MEDICAL AND SURGICAL REPORTS

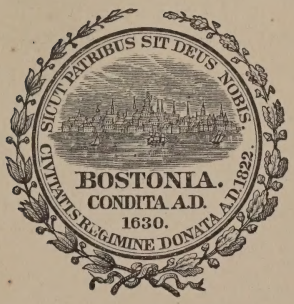
OF THE

BOSTON CITY HOSPITAL.

Second Series.

EDITED BY

DAVID W. CHEEVER, M. D., and F. W. DRAPER, M. D.



BOSTON:
PUBLISHED BY THE BOARD OF TRUSTEES.
1877.

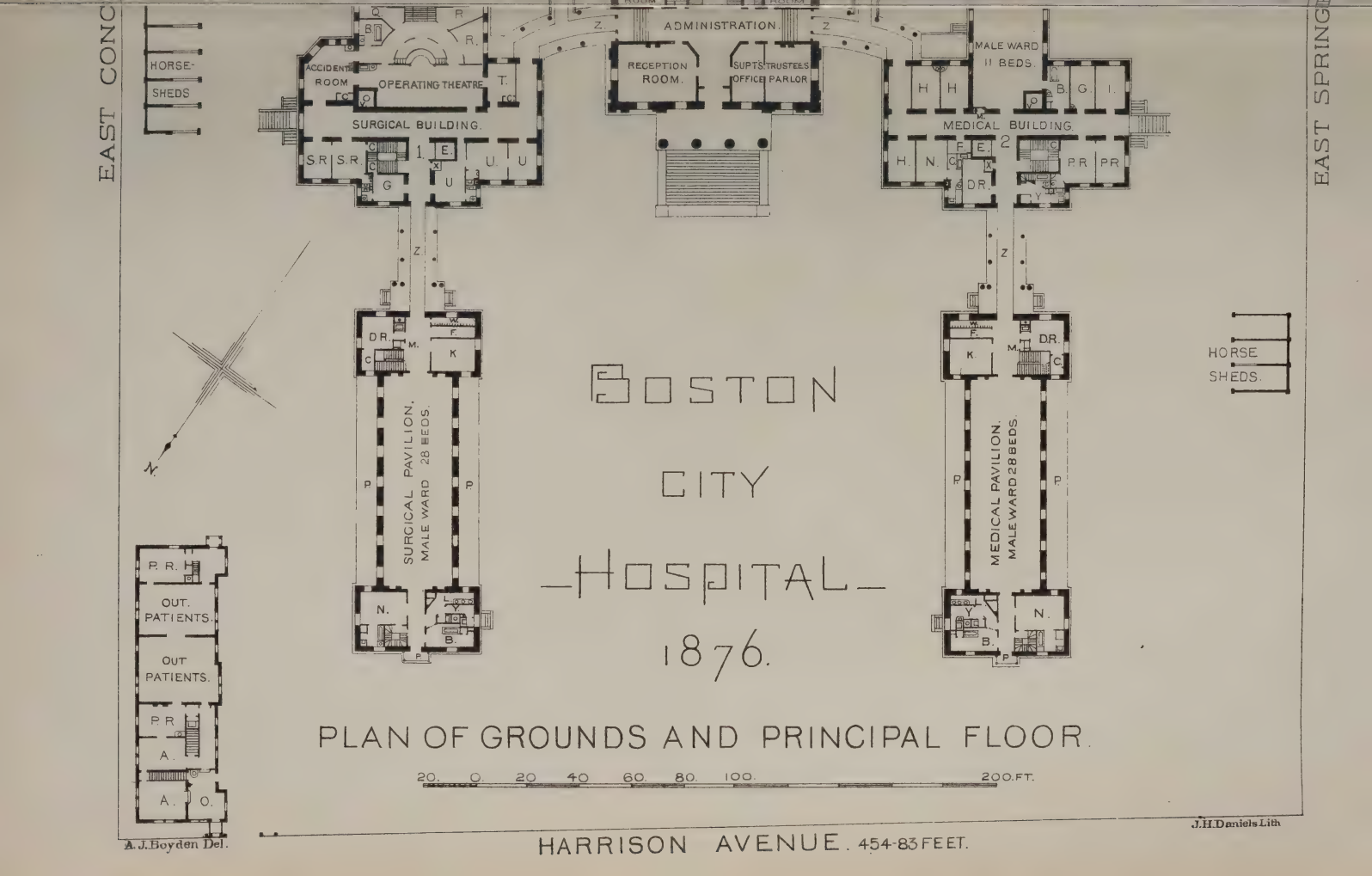
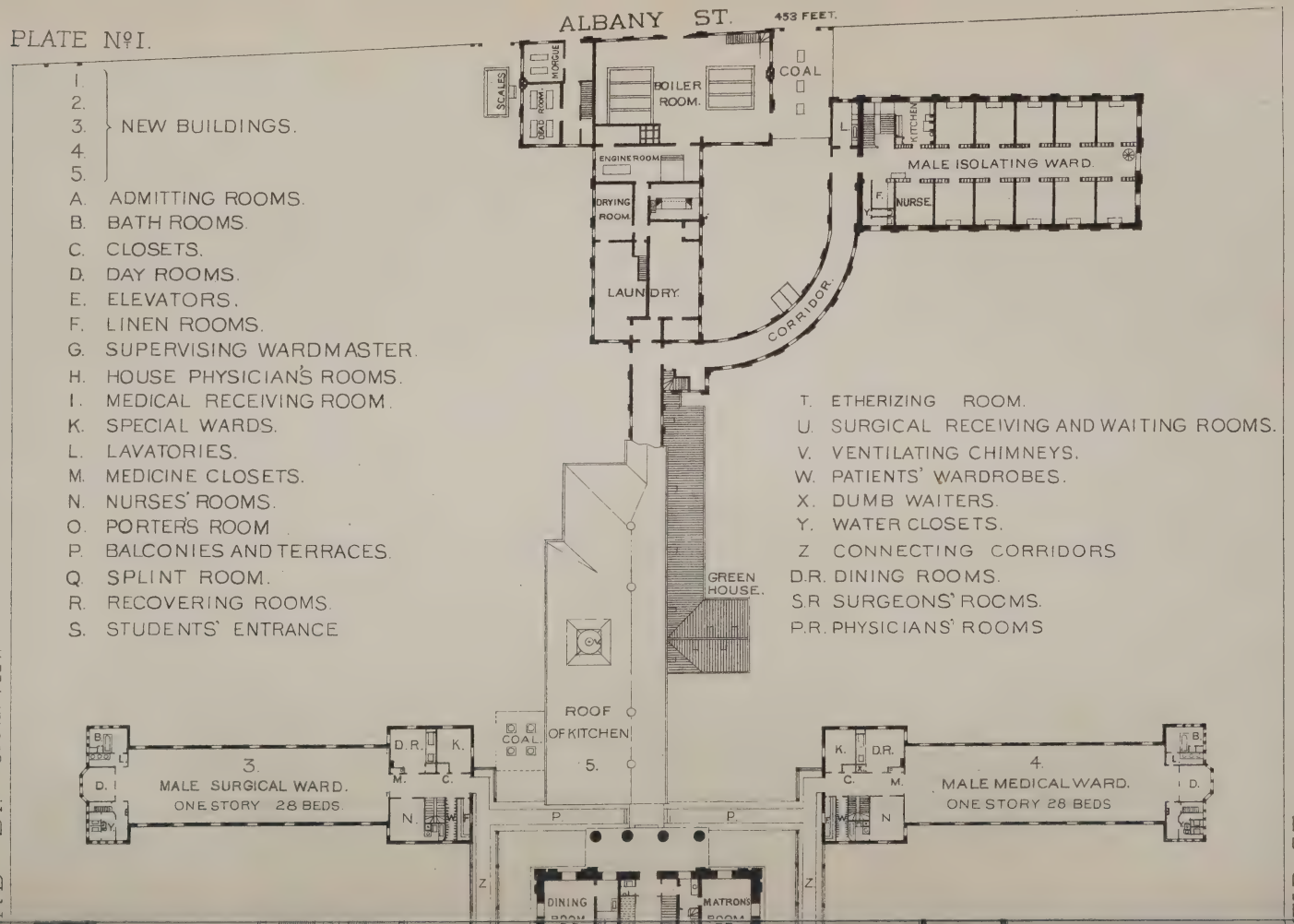

EAST CONC
EAST SPRINGF
HORSE-
SHEDS
ACCIDENT
ROOM
OPERATING THEATRE
SURGICAL BUILDING.
ADMINISTRATION.
RECEPTION
ROOM.
SUPTS. TRUSTEES.
OFFICE PARLOR
MALE WARD
11 BEDS.
MEDICAL BUILDING.
HORSE
SHEDS.
SURGICAL PAVILION.
MALE WARD 28 BEDS.
MEDICAL PAVILION.
MALE WARD 28 BEDS.
BOSTON
CITY
HOSPITAL
1876.
P. R.
OUT.
PATIENTS.
OUT
PATIENTS.
P. R.
A.
A.
O.
PLAN OF GROUNDS AND PRINCIPAL FLOOR.
20. 0. 20 40 60. 80. 100. 200. FT.
HARRISON AVENUE. 454-83 FEET.
A. J. Boyden Del.
J. H. Daniels Lith

PLATE Nº I.


