof* building materials as enter into the construcrion of the new wing. This interior woodwork should be removed, and fire-proof work substituted in its stead. We deem it unwise to leave to danger of destruction by fire this grand old home of the State, so rich in memories of the historic past, so fitting a monument to the faithfulness and self-sacrifice of the men through whose energy it was erected.

We earnestly recommend an appropriation for the purpose indicated, and of sufficient amount to bring the old building into harmony with the new.

A plan has been made and will be laid before you for your consideration.

Respectfully submitted,

EDWIN C. BURLEIGH, Chairman,
GEO. E. MACOMBER,
E. C. ALLEN,
HENRY INGALLS,
} *Commissioners.*

C. S. HICHBORN, *Secretary.*

AUGUSTA, January 20, 1891.

Report of Architects.

BOSTON, MASS., January 1, 1891.

To the Commission on the Enlargement of the Maine State House.

GENTLEMEN:—On the day of , 1889, we were commissioned by your Honorable Board to prepare plans and specifications and to superintend the construction of an addition to the Maine State Capitol: having completed the labors imposed upon us, we beg leave to submit the following report:

DESCRIPTION.

The original building, designed by the distinguished architect, Charles Bullfinch, was completed in 1832, and the style of architecture adopted by him has been faithfully followed in the new addition; and we trust we have detracted nothing from the dignity of the parent structure.

The new building is fire-proof in its construction throughout. Its general dimensions are as follows:

Length, 75 feet, exclusive of the circular projection; width, 81 feet; and height from grade to cornice, about feet.

Three full stories are obtained for departmental purposes, as well as the greater portion of the basement.

CONSTRUCTION.

The foundation of the building resting mainly upon solid ledge, a great part of which required blasting, is very solidly built of granite blocks bedded in cement.

SUPERSTRUCTURE.

The entire exterior walls are faced with granite similar to the original building and backed up with brick. The interior walls are mainly of brick, the Speaker's alcove and certain partitions, are of fire-proof blocks. All floor and roof beams are of steel.

In the construction of the first floor brick arches are used and in the three upper stories, hollow arched fire proof blocks. These are covered over from two to three inches of concrete, making something over 12″ of solid masonry in each floor.

The finished floors are of marble tiling in the halls, corridors and lavatories, and rift hard pine in the finished rooms. The door and window frames are of wood but the architraves or finish around

them, with but few exceptions, are of Keen cement on a foundation of Portland cement.

The wainscotting and bases throughout the building are of marble or Keen cement. The stairways, except the hand-rails are of iron and marble. It will be seen, therefore, that the construction is so thoroughly fire-proof in all respects that no possible damage by fire to the new structure can arise from within, although a constant source of danger must be admitted to exist in consequence of the very close communication of the interior of the old part with the new, the former being entirely of wood.

HEATING AND VENTILATION.

The entire building is heated by two boilers of 75 H. P. each, located in an underground boiler-house about 30′-0″ from the main building.

Ventilation is secured by means of a large Sturtevant blower set in the basement of the addition. Fresh air is supplied to this fan through a large steam coil and passes to every room in the new part, and to the House and Senate through large galvanized iron pipes. Fire-places and ventilating ducts from the room carry the vitiated air to the outside of the building.

Prof. S. H. Woodbridge of the Institute of Technology, Boston, has had charge of the heating and ventilation and has devised a system which from its simplicity and freedom from complication, we may expect a successful result creditable to his ability and skill as an engineer. Special care has been taken with the House of Representatives, the space beneath the floor having been converted into an immense air-chamber to be filled with warm fresh air forced in through the fan in the basement and having outlets beneath each member's chair and through the various registers in the floors and galleries.

PROGRESS.

Excavation was begun on the 31st day of June, 1889, the contract providing that the building should be completed on or before September 15th, 1890, but owing to inevitable delays, the time was extended to December 30, 1890.

CHANGES.