1.
2.
3.
4.
5.
NEW BUILDINGS.
A. ADMITTING ROOMS.
B. BATH ROOMS.
C. CLOSETS.
D. DAY ROOMS.
E. ELEVATORS.
F. LINEN ROOMS.
G. SUPERVISING WARDMASTER.
H. HOUSE PHYSICIAN'S ROOMS.
I. MEDICAL RECEIVING ROOM.
K. SPECIAL WARDS.
L. LAVATORIES.
M. MEDICINE CLOSETS.
N. NURSES' ROOMS.
O. PORTER'S ROOM
P. BALCONIES AND TERRACES.
Q. SPLINT ROOM.
R. RECOVERING ROOMS.
S. STUDENTS' ENTRANCE
T. ETHERIZING ROOM.
U. SURGICAL RECEIVING AND WAITING ROOMS.
V. VENTILATING CHIMNEYS.
W. PATIENTS' WARDROBES.
X. DUMB WAITERS.
Y. WATER CLOSETS.
Z CONNECTING CORRIDORS
D.R. DINING ROOMS.
S.R SURGEONS' ROOMS.
P.R. PHYSICIANS' ROOMS
ALBANY ST. 453 FEET.
SCALES
MORGUE
BOILER ROOM.
COAL
ENGINE ROOM
DRYING ROOM.
LAUNDRY.
CORRIDOR.
KITCHEN
MALE ISOLATING WARD.
NURSE.
GREEN HOUSE.
ROOF OF KITCHEN
5.
3.
MALE SURGICAL WARD.
ONE STORY 28 BEDS.
4.
MALE MEDICAL WARD.
ONE STORY 28 BEDS
DINING ROOM
MATRONS ROOM
D.R.
K.
C.
M.
N.
P.
Z.
B.
D.
L.
F.
600.27 FEET
623.68 FEET.

DESCRIPTION OF THE HOSPITAL.

By Edward Cowles, M. D.

The City Hospital was first occupied in the year 1864, fifteen years after the establishment of such an institution had been proposed in the project of continuing the Cholera Hospital at Fort Hill, in the year 1849. In 1857 the first decided action was taken by the city government, upon the urgent recommendation of Hon. Alexander H. Rice, then Mayor. This, however, accomplished but little more than the obtaining an act of the Legislature authorizing the establishment of "a hospital for the reception of persons who by misfortune or poverty may require relief during temporary sickness." In 1860 the City Council, responding to the appeal of the Mayor, Hon. F. W. Lincoln, Jr., definitely agreed to the project, and set apart from the city lands, on the South Bay territory, the present site of the hospital. During the next year plans were adopted, and the actual work of erecting buildings was begun.

The lot of land upon which the hospital stands is bounded northwesterly on Harrison avenue, 454.83 feet; southwesterly on East Springfield street, 623.68 feet; southeasterly on Albany street, 453 feet; northeasterly on East Concord street, 660.27 feet; and contains in all about 292,000 square feet, or $6\frac{7}{10}$ acres. In addition, there was set apart a lot of land containing 69,318 square feet, in the rear of the hospital buildings, and east of Albany street, upon which were built a small-pox hospital, cholera wards, coal sheds, and a stable; but, excepting the latter, these buildings and the land were temporarily leased for other purposes in 1872.

The plans for the hospital were made by Mr. G. J. F. Bryant, architect, and were elaborated with much care, and

with the aid and counsel of physicians and others interested in its establishment. The hospital was one of the first built in this country upon the "pavilion plan," and was believed to contain all the modern improvements then accepted as essential in hospital construction.

It is well known that in the comparatively short period since the plans of this hospital were adopted, in 1861, very large experience has been gained in hospital construction in our own and in foreign countries, and very great and general interest has been excited in this and other sanitary questions. The experience of ten years here has pointed out some deficiencies and errors of construction in the original buildings of the hospital, and some very important alterations and improvements have been effected. In response also to the rapidly growing demand for increased accommodations, large additions have recently been made to the hospital. The object of this paper is to show what has been done here in improved hospital construction, and to set forth the reasons for the important changes and additions.

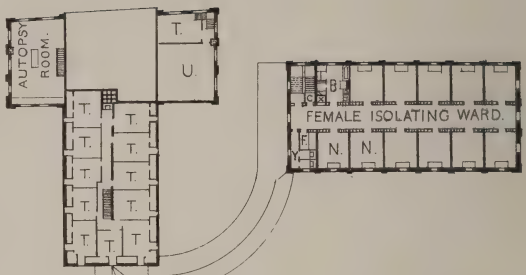
When substantially completed and occupied, in 1864, the hospital consisted of a central or administration building, two three-story pavilions and the necessary auxiliary buildings, — boiler-house, laundry, etc. To these there was added, in 1865, a two-story building for isolating wards. Subsequently a small building was erected, at the main entrance to the grounds, containing rooms for the out-patient department; and an enlargement was made of the boiler-house, with the addition of a dead-house, morgue, and autopsy-room. The buildings stood thus, with little material change, till 1875. Their general arrangement and the use of each are shown in Plate No. 1, excepting that the new buildings, numbered 1 to 5, have been recently erected, of which the first two occupy the places of the curved portions of the original connecting corridors. The principal alterations made in the older buildings were in their basements, for the improvement of their sanitary condition, and will be noticed in connection with the description of the new method of heating and ventilating. Other changes will be alluded to in the description of the buildings.

PLATE Nº 2.

BASEMENT PLAN OF
SURGIGAL BUILDING.

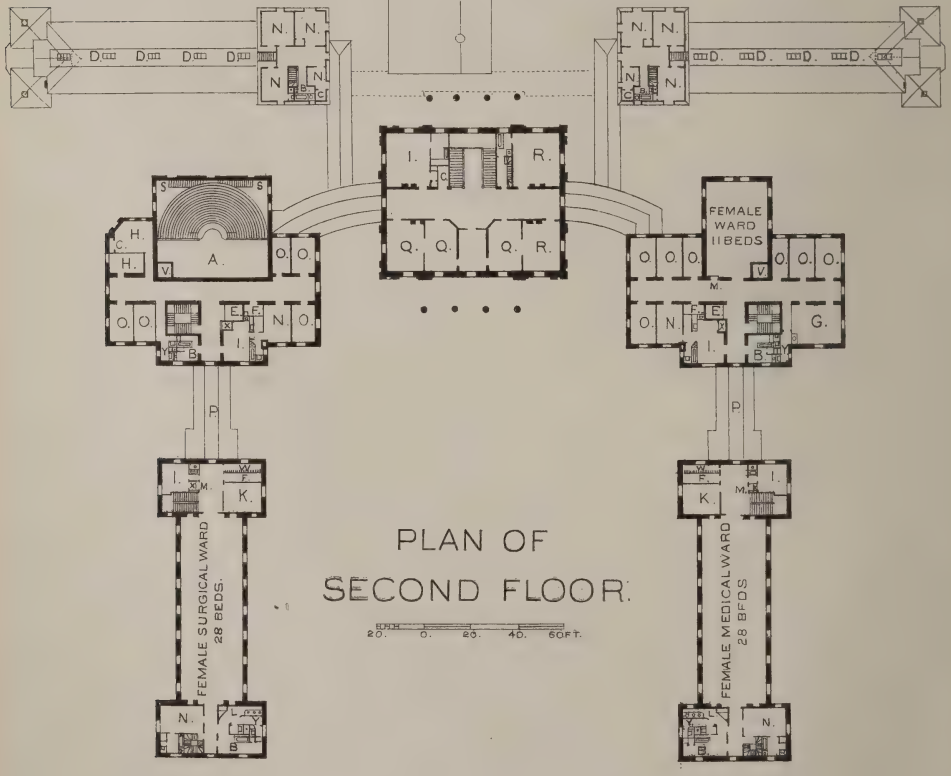
OUT PATIENT DEPT.