During the progress of the building several important modifications, or more particularly additions, were made to the plans and scheme; the most important of which were the location of the boilers in a

separate structure outside of the building, and the reseating and decoration of the House of Representatives. The present boiler-house is located under ground about thirty feet from the main building with which it is connected by tunnel. By this arrangement danger from fire and explosion is reduced to a minimum.

The House of Representatives has been considerably enlarged by the addition of an alcove for the Speaker and Clerk. The former chairs and desks have been replaced by new and more convenient one. The chairs were furnished by the West Paris Manufacturing Company; the desks by Walter Corey and Company of Portland.

Changes have been made in the entrances to this Hall and a portion of the walls rebuilt and the entire room redecorated; the decoration being done by Maj. J. W. Berry of Gardiner.

PRINCIPAL CONTRACTORS.

Messrs. M. C. Foster & Son of Waterville, masonry, carpentry, roofing, plastering, plumbing and painting.

Messrs. Booth Brothers and Hurricane Isle Granite Company, granite.

A. D. Ward, Augusta, heating and ventilating.

Whittier Machine Company of Boston, Mass., elevator.

Messrs. Kendall & Slade of Boston, electric wiring and speaking tubes.

Messrs. Walter Corey of Portland, wood mantels.

SUB-CONTRACTORS.

Iron work, Megquier & Jones, Portland.

Marble, Messrs. Chas. E. Hall & Company of Boston.

Plumbing, Charles Greenwood, Lewiston.

Plastering, Joseph E. Howard, Augusta.

Painting, C. Beale & Company, Augusta.

Ventilation, B. F. Sturtevant, Boston, Mass.

Granite, Joseph Arche & Company, Hallowell Granite Company and Mt. Waldo, Granite Company.

CONCLUSION.

We believe the work throughout to have been well done, and we trust as it is now delivered into your hands, may prove a credit to the various mechanics employed as well as to ourselves.

Respectfully submitted,

BRIGHAM & SPOFFORD.

Report of Prof. S. H. Woodbridge on Steam Heating and Ventilation.

To the Commission on Enlargement of the State House:

My Dear Sir:—The work given to my care by the Board of State House Commissioners has been executed in as close accordance with the plans proposed in my communication to the Board under date of June 8, 1889, as has been found practicable.

The apparatus advised consisted of a fan and engine capable of moving and distributing under slight pressure 25,000 cubic feet of air per minute, a heater capable of heating that air from 20° below to 70° above zero, a system of iron conduits and of wall flues for the distribution of this air throughout the extension and to both the assembly halls of the main building, a system of dampers for the control of the quantities and the direction of flow of the air volume moved; a system of direct steam heaters under automatic control for the even warming of the rooms; boilers and chimney of sufficient capacity for the required work, a system of vent flues and channels for the discharge of vitiated air.

The several parts of this combined system were in plan carefully proportioned to their required individual and associated duty and to the ordinary and the special requirements for which they were designed. Departures from that plan have been chiefly due either to modification in the building itself and in required adatpion to such changes, or else to the limited means at the disposal of the Commissioners for the execution of the work.

Trials of the system have been personally made under conditions of weather favorable to a test of its ability to meet assumed maximum requirements. The result of the tests are herewith submitted in some detail, together with such notes as appear of possible value to a clearer knowledge of the purposes for which the several parts are designed, and the method of their use for obtaining the best results.

The Fan.—With the conduit dampers arranged for the movement of a maximum volume of air, the amount that passed through the fan when making 196 revolutions a minute was found to be 21,000 cubic feet at 4° (F) or nearly 25,000 cubic feet at 70°. A higher fan speed, and a proportionately larger volume of air moved, are easily obtainable by the use of a higher boiler pressure than the

thirty-six pounds carried at the time of the experiment. The specifications called for a maximum of 25,000 cubic feet per minute, with a fan speed of 250 revolutions.