1. SURGEONS ROOM.
2. WAITING ,,
3. MEN'S ,,
4. DRESSING ,,
5. WOMEN'S ,,
6. DIET KITCHEN.



A. OPERATING THEATRE FIRST FLOOR.
D. OPENINGS FROM WARD TO VENT. CHAMBER.
G. OPHTHALMIC OPERATING ROOM.
H. HOUSE SURGEONS' ROOM.
I. DINING ROOMS.
O. PAYING PATIENTS' ROOMS.
Q. OFFICERS' ROOMS.
R. SUPT'S ROOMS.
T. LAUNDRESSES ETC.
U. CARPENTER'S SHOP.

FOR OTHER REFERENCES SEE PLATE 1.



PLAN OF
SECOND FLOOR.

20. 0. 20. 40. 60 FT.

The administration building (Plates 1, 2, and 3) is 60 by 80 feet, and contains practically two stories, a basement and an attic; it is surmounted by a high dome, the apex of which is 148 feet above the level of the street. The building is of brick, upon granite basement walls, and finished inside with lathing and plaster. The basement rooms are 13 feet high, with floors $3\frac{1}{2}$ feet below the ground level, with an air-space, and concrete upon the earth underneath, and are used as dispensary, laboratory and store-room, dining-rooms for employés, and steward's office. The culinary work has been removed from the basement of this building to the new kitchen and bakery in the rear. The first and second stories, being respectively 16 feet and 14 feet high, are restored to the uses for which they were originally planned. On the first floor are the trustees' room, superintendent's office, room for the reception of visitors and for the library, matron's room and dining-room. On the second floor are the rooms occupied by the superintendent and his family, for officers, etc. The rooms on the third or attic story are lighted only from the ceiling, and are used as chambers for employés. The operating theatre in the dome, early found to be inadequate and difficult of access, is now disused. This building is connected with the others by corridors, open above and covered in below. The lower floors of the corridors, being $3\frac{1}{2}$ feet below the ground level, are at the general level of all the basement floors of the principal buildings, and the floors of the upper or open portion of the corridors are on a level with the first floors of the buildings.

The two pavilions, medical and surgical, are substantially alike in construction. They are 148 feet in length, 48 feet in width, three stories in height, besides the basements. The walls are of brick, upon granite base, and with lath and plaster finish inside. The basements, formerly occupied by patients, are now disused. On the first, second, and third floors are wards, each 80 feet long, and $27\frac{2}{3}$ feet wide, the two lower being each 16 feet, and the upper being 10 feet high. The first floors are about 6 feet above the general ground level. Each ward is lighted by 14 windows, 7 on

each side, and is arranged for 28 beds. At the entrance to the building on each floor (see Plates 1, 2, and 3) there are upon one side of the hall the patients' dining-room, medicine closet, dumb-waiter, etc., in place of what was originally the bath-room; and on the other side of the hall are a patients' wardrobe, linen-room, and room for special cases requiring removal from the ward, or for paying patients. The linen-room, and patients' wardrobe for clothing in daily use only, are both well-lighted rooms, and take the place of what was formerly the water-closets, and a dark closet for linen, etc., both without ventilation. A ventilating shaft adjoining the dining-room will independently ventilate all these rooms. The main stairway is also at this end of the building. At the farther end the nurses' room and a small stairway are on one side of the hall, as originally built; but on the other side the former arrangement of dining-room, closets for dishes, etc., is replaced by a comparatively isolated and independently ventilated apartment for the water-closets, slop-sink and urinals, and by a bath-room and lavatory. The doors of the two latter rooms close automatically by springs, and the bath-room and lavatory are separated only by a low screen, 7 feet high, so that air can pass freely through it, and light can enter over it, between the rooms and around the exterior of the inner apartment containing the water-closets. The door to the last-named apartment will also close automatically, swinging both ways. Thus will be prevented the danger of currents of air being induced through open doors from the water-closets to the ward. A special arrangement is made for independently ventilating the water-closet apartments by a shaft, 3 feet square, of wood lined with tin, which passes upward through them from the basement through the roof. The shaft contains within it the soil-pipe, hot-water pipes, steam-pipes for the supply of the steam-bath in the bath-rooms adjoining, and gas jets for lighting the water-closets, on each floor, through glazed windows in the sides of the shaft. The heat unavoidably radiated from these necessary appliances furnishes a continuous extracting force for the ventilating shaft at all seasons of the year.

The boiler-house and laundry, which are 300 feet from the administration building, and connected with it by a covered way, contain the boilers, the fan for forcing fresh air into the wards (but now disused), the engines, the laundry-machinery, and the washing, ironing and drying rooms. Over the laundry are a number of rooms for employés. In the year 1871 the boiler-room was enlarged, and adjoining it there were placed, on the ground floor, a dead-room and morgue, and on the second floor a commodious and conveniently arranged autopsy-room, with pathological cabinet, etc. Near the building a drive-way from Albany street was opened in 1874, and just within this entrance to the grounds large scales were placed for the weighing of coal and many other articles of hospital supplies.

A two-story brick pavilion, located near the southern corner of the grounds, contains the male and female isolating wards, which are shown in Plates 1 and 2. The building is $101\frac{1}{2}$ feet long, and $46\frac{1}{2}$ feet wide, with a basement or cellar underneath, which brings the first floor to a height of about 2 feet above the ground level. There is a ventilating chamber in the roof, 10 feet wide, extending the whole length of the building. A hall or passage-way, 10 feet wide, divides each story, with rooms on each side, and windows at each end, excepting at the entrance-door on the first floor. There are 10 rooms on each floor, 14 feet by 15 feet in size, and designed to accommodate one or two patients in each. Two additional rooms on each floor are for nurses, kitchen, bathing-room, etc.; and there are also water-closets and linen-rooms. The rooms on the first floor, for male patients, are 14 feet high; and those on the second floor, for females, are 18 feet high. Each room is surrounded by brick walls, upon which hard-finished plastering is laid. An important change made in this building, in the method of heating and supplying fresh air, will be noticed hereafter, in describing the general plan of heating and ventilating. The building is connected with the basements of the main buildings by a covered corridor.

The building for out-patients, added in 1867, is located

in the northern corner of the grounds, and at the main entrance to the hospital. It contains the porter's room, waiting and examining-room for applicants for admission, large waiting-rooms for out-patients, and physicians' rooms. Medical out-patients, and those having diseases of the eye, ear, skin, throat, and nervous system, and diseases of women, are treated here, the service being so arranged that each of the classes named receives attention on three days of each week, and on alternate days. The surgical out-patients were formerly treated in rooms in the basement of the surgical pavilion, but new accommodations have been provided for this department.

In 1874 a propagating-house was built along the southern side of the corridor in the rear of the administration building, and a gardener employed by the year to care and provide for the ornamentation of the grounds. The plan has resulted in a great saving from the previous expense for this purpose, besides the accumulation of a valuable stock of plants, etc. The heating of this greenhouse is done by a novel method and at a small cost: the water in the cast-iron pipes, circulating about the building in the usual way, is made hot in a common "feed-water heater" (such as is used by engineers for the saving of the heat of exhaust steam), in size 3 feet high by $1\frac{1}{2}$ feet in diameter, and requiring an inappreciable quantity of steam.

The hospital stood in 1874 substantially as first built, except the minor additions and alterations just described. As early as the year 1868 the hospital was felt to be crowded by the number of its patients, there being a daily average of 174 during the year, and the necessity of the enlargement of the hospital was represented by the trustees to the City Council. The rapid growth of the city and a greatly increasing demand for accommodations continued until, in 1874, the number of patients reached a daily average for the year of 230, and a maximum at one time of 285. The capacity of the hospital was at this time reckoned at 230 beds, including the occupation of 40 beds in the basements of the medical and surgical pavilions. The insufficiency and great inconvenience of the surgical operating

theatre in the dome had been early recognized. The great overcrowding of all the wards made the management and service of the hospital very difficult and laborious; and the impossibility of giving proper attention to sanitary requirements, and unavoidable neglect of needed repairs, were positively detrimental to the welfare of the sick.

In the beginning of the year 1874 decided steps were taken by the trustees for the enlargement of the hospital, and the City Council appropriated the sum of $190,000 for the purpose. It was not easy to determine the best way in which the desired alterations and enlargement should be made. It was evidently necessary to revise the system of heating and ventilating, and to replace nearly the whole of the steam apparatus for that purpose; it was desirable that a large increase of capacity should be gained, and, at the same time, by a wise economy of expenditure, all essential modern improvements in hospital construction should be secured. While the simpler structures were believed to be the best, it was also demanded that the new buildings should conform architecturally to the older ones. Appreciating the value of the experience of the medical gentlemen long connected with the institution, the Board of Trustees first invited the medical and surgical staff of the hospital to present a general statement of what was needed to be done. Subsequently a committee of the Board of Trustees was appointed "to procure plans for the enlargement and additions to the present hospital buildings, in conformity to the needs therefor, as set forth in the communication of the medical and surgical staff." It was decided by the Board that while certain conditions should be fulfilled, as to the architectural appearance of the new buildings, it was also of the first importance to plan and adapt them in their relations to the older buildings, so as to gain both the best results for the sick and the greatest convenience and economy of administration. In accordance with their very considerate and liberal policy, the trustees determined that the plans should first be prepared in detail, at the hospital, under the supervision of those who were practically familiar with its needs. This was done chiefly under the direction

of one of the Committee on Plans, George W. Pope, Esq., well-known in Boston as a skilful practical builder, to whom the sketch-plans were frequently submitted during a period of several months, while being prepared by a draughtsman at the hospital, under instructions given him by the Superintendent.

The plans thus prepared were substantially carried out in all their details in the new buildings, and had the full approval of the hospital staff as being the best that could be devised to meet the many and conflicting indications presented in the attempt to engraft new features of construction upon older ones. These sketch-plans were afterwards placed in the hands of the architect, Mr. Carl Fehmer, of Boston, by whom the perfected plans and specifications were prepared, with some modifications only of the architectural exteriors, and with the details of construction. They were finally approved by the Committees on the City Hospital, and on Public Buildings, of the City Council, in March, 1875, and the work of building began in April of that year, reaching completion in the following year.

A plan of the principal floor of the new buildings is given in Plate No. 1. They are numbered from 1 to 5, and consist of a surgical and medical building, each three stories high, with basements; two one-story pavilions, surgical and medical; and a low building along the side of the rear corridor for kitchen, bakery, etc. These buildings are connected with the older ones by additions to the original corridors, and a part of the latter was removed to make room for the two larger buildings. The original plan of the hospital contemplated the erection of two additional pavilions in the rear of the first ones, to be connected in like manner, by corridors curved in reverse directions, with the administration building. The present arrangement of the buildings, as shown in Plate No. 1, is peculiar, and one that would hardly have been made under other circumstances; but it is found practically to have remarkable advantages in convenience, ease, and economy of management. In devising this arrangement, it was at the outset determined that as large an area of ground as possible should be reserved for

the present and future construction of one-story pavilions.* It was next agreed that the separate rooms to the limited number required for paying patients, and the smaller wards for children and for ophthalmic and gynecological patients, could be placed in buildings of more than one story. It was necessary, also, that one of the larger buildings should contain, on its first floor, the operating theatre, etc., for the surgical service, and should be conveniently located for easy communication with other buildings. Then it was made a matter of great importance that certain indications should be met as to the architectural appearance of the new buildings. The result obtained in this regard is well shown in the frontispiece, in which the surgical and medical buildings appear upon the right and left of the central or administration building. These locations were first chosen chiefly for convenience in administration, and to economize ground-space, but the arrangement was afterwards fully approved by the architect, the new buildings not being treated architecturally as wings of the central structure, but as separate members of the whole group, which, it is believed, has been greatly improved in appearance by the additions. The advantages of the separation of the pavilions are practically preserved by the distances left between the new and the older structures. The prevailing winds, in the warmer months, being from points between the west and south, readily traverse the spaces between the buildings as well as the buildings themselves, which, it is also to be noticed, approach each other by their ends, and thus admit of being more in proximity than otherwise. The corridors connecting the one-story buildings with the others offer little obstruction to the currents of air, being very open in their construction.

The surgical building is 48 feet by 94 feet in general dimensions, with a projection of 8 feet by 48 feet from the front wall, and another of 24 feet by 52 feet from the rear

*An acknowledgment is due to Frank H. Hamilton, M. D., of New York, for valuable advice given to the Committee of the Trustees and the writer, in the winter of 1875, as to the merits of such structures, and the importance of including them in the contemplated additions to the hospital.

wall. It is three stories high beside the basement; and the heights of the stories correspond with those of the older buildings, two of them being 16 feet, the upper one 10 feet, and the basement 9 feet. The foundations of the building are laid upon piling. The basement walls are granite, with faced brick inside, and the walls above are of brick, and 20 inches thick. All the walls are hollow, with a four-inch air-space, including the corridor walls, and all are plastered upon the brick, with all the corners of the rooms rounded. There is very little wood-work in the building, except the floors, and about the doors and windows, where it is very plain, being finished with a simple half-round moulding. The doors themselves have plain panels and bevelled stiles without mouldings, and all the wood-work is of clear white pine, filled with shellac and varnished. The base-boards are also bevelled at the top and joined to the hard-pine floors by a quarter circle in a strip of hard pine, and the floors are laid in $2\frac{1}{2}$-inch strips, matched and blind-nailed. There are thus very few corners in which dust can collect, and the labor of preserving cleanliness is greatly reduced.

The main entrance to the principal floor of this building (Plate No. 1) is at its northern end, from which a corridor 8 feet wide extends through the length of the building, joined at its centre by another corridor which communicates with the open connecting corridor in front. At the right of the entrance is a private consulting-room, 11 feet by $15\frac{1}{2}$ feet, for the visiting surgeons, and a larger room for the office of the house surgeons, to which room are adjoined closets, etc. Next, along the corridor, is the main stairway, surrounded entirely by brick walls, and having double doors at the landing of each story, so arranged as to cut off currents of air from one story to another. Between the stairway and the front of the building is the room of the supervising ward-master, who has general supervision of all the surgical wards as to the reception and assignment of patients, the control of the male nurses, and the charge of the general business of the surgical service. Near the stairway, and in the opposite angle of the two corridors, is an elevator-

way, by which patients are to be carried to the upper stories of this building, and of the surgical pavilion in front of it, over the terrace of the connecting corridor, as shown in Plate No. 2. Beyond the elevator-way, and occupying the remainder of the front half of the first floor, are three waiting-rooms, in which male and female patients are separately placed before surgical operations. These rooms have water-closets, etc., adjoining two of them, and they serve also as small accident-wards, in connection with the accident-room, for severe cases received by night, or for such as cannot at once be placed in the common wards. On the opposite side of the corridor from the waiting-rooms, and quite isolated from the sight and hearing of their occupants, is the etherizing room. Adjoining this is the operating theatre, a large room about 49 feet by 42 feet in the clear, and 33 feet high, occupying two stories of the building. An enlarged plan and section of this room are shown in Plate No. 4. The arena is ample and roomy, being 17 feet wide from the corridor wall to the semi-circular seats which occupy the rest of the room, with a seating capacity of about 250 persons. A large skylight, 19 feet by 14 feet, gives abundant and satisfactory light. Operations requiring lateral light are done in the accident-room adjoining. Under the seats of the amphitheatre is considerable space occupied by a passage-way, 6 feet wide, from which a few steps lead to the front row of seats, two recovery-rooms, a stairway from the students' entrance in the rear of the building, a splint-room, and a small bath and linen-room pertaining to the accident-room. The accident-room is situated immediately at the left of the main entrance to the building, and is large and well lighted, being about 19 feet by 22 feet; it communicates by a wide doorway with the operating theatre. These rooms are amply supplied with hot and cold water, and other conveniences. A large ventilating chimney is marked V, and is shown also in section in Plate No. 4, Fig. 1.