THE HEATER.—The heater is made up in three sections of about 340 square feet of steam-pipe surface each. Two of these sections are connected with the boilers and one with the engine for the use of exhaust steam and the utilization or its heat. It is specified that this heater shall be capable of warming 25,000 cubic feet of air per minute from 20° below zero to + 70° above. With steam shut off one of the boiler sections, and but five pounds steam pressure on the other, the exhaust steam from the engine filling the third, the temperature of 21,000 cubic feet of air a minute was raised from 4° to 65°. By increasing the steam pressure in the one coil used for boiler steam to forty pounds, the temperature of the air could have been raised to 85°. There can, therefore, be no question as to ability of the heater to perform the stipulated duty.

The absence of the by-pass called for in the specifications is a matter of oversight on the part of the contractors, and it is hoped that the Commissioners will not accept the work as complete until that needed means of regulating the temperature of the air flow is provided.

Its purpose is to allow cold air to pass by rather than through the coil, and to mix with the heated air before its passage through the fan, which mixes them thoroughly, the proportion of warm and cold air determining the temperature of the mixture.

The sectional form of the heater furnishes the means for an approximate regulation of temperature. General directions for their use may be given as follows:

Outside temperature.	Exhaust section.	Boiler section No. 1.	Boiler section No. 2.
Below 10°	On full	On (at req. pres.)	On (at reg. pres.)
Between 10° & 20°	On full	Off	On (at req. pres.)
Between 20° & 40°	On (at req. pres.)	Off	On (at req. pres.)
Above 40°	On (at req. pres.)	Off	Off

AIR DISTRIBUTION.—The iron conduits are proportioned for a maximum flow rate of 1200 linear feet per minute, and the area of the flues are scheduled for a flow rate of 600 feet. By means of dampers in the conduits and at the bases of the flues the air movement may be directed and distributed as desired.

It is assumed that the rooms are to be continuously warmed and ventilated only when occupied, and that the air furnished by the fan is primarily for purposes of ventilation, and not for heating. For

ventilation alone the air need be heated only to the point of comfort as 70° or under. When, as in early morning heating, the fan current is also used for warming its temperature may be anything desired within the range of the apparatus.

The method of quick heating in the morning by a rotation of the air of the rooms through the fan is to be recommended on the ground of economy. In all but the severest weather the steam may be shut off the Extension at night, and at 6 o'clock next A. M. the doors opened between the rooms and the hallways, and from the basement hallway into the fan room, and in the heater duct to window. Steam may then be put on the entire system and the fan started. From one to two hours of rapid circulation of heated air will be found sufficient to bring the rooms to a comfortable temperature. At eight o'clock the fan and heater may be adjusted for their day's work of ventilation.

When the Senate and the House are in session, the air is to be shut off from the committee rooms and directed to the Assembly Hall, and *vice versa*. The air is to be directed where the occupants are assembled. The only rooms necessary to be continuously ventilated are those permanently occupied by the several departments of State.

The schedule of rooms supplied directly from the fan is as follows: Rooms marked (c) were at the time of scheduling assigned to committee uses, and all others to State departments. All work has been done on the basis furnished by this schedule, and the system cannot be held responsible for any results growing out of changes from the schedule arrangement and uses of rooms.

Rooms.	Area of Flues, square feet. Supply.	Discharge.	Required Air Volume. Cu. ft. per hour.	Measured Air Volume.
Basement.				
S. E. Room,	0.50	1.00	18,000	
S. W. "	0.50	1.00	18,000	
W. M. "	0.50	1.00	18,000	
N. W. "	0.50	1.00	18,000	
			72,000	
First Floor.				
S. E. Room,	1.25	2.50	45,000	
S. M. "	0.50	1.00	18,000	
S. W. "	0.50	1.00	18,000	
W. M. "	1.25	2.50	45,000	
N. W. "	1.25	2.50	45,000	
N. M. "	0.30	0.60	11,000	
N. E. "	0.20	0.40	7,000	
			189,000	
Second Floor.				
S. E. Room (C),	1.25	2.50	45,000	26,000
S. M. " (C),	1.25	2.50	45,000	38,000
Library "	1.50	3.00	54,000	65,000
N. M. "	0.25	0.50	9,000	13,000
N. E. " (C),	1.25	2.00	45,000	
			198,000	
Third Floor.				
S. E. Room (C),	0.75	1.50	27,000	27,000
S. M. " (C),	1.25	2.50	45,000	35,000
S. W. " (C),	2.00	4.00	72,000	56,000
W. M. " Court,	2.00	4.00	72,000	58,000
N. W. " (C),	2.00	4.00	72,000	76,000
N. M. " (C),	0.75	1.50	27,000	26,000
N. E. " (C),	0.75	1.50	27,000	25,000
			342,000	