The second floor of the surgical building is shown in Plate No. 2, and on a larger scale in Plate No. 4. The rooms over the accident-room are occupied by the house surgeons, and those numbered 1 to 5 by patients. All the rooms

average in size 15½ feet by 10½ feet. Adjoining the nurse's room, occupied by the head-nurse of the ward and one assistant, is a bath-room, containing water-closet, etc. The dining-room is about 16 feet by 14 feet, and contains in one corner a soapstone sink, steam-table and shelves for crockery. A dumb waiter communicates with the diet kitchen in the basement. The bath-room has a bath-tub free from the wall on both sides, a sitz bath, hot and cold shower-bath, steam-bath and wash-bowl. The water-closet apartment is quite isolated by being shut off from the rest of the building behind the brick walls of the stairway, and is entered by a passage-way having two doors closing automatically, so that both shall not be open at the same time. This apartment contains two water-closets, a porcelain slop-sink and a urinal, and is ventilated independently of all other rooms by a special arrangement shown in Plate No. 4, Figs. 1 and 3. A tin-lined shaft, 2 feet square, contains within itself the soil-pipe, hot-water and steam-pipes in constant use, and gas jets on each floor to give light through small windows in the sides of the shaft. The ventilation is efficient at all times. The soil-pipe passes upward above the roof, and is open at its top. A side of the shaft can be easily removed at any time for inspecting or repairing the pipes. All sinks, wash-bowls, etc., are supported on brackets, and the space underneath left open, with the plumbing work exposed. A number of Jennings' all-earthenware water-closets are in very successful use; these are also left exposed under the seats, which have no risers, thus securing great advantage as to cleanliness. The description here given of the service-rooms applies also to the other upper stories of this and the medical building. The upper floor of this building (Plate No. 3) differs from the one just described in having three small wards for children, one for ten beds, about 49 feet by 15 feet, and two for four beds each, about 18 feet by 14 feet. The basement plan of the surgical building is shown in Plate No. 2, where the use of the rooms numbered from 1 to 5, for surgical out-patients, is indicated. The dressing-room is supplied with appliances, splints, etc.; and adjoining these rooms are separate water-closets for each sex. Patients

PLATE Nº 3.

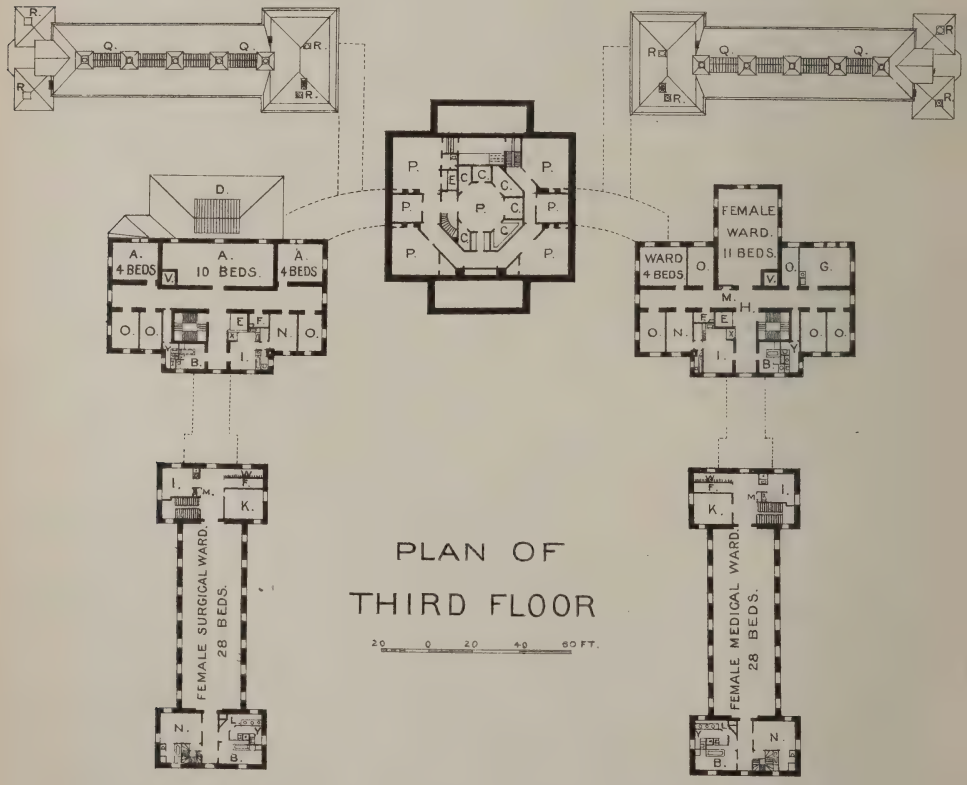
KITCHEN, BAKERY AND STORE ROOMS.

10. 0. 10. 20. 30. 40. 50.

SCALE OF FEET.

A CHILDREN'S WARDS.
D SKYLIGHT OVER OPERATING THEATRE.
G OPERATING ROOM.
H WARDS AND ROOMS FOR DISEASES OF WOMEN.
O PAYING PATIENTS' ROOM.
P CHAMBERS.
Q GLAZED ROOF OF VENT. CHAMBER.
R VENTILATORS.

FOR OTHER REFERENCES SEE PLATE Nº 1.



requiring other than minor operations or treatment in the wards are sent to the surgical rooms above, on the first floor. The diet-kitchen (room No. 6) has a cook in attendance for the preparation of special diets for all the surgical wards. The basement floors are all made hard with concrete and cement, upon which hard-pine flooring is laid, excepting in the diet kitchen, where there is a flagging-stone and brick paving. The walls of these rooms are finished by simply painting the faced brick a light color.

The medical building (numbered 2 in Plate No. 1) is symmetrical in general appearance and dimensions with the one just described, except that the projection in its rear is 30 feet by 24 feet. A small ward of eleven beds is thus formed on each of the three stories, in size about 26½ by 40½ feet. The ward on the first floor is designed for male ophthalmic patients, and contains all the sick who are treated on this floor. Near the main entrance are the offices of the visiting and house physicians. On the opposite side of the corridor is a receiving-room for medical cases, and adjoining it the room of the supervising ward-master of the medical service. Three rooms, marked H in the plan, are occupied by the house physicians. The bath-room for patients on this floor is placed near the ward, but otherwise all the service-rooms of this building are like those in the one previously described. A medicine closet, 20 inches deep, occupies the thickness of the corridor wall near the entrance to the ward on each floor. This closet is furnished with a marble slab, small wash-bowl, hot and cold water, shelving, and gas-light. It is very convenient, and having glass doors, is constantly under inspection, and easily kept in a cleanly and tidy condition. The second floor (Plate No. 2) has seven rooms, each averaging 16½ feet by 11 feet, for paying patients of the medical and ophthalmic service. For free patients of the latter class the ward is designed. A large room, G, is for an ophthalmic operating room, but available also as a small ward. The third floor (Plate No. 3) is devoted entirely to the treatment of diseases peculiar to women. There are five rooms for paying patients, and a small ward, of four beds, besides the larger ward containing eleven beds. An operat-

ing-room, at the southern corner of the building, is light and capacious, and, with low window-sills, abundant lateral light is obtained. In the basement of this building is a kitchen for preparing special diets for the medical wards, a room, with a chimney for ventilation, etc., for a laboratory, where the chemical and microscopical examinations may be made, a general linen-room, and a sleeping-room for male nurses. These rooms are finished in the same manner as those in the basement of the surgical building. The water-closet apartments of this building also have a special ventilating shaft, as already described, and the bath-rooms adjoining the nurses' rooms in each building are ventilated by a chimney warmed by the copper smoke-flue of the range in the basement diet-kitchen.

The one-story buildings are shown in plan, in Plate No. 1, where they are numbered 3 and 4; and a section and elevation of the surgical pavilion are shown in Plate No. 5. The two buildings are alike in form and arrangement. The underpinning is laid upon a foundation of concrete with no piling. The framing is wood and iron, with a covering of boards and, outside of this, corrugated iron. The roof is slated; the inside of the building has a lath and plaster finish, and the wood-work is very plain, as described in the surgical building. The general dimensions are 137 feet by $40\frac{2}{3}$ feet, except that the portion of the building occupied by the ward is narrowed to 28 feet, so that the ward is 94 feet by $26\frac{1}{3}$ feet in the clear. The entrance to the building is from the connecting corridor. The hall, 8 feet wide, has, upon the right-hand side, a small special ward or examining room, 15 feet by 11 feet, a drying closet, a medicine closet, and the dining-room, 15 feet by 17 feet, furnished with a soap-stone sink, steam-table, shelving, small broom-closet, and a dumb-waiter by which food is sent from the corridor basement. On the left of the entrance is a linen-room, and a room for patients' clothing in daily use, other clothing being kept in an appropriate place in the basement. The last-named rooms are each 4 feet by 15 feet, and each is lighted by a window. The patients' wardrobe has along its sides twenty-eight small stalls, numbered to correspond with

the beds in the ward. Every article of a patient's clothing as soon as taken off is hung in its proper place in this room. The room for the head-nurse and her assistant is 12 feet by 15 feet, and has a bath-room, etc., adjoining. These service-rooms are 14 feet high to the ceiling, and over them, in this part of the building only, is a second story, reached by a narrow stairway with a door at its foot, where there are four rooms for nurses, and a common bath-room. There is an arrangement for ventilating the water-closets and clothing rooms by an independent shaft enclosing the soil-pipe, etc., as already described.

The ward is 94 feet long by $26\frac{1}{3}$ feet wide in the clear, and has 7 opposite windows and 14 beds on each side. The windows, having double sashes, are 9 feet high by 4 feet wide, and the space between them is nearly $9\frac{1}{2}$ feet. The height of the ward, from the floor to the centre of the arched ceiling, is 22 feet, or an average of about 19 feet. Each bed occupies about $6\frac{3}{4}$ feet along the wall, and $13\frac{1}{6}$ feet to the centre of the ward. Thus a floor area of 89 square feet and an air-space of about 1,700 cubic feet is given to each bed.

At the end of the ward is a day-room, 11 feet by 12 feet, lighted by a bay-window. Wide glass doors open into this room from the ward, and in the end wall over these doors there are windows, thus giving the end of the large room a light and open appearance. These arrangements are shown in Plate No. 5, Figs. 1, 2, 3 and 5. On the right of the day-room is the lavatory, a narrow room with a window, marble slab and wash-bowls. In a separate room adjoining, with doors so arranged that entrance is easy for carrying in a patient on a stretcher, is the bath-room, 9 feet by 13 feet, furnished like the bath-rooms before described. At the opposite corner of the building is the room for water-closets, etc. The entrance from the ward opens by a self-closing door, first into a lobby $3\frac{1}{2}$ feet wide, with a window at each end. In one section of the lobby is a narrow stairway, for occasional use, leading to the basement. A low partition and lattice door shuts off this section, but does not obstruct the passage of air from one window to the other. From the

lobby a self-closing door opens into the water-closet apartment, the arrangement of which is shown in the plan (Plate No. 5). A section of the ventilating shaft for the water-closets is shown in Fig. 4. A steam-pipe heats the shaft, aided by a gas-jet, which lights the room by night. Fresh air is supplied to this room by an independent inlet, and the lobby also has separate air-supply and ventilation. All the spaces under the sinks, washbowls, seats of water-closets, etc., are left open, and the plumbing is exposed to view.

The basement, excepting of that part of the building occupied by the service-rooms at its entrance, is an open and free air-space, containing only heating apparatus. The floor is made hard and impenetrable to moisture by concrete and cement, and is on a level with the ground outside. Its numerous windows can be left open many months in the year, and, its doors being locked, it is kept cleanly and free from any intrusion but for proper purposes.

The main kitchen of the hospital was formerly under the administration building, and there was great deficiency of space, storage-rooms and proper ventilation. The place of the new kitchen is shown in Plate No. 1, and a plan of it is given in Plate No. 3. Its general dimensions are 45 feet by 30 feet, and it connects with the basement corridors. It is about 10 feet high in the clear, and its roof is nearly on a level with the first floor of the other buildings, so that the winds pass freely over it and between the other buildings. It has brick walls, which are painted inside, and a solid floor of slate tiles and bricks laid in cement. It is well-furnished with a Whiteley's range and steam-jacket kettles for cooking meats, soup and vegetables; a large tea and coffee apparatus; iron sinks; shelves for utensils upon a movable table, and a brick oven for roasting meats, etc. All the furnishing of the kitchen, except the range, stands away from the wall. The plan shows the arrangement of the bakery, store-rooms for flour and bread, the refrigerator and store-rooms for meats, vegetables, etc. A small cellar and coal-bin, underground, is connected with the kitchen. A large chimney, with the smoke-flue inside of it, over the ovens, ventilates the heated space over them and the kitchen and bakery. Openings are

PLATE Nº 4.

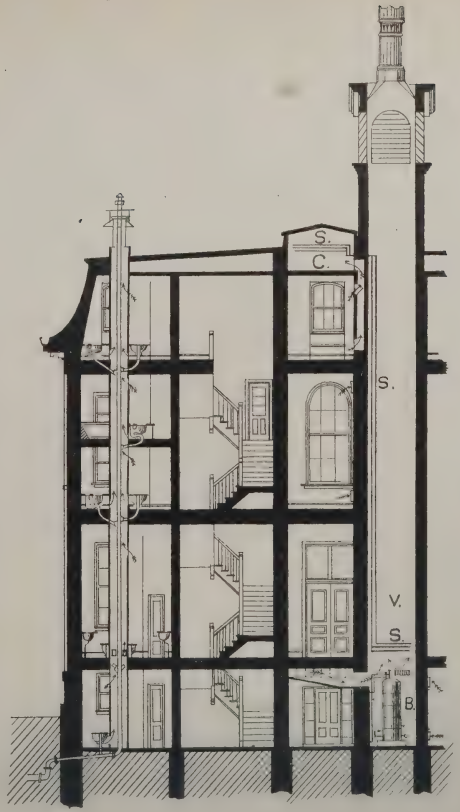


FIG. 1. SECTION ON LINE E---F.

FIG 2. SECTION ON LINE O--P.

SURGICAL BUILDING.

PLANS SHOWING
SYSTEM OF HEATING AND VENTILATING.

B. BOILER.
C. VENTILATING CHAMBER.
D. VENT. DOWNWARD — FIRST FLOOR.
I. FRESH AIR INLETS.
R. RADIATOR.
S. STEAM PIPES.
U. VENT. UPWARD. — UPPER FLOORS.
V. VENTILATING CHIMNEY.
X. SMALL VENTILATINC CHIMNEY.

10. 0. 10. 20. 30 40. 50 FT.

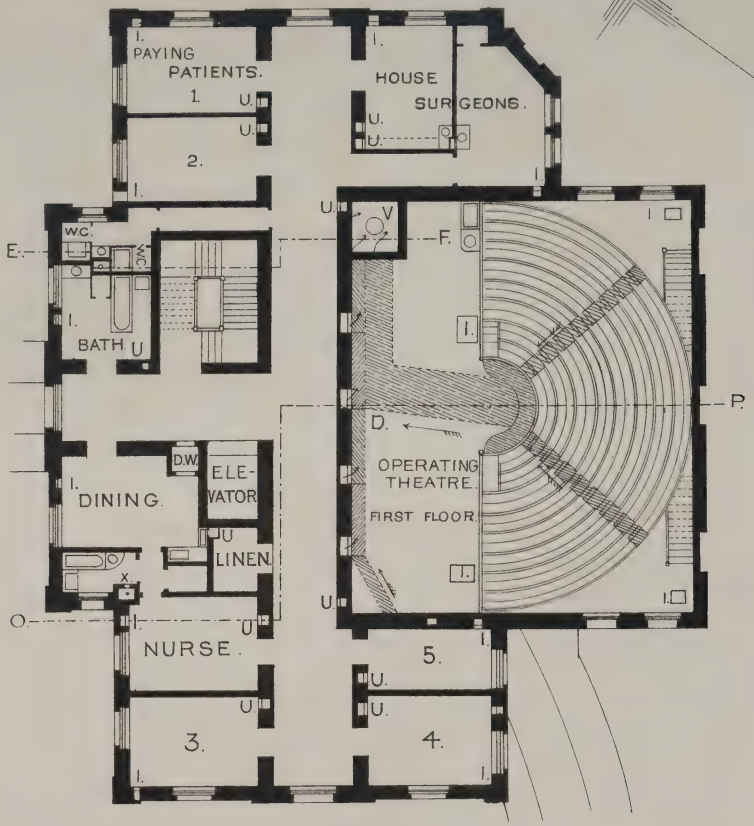


FIG. 3. PLAN OF SECOND FLOOR.

left in the brick walls outside, near the eaves, so that air can enter the space between the ceiling and the roof, from which it escapes through ventilators, thus cooling the roof and the rooms below in hot weather. The kitchen is centrally located, and the food is conveniently distributed in covered cars to the various buildings.

Heating and Ventilating.