Main Building.	Required. Minimum.	Maximum.	Measured.
House of Representatives,	300,000	750,000	526,000
Senate,	90,000	300,000	133,000

The supply for department rooms is based on the largest number of permanent occupants each is likely to accommodate, and that for committee room on a maximum rate of change of six times an hour.

The tests were confined chiefly to the rooms farthest removed from the fan because those most likely to be given less than their proportion of supply. All tests made in the basement and first floor rooms showed their supply to be in excess of requirement. The results above given were obtained by measuring the rate of air flow through the registers and assuming the effective area of the registers as two-thirds that of its face, a method which generally gives minor rather than major values. By partially closing the dampers belonging to the basement and first floor rooms, and, if necessary by speeding up the fan to 250 revolutions, the full maximum of air required may be furnished the most remote rooms, should such quantities ever be called for.

THE HALL OF THE HOUSE of REPRESENTATIVES.—The minimum supply to this room is based on an attendance of 200, and the maximum supply on a possible attendance of 500 on rare occasions. The air conveyed from the fan by two iron conduits, enters the under floor space at the two western corners, and finds entrance into the room through the floor register under the members' fixed chairs, and next the eastern wall. The aggregate free area of these inlets is 8320 square inches, or fifty-two square inches to each member. To supply the minimum volume the velocity of flow must therefore be seventeen inches a second through the register *openings*. The air movement above the registers being diffused over their entire area, the minimum and the maximum velocities will be practically reduced to twelve and thirty inches.

It is a matter of regret that the necessities of floor and desk arrangements were regarded as adverse to the method of inlet proposed in my communication of June 8th, '89, and designed to reduce the danger of troublesome draught to a minimum. The per capita inlet area obtainable by that method was shown to be 180 square inches, and its position, directing the flow of entering air into the aisles, would have been favorable to the least possible disturbance from draught effect. The significance of such details in arrangement cannot be rightly appreciated until the fatality of a sensible draught to any system of ventilation is accepted as a guiding fact of the first importance in the designing or choosing of methods.

When the air moved by the fan making 196 revolutions was diverted from the committee rooms to the House and Senate Chambers, the quantity entering the House was found to be 526,000

cubic feet per hour, sufficient to give 300 occupants 1,750 cubic feet per hour each, or to "change" the air of the Hall once every nine or ten minutes. To neutralize the heating effect of the audience the air supplied in the above quantity must have a temperature lower than that of the room by about 0.009° for each occupant when the outside temperature is at or near 0°, and this difference must be greater as that between in-door and out-of-door temperature is less.

To roughly test the correctness of theoretical computation 216 candles evenly distributed over the desks and eighteen gas jets were burned with the following results.

	Beginning.	End.
West side of hall, 5 feet from the floor.....	62°.0	62°.5
East " " " " raised floor....	64°.0	68°.
Air supply.....	64°.0	64°.5
Gallery, men's side.....	66°.0	68°.5
Attic vent., over women's gallery	68°.0	72° 0
Outside air.....	4°.0	5°.0

The computed heat developed by the gas and the candles burning equals that produced by about 300 average adults; but the greater concentration of warm air currents ascending from the flames as compared with the more diffused current rising from an occupant in sitting posture caused a somewhat lower floor temperature than would have resulted had 300 men crowded the floor space. The unprotected east side thermometer was doubtless affected by radiation from the candle flames, and therefore failed to register the air temperature. The increase in atmospheric temperature is best indicated by the two gallery thermometers taken in connection with the air volumes moved through each. The proportions of air passing out through the men's gallery was twice that finding exit through the women's side. The resulting temperature increase for the whole would be 2°.8. The theoretical increase due to the presence of 300 occupants would have been 2°.7.

It may therefore be safely assumed that for 250 occupants, and each supplied with 2500 cubic feet of air per hour, the temperature of the supply should be kept about 3° than that of the discharge air. The number of occupants being constant, the temperature of supply must be reduced in proportion to the reduction of the supply volume. If on the other hand, the supply remains constant in volume and the number of occupants vary, the temperature difference between supply and discharge must vary as the number.

It is not expected that the very best results obtainable can give satisfaction to every occupant of the hall. The varieties of temperature, humidities and air movements to which they are habituated in their domestic, business or out-of-door life cannot be furnished within the Hall at one and the same time. A temperature of 65° cannot be furnished the occupant of one desk, and a temperature of 75° another, or dry air to one and humid air to another, or "lively" air to this member, and motionless air to that member. Only the thoughtless can imagine such a variety of local conditions within one room as possible, and only the selfish will demand that condition throughout the room which is agreeable to himself. All are to come to atmospheric conditions as nearly staple as it is possible to maintain them. These conditions are chosen with reference to the greatest comfort of the greatest number, and to them all are expected to adapt themselves in clothing or otherwise, just as though they were going to a fixed climate where the man who is too warm must wear lighter clothing, and the man who is too cold, heavier clothing, and the man with cold ankles doffs low shoes for boots. The utmost to be attempted in artificial warming and ventilation, is to provide such conditions as shall make it possible for every occupant to make himself comfortable with proper clothing, and with the least amount of total individual adaptation. Such adaptation there must be, and the attempt to avoid it by adjusting the conditions to special idiosyncrasies will prove disastrous. The idiosyncrasy must adapt itself to the common comfort, and not be allowed to impose discomfort on the many by demanding personal gratification at their expense. For this reason the engineer should receive orders only from the Speaker of the House, or such officer as may be duly authorized to direct the proper warming and ventilation of the House.

The Senate Hall.—The large per capita floor space in this room and the arrangement of its seats make a special provision for the distribution and diffusion of the air supply unnecessary. The scheduled minimum supply is 90,000 cubit feet an hour for 45 occupants. The volume delivered with a fan speed of 196 revolutions was found to be 133,000 cubit feet. A fan speed of 250 revolutions would result in a supply of 170.000 cubit feet as against the 300,000 scheduled maximum. On the rare occasions when such maximum quantities are required for the House and the Senate they may be had by shutting off the extension and directing the full volume of air moved by the fan to the House and Senate. It is doubtful, however,

whether, with the present arrangement of inlet in the House, such a supply would be tolerable.

THE DIRECT HEATING SYSTEM.—The entire apparatus for this work seems to be doing its work admirably in the circulation and distribution of steam, in the return of condensed water, and in noiseless action. The amount of heating surface required for each room, and the form best adapted to the rooms used were carefully determined with reference to the extent, character and exposure of cooling surfaces, and the heater's location. For obtaining the greatest thermal efficiency of the radiators and its best effect in preventing cold floors, as well as for the purpose of locating them with reference to the least possible floor obstruction—they were planned for the window recesses. Architectural necessities prevented the complete carrying out of this plan and the altered position of some, and form of others somewhat impairs their action.

They were designed—with the aid of an open fire—to keep the rooms comfortably warm in the severest weather (—20°) for which the entire system is planned. They have been tested when the outside temperature has been +15° above, with no fires in the fireplaces, and the fan stopped, and a fresh westerly wind blowing, and also when the outside temperature was —15° below only a light wind blowing and the fan circulating air for two hours at 70° temperature and no hearth fires in use.

The results are given below, together with the scheduled and actual heating surfaces for each room, (R) indicating a removal of some or all of the surfaces from window recesses, and (R) change in form from that scheduled. The temperatures were taken in every case by means of a rapidly whirling thermometer in order to expedite work as well as to reduce the effect of wall radiation and obtain atmospheric temperature solely.