The boiler-room (Plate No. 1) contains seven steam-boilers. The four older ones are each 16 feet long by 48 inches in diameter, with forty tubes, each 15 feet by $3\frac{1}{2}$ inches. The three new boilers are each 15 feet by 48 inches, with forty-nine tubes, 14 feet by 3 inches. The method by which the hospital was formerly heated and ventilated was as follows: *—

"Air forced through ducts, by means of a large fan at the boiler-house, and warmed by coils of steam-pipes placed in these ducts, is carried to every part of the buildings, thus affording the means of heating as well as ventilation. Direct radiation is provided for in a portion of the rooms, to be used in case of necessity. The steam-pipes over which the air passes for heating the different apartments in the central buildings are placed in coils, in chambers connected with the air-ducts. Those for heating the pavilions are located in the air-passages, beneath the floor under the corridors leading to the pavilions. The passage through which the air passes, after having left the main duct on its way to the pavilions, is divided into two compartments, in one of which is located coils of one-inch wrought-iron pipe. The steam, after passing from the boilers in a large iron pipe, is distributed through these coils, being regulated by valves, under charge of the engineer. After passing through the coils, it enters a steam-trap, located at the foot of the coil, which is so constructed that no steam can pass, where, after being converted into water, it is conveyed through a cast-iron pipe to a reservoir, located at the head of the air-duct; from thence it

* City Hospital Reports, First Series, page 17.

is pumped into the boilers, at a temperature of from one hundred and eighty to one hundred and ninety degrees. Through the other compartment cold air passes. These two compartments are so arranged that the cold and warm air are brought together in the several wards, where they come in contact before entering the room."

The cemented floor of the air-duct here described as passing under the corridor basement-floors, was about $3\frac{1}{2}$ feet below the latter, and thus about 7 feet below the ground level. Because of certain faults of arrangement, and in consequence of troubles to be hereafter described, arising from the location of the air-duct at such a depth, this system of heating and ventilation by impulsion was entirely abandoned in 1875, and the method by aspiration was adopted. The steam-radiators in the various parts of the buildings being raised to the basement ceilings, and the floor of the boiler-room being lowered six feet, the boilers, with the three new ones added to their number, could thus receive the water of the condensed steam flowing back into them without the intervention of a tank and pump, involving much loss of heat. In this manner the four older boilers have, at the date of this writing, been applied for one whole year to the warming of the main buildings of the hospital, excepting the isolating wards. This has ordinarily been done in cold weather by three boilers at low pressure of steam, rarely as high as 5 lbs., and with the index of the pressure gauge standing for days at zero. In extreme weather, the fourth boiler was put at work on a few occasions. The average daily consumption of coal in these boilers was from 3,000 to 3,500 lbs. per boiler, never over 4,000 lbs. in very cold weather. The three new boilers have been applied at high pressure (15 lbs. to 30 lbs.) to running the laundry machinery, cooking, heating water for all purposes in all the buildings, heating ventiducts of water-closets, the ventilating chambers in the roofs of the medical and surgical buildings, and in the ridges of the one-story pavilions, besides warming the two isolating wards. With these boilers, the use of the tank and pump has been necessary, and two of them have done all the work, except in extreme weather,

consuming daily per boiler but little more coal than the low-pressure boilers. Any one or more of the boilers can be used at high or low pressure.

The steam is conveyed to the different buildings in large pipes, the main pipe from the boilers to the administration building being eight inches in diameter. The distribution of the heating apparatus, the method of furnishing the fresh-air supply and of ventilating are shown in the plans in Plate No. 4. In Fig. 1, a section of a part of the surgical building, is shown the arrangement and special ventilation of the water-closets already described, the motive aspirating power in the shaft being furnished by steam-pipes, hot-water pipes and the gas-jets in daily use. The manner of covering the soil-pipe, imbedded in cement, to its exit through the foundation of the building to join the drain outside is here shown.

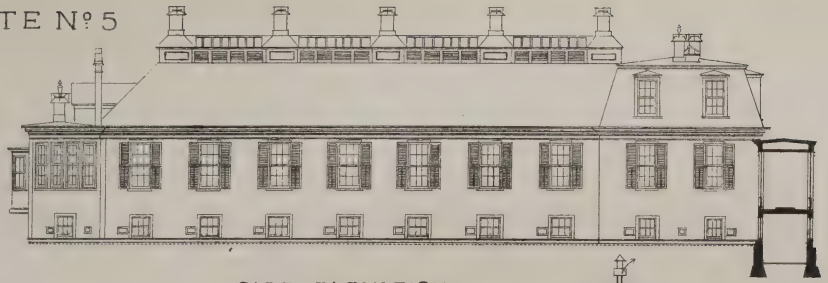
The aspirating chimney of this building, shown in Figs. 1, 2 and 3, is 6 feet square inside, and about 70 feet high from the basement floor to the bottom of the openings in its sides near its top. It was first proposed to place the boilers for heating all the surgical wards in the basement of this building, and to make a similar arrangement for the medical wards also, the smoke-flue to stand within the chimney, and thus furnish motive-power for ventilation; but the plan of concentrating the boilers in the present boiler-room being continued, heat is furnished to the chimney by utilizing the unavoidable radiation from the bath-boiler placed conveniently at its base. The additional steam-pipes to increase the aspirating power of the chimney, shown in Fig. 1, have not yet been found necessary, and there is always found a positive upward current of air. It is believed that decided advantages are gained from the somewhat novel plan of managing the ventilation of these new three-story buildings. The chimney is used only to ventilate the rooms of the basement and first floor; the warm and vitiated air from them, being conveyed laterally, or only a little downward, to the base of the chimney, is practically kept on its way upward and outward. The two upper stories are ventilated by a different plan, their outflowing air being simply aided in its

upward tendency by being drawn into the chamber in the roof (Figs. 1, 2). There is thus no loss of power in first drawing the air downward to the chimney base; there is no danger of the common trouble in such cases of reversed currents of foul air from the first to the upper stories through the ventilating flues of the latter. All communication is thus very perfectly cut off between the lower and the upper stories. The ventilating chamber in the roof can be warmed by steam-pipes, which have been employed only in damp or still warm weather. The air escapes through the sides of the chamber, which receives additional warmth in sunny days through its glazed roof.

Each room in the building has one or more separate ventilating flues, extending from floor to ceiling in the wall next the corridor, and each flue has two openings into it, and within it a valve, so arranged that it can only be moved by a key. The entrance to the flue is thus practically always open either at the top or bottom of the room. Thus all the upper outlets can be closed, compelling ventilation through the lower openings during the winter season, with the certainty of remaining so at the will of the superintendent, and beyond the reach and interference of unwise attendants or meddlesome patients. In the same manner, by simply turning the valves, the ventilation can be made to proceed through the upper openings in summer. It is to be noticed that the air passes downward from the rooms on the first floor, and upward from the upper stories.

Each small room has one, and the larger rooms have several inlet flues in the outer wall of the building for supplying fresh air, also arranged with valves so that the fresh air must enter in a given volume either at the bottom or the top of the room at will. This is illustrated in Fig. 1, in the room on the second floor. The cold air is introduced through openings in the outer basement-walls, passes immediately over the steam coils, of which there is a separate one for every flue, and upward to the rooms, which it enters through the lower or upper register, according to the adjustment of the valve. The most satisfactory method for the winter season has been to introduce fresh air by the upper registers,

PLATE Nº 5



SIDE ELEVATION
FIG. 1.

FIG. 2 REAR.

FIG. 3.

PLAN OF BATH ROOM AND W.CLOSETS.

10. 0. 10. 20. 30. FT.

C. SITZ BATH.
STEAM BATH.
SHOWER BATH.
VENT SHAFT.
D. SLOP SINK.
URINAL.
E. LOBBY.

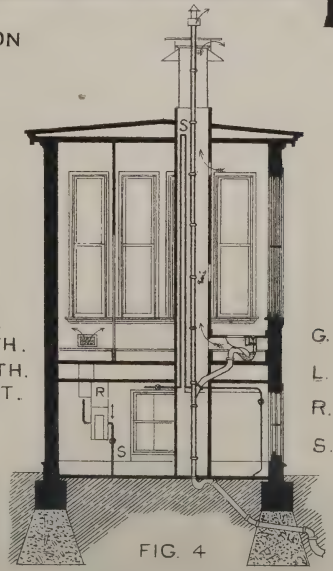
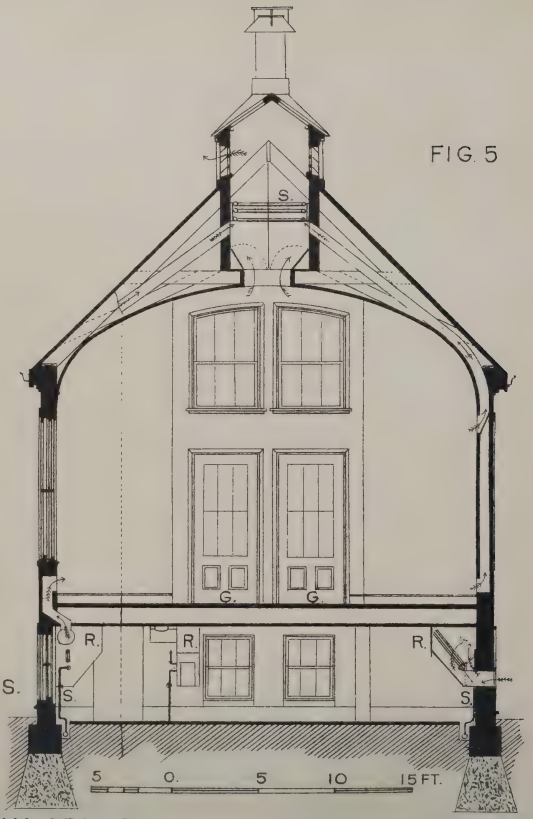


FIG. 4

SECTION ON LINE A.B.
VENT. OF W. CLOSETS.

G. DOORS TO DAY ROOM.
L. LAVATORY.
R. CASING OF RADIATOR.
S. STEAM PIPES.

FIG. 5



PARTIAL SECTION.
THROUGH WINDOW.

PARTIAL TRANSVERSE
SECTION BETWEEN WINDOWS.

DETAIL OF HEATING AND VENTILATING.

and extract foul air by the lower ones. In summer the reverse arrangement is the best.

The steam-radiators in the basements are encased with galvanized iron, forming a small chamber in which a switch-valve directs the fresh air, so that it passes either through the coil so as to be warmed, or, unwarmed, directly into the flue above. A wire connects the switch-valve with the lower register in the room above, where by the use of a key the valve can be adjusted to alter the temperature of the entering air. The volume of air can only be changed by opening or closing a sliding valve covering the inlet through the basement wall, and this is under the charge of the engineer. The arrangement of the apparatus for introducing, heating and controlling the fresh-air supply is more plainly shown in Plate No. 5, Fig. 5.

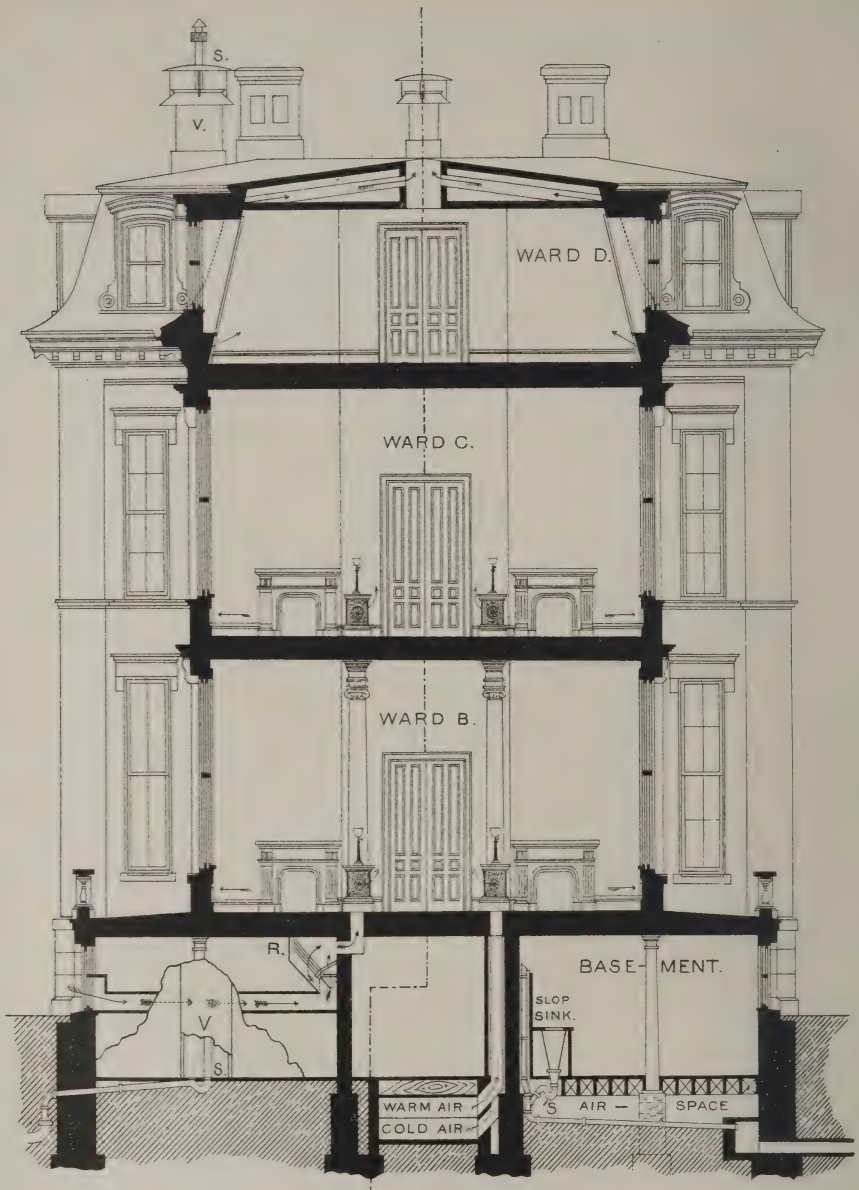
In the plan of the second floor of the surgical building (Plate No. 4, Fig. 3), the fresh-air inlets and outlets are shown. Some observations made in these rooms, to test the efficiency of the ventilation, have given satisfactory results. In the room numbered 3, where there are about 2,600 cubic feet of air space, and the inlets and outlets have each one square foot of clear openings, the velocity of inflowing and outflowing air, as shown by the air-meter, averaged in a number of observations 150 feet per minute. At this rate, 9,000 cubic feet of air pass through the room, changing its contents between three and four times per hour. The atmosphere out of doors, at the time of the observations, was clear, and quite still, the temperature about 30° F., that of the room 68° F.; and there was no artificial heat in the ventilating chamber in the roof. With added heat by the steam-pipes in this chamber, its aspirating power is increased, and good ventilation can be obtained at all times.

The plan (Plate No. 4, Fig. 3) shows the first floor of the operating theatre, the room being two stories high. The shaded lines and arrows indicate the downward and lateral direction of the foul air, under the floor, to the base of the large chimney, from the ventilators in the corridor-wall and in the risers of the steps leading up to the seats of the amphitheatre. The amphitheatre is capable of seating 250

persons, though the number likely to be present will rarely exceed 200. The room contains 55,000 cubic feet of air-space, and its atmosphere is easily changed between two and three times per hour, with ventilating outlets equal to 12 square feet of clear opening, and a usual outflow velocity of not less than 200 feet per minute. It is safe to say that more than 700 cubic feet of air per hour is supplied to each person. The efficiency of the ventilation is well indicated by the notable absence of the odor of ether in the theatre during operations, while at the same time that odor is very strong within the base of the chimney. Observations made almost daily, during the last year, of the working of the chimney, prove its up-cast draught to be continuous, and without any added heat from the available steam-pipes. The total cubic space ventilated by the chimney in the surgical building equals about 88,000 cubic feet; the area of the chimney is 36 square feet, and the air-meter indicates that a velocity of outflow of at least five feet per second may be constant. The motive-power producing this result is simply the waste-heat unavoidably radiated from the upright bath-boiler standing in the base of the chimney. The velocity mentioned is considerably less than the theoretical velocity of such a chimney, but the means are provided for easily increasing and insuring the constancy of its aspirating power.

The method of heating and ventilating the one-story buildings is shown in Plate No. 5, Fig. 5. The arrangement for introducing and controlling the quantity and temperature of the fresh air has already been described. The engineer alone has access to the basement, and the sole charge of the adjustment of the valves controlling the volume of inflowing air. The air enters the wards only through inlets under each window, 14 in all, each inlet equal to $1\frac{1}{4}$ square feet of clear opening. The foul air escapes through five large openings along the centre of the arched ceiling, each 3 feet by 6 feet, into the ridge-chamber, and thence either through the free openings in the sides