Rooms.	Square Feet of Radiator Surface. Scheduled.		Actual.		Temperature of Rooms. Outside + 15°	— 15°
Basement.						
S. E.,	45		45			
S. W.,	60	(F.)	42		67°	
W. M.,	78		78		74°	
N. W.,	108	(F.)	144		74°	
Hall,	66	(F.)	42			
First Floor.						
S. E.,	156	(R.)	144		75°	
S. M.,	45		45			
S. W.,	84		56		60°	64°
W. M.,	132	(F.)	132		66°	69°
N. W.,	180		180		70°	70°
N. M.,	66		66		73°	
Hall,	90		90			
N. E.,	66		66			
Telegraph Office,	15		27			
Second Floor.						
Stairway,	27		27			
S. E.,	33	(R.)	33		76°	
S. M.,	33	(R.)	33	steam off.	62°	
Library S. W.,	132		132			
Library W. M.,	108	(F.)	108	floor.	62°	65°
Library N. W.,	156	(F.)	156	loft.	70°	72°
N. M.,	45		45		72°	
N. E.,	45	(R.)	45		72°	
Stairway,	33		33			
Third Floor.						
Stairway,	27		33			
S. E.,	33	(R.)	33		74°	
S. M.,	33	(R.)	33		74°	
S. W.,	90	(R.)	90		66°	77[c]
W. M.,	54	(R.)	54		65°	
N. W.,	132	(R.)	132		69°	
N. M.,	39	(R.)	39		72°	
N. E.,	39	(R.)	39		78°	
Stairway,	33		33			

The temperatures were taken on the second day only in those rooms in which they had been found low on the milder day, it being assumed that they were by that test proved the most difficult to

heat. The effect of the low temperature fan current was to lower the higher temperature and raise the low. The steam pressure carried on the direct system during these tests was five lbs. By increasing this pressure the efficiency of the heater may be so increased that it is doubtful whether open fires will be required in any but the most exposed rooms, or the most extreme weather.

The double sashing of the Library windows would greatly aid in securing and may be found necessary to, an equal distribution of the heat between the floor and high ceiling. Such additional protection for the entire western exposure is to be advised on economic as well as hygienic ground.

Rectifications promised and doubtless made with a view to bringing the heating surfaces in all rooms more nearly into correspondence with the amount and form of that scheduled and shown on plans will have a beneficial effect in bringing up some temperatures and reducing others. The generally high temperature of the southerly rooms is due to the sun and wind effect. On a cloudy day with southerly wind, they would more nearly equal the northern rooms in temperature.

AUTOMATIC REGULATION OF TEMPERATURE—The steam heating surfaces are necessarily designed to meet the requirements of severe weather. In milder weather they are too large, and the heat yielded if they are continuously used is too great. Reduced steam pressure in the distributing mains affords only partial relief. Intermittent supply of steam by valve manipulation is easy nor likely to be so well regulated as to maintain anything like uniformity in room temperature. The occupant with sensibilities dulled by slow changes in temperature shuts off the steam only when the heat becomes intolerable or lets it an only as forced to do so by the persistent discomfort of chilliness. The general results are enervation by the higher temperatures which demands a warmer air for comfort and increased susceptibility to cold and the harmful results of the inevitable fluctuations attending this method of heat regulation ; a general tendency to wastefulness through overheating and open window cooling in weather admitting of such a method of relief.

Any heating system however perfect in design, material and workmanship is in as much need of means, as nearly automatic as is practicable for adapting it to its variable duty, as is the finest engine in need of a governor to adapt and hold it to its varied work. The larger the engine and the more fluctuating its work, the more liable

it is to condemnation if governorless. The wastefulness, the affected health, the discomfort and complaints which attend the use of an unregulated heating system only wait a better knowledge of the possibilities of its automatic control to find expression in protest and condemnation when the means for such control are wanting.

An inspection of the above columns of temperature will furnish sufficiently suggestive evidences of the value of automacy in heat regulation to make unnecessary any further expression of regret that a lack of funds in the hands of the Commissioners has thus far prevented them from authorizing the incorporation of the available means.

THE DISCHARGE VENTILATION.—Provision for this part of the system has proved more difficult is correspondingly less complete than that for any other part. This has resulted from the lack of wall space for suitable wall flues, the necessity of placing many in the outside walls, and the encroachment of mason or other work on flue areas as provided in the schedule and plans. The location of both supply and discharge flues were generally determined more by necessity than by considerations of efficiency, and in this matter the vent flues suffered most.

The ventilation values of an effective area of one-seventh foot each given the fire-place flues, instead of the actual two-thirds foot, was based on the assumption.

THE BOILER AND CHIMNEY POWER —These have proved themselves to be in possession of a safe residual capacity for the maximum duty likely to be imposed on them for warming and ventilating work. If it is the practice of the State to insure its property, the insurance of the boilers in such a company as the Hartford Boiler Inspection and Insurance Co., is to be recommended as much for the value of their inspection and oversight in the use of the boiler as for protection against loss.

As a matter of record as well as for the purpose of a check upon the fireman, and an incentive to the best work of which he is capable, a water meter—Worthington's special make for high temperature, $\frac{3}{4}''$ and costing $32—would serve a good purpose. The meter reading would show the weight of steam used and that quantity compared with the weight of coal burned would indicate the character of the work done in the boiler-room. If such a meter is to be used, as indeed in any case, the feed water from the main should be passed to the boiler through the tank and pump.

TELETHERMOMETER.—For the use of the engineer a thermal indicator should be provided him in his engine room which should register the temperature of the Hall of Representatives so that at any moment he may there know the Hall temperature and be spared the necessity of leaving his room and climbing the stairs and entering the Hall for an observation of thermometers. Such an instrument is made by the Standard Thermometer Company and may be had for $130.00 or so.

SPECIFICATIONS AND RECOMMENDATIONS.—With the complete carrying out of the specifications and recommendations made in previous communications and with a due regard to the enclosed general directions for use it is believed that satisfactory results may be had. Departure from either must be attended with effects not chargeable to the system as designed.

COST OF SYSTEM AND OF ITS USE—The estimated cost of the heating and ventilating apparatus proposed in the original plan was about $4300, not including boiler or the fittings required by the Halls of the Senate and House, nor the extra cost involved in the outside location of the boiler-house, and excluding the Johnson electric service.

The total cost of this combined plant has reached the sum of $7,500, of which $2,500 may be assigned to the boiler-rooms.

The cost of use may be put at eight per cent interest on the cost of the ventilating apparatus to cover interest lost and the cost of repairs, and an average of 75 pounds of coal for every 1,000,000 cubic feet of air passed through the fan during the months between the first of October and the last of May. The latter item of cost must depend largely on the skill and thoughtfulness of the engineer in the use of dampers and the fan. Except during the session of the legislature the dampers to the committee rooms and the Senate and Representatives' Hall may be closed, and 320,000 cubic feet an hour will supply the department offices. The committee rooms require full ventilation only when crowded. The House with an attendance of 200 would be well ventilated by a supply of 400,000 cubic feet of air per hour, and the Senate chamber with a 100,000 cubic feet supply for 50 occupants.

The present engineer has shown an interest, faithfulness and skill which augers well for the State's interest, and that he may be as well as possible equipped for his work it would be well to provide

him with an anermometer for the measurement of air flow and the regulation of air quantities supplied.

In closing my report and my work for the State, allow me to express the pleasure afforded me in all my association with the Board of Commissioners and in their cordial co-operation in the work to which they called me, and also in the respectful consideration accorded all my proposals and demands on the part of both the Commissioners and the architects.

Respectfully submitted,

S. H. WOODBRIDGE.

To His Excellency the Governor, HON. EDWIN C. BURLEIGH, *Chairman of the Board of State House Commissioners, Augusta, Maine.*

BOSTON, JANUARY 1, 1891.

STATE OF MAINE.

IN SENATE, January 21, 1891.

Read, and on motion by Mr. SPEAR of Kennebec, laid on the table to be printed.

KENDALL M. DUNBAR, *Secretary.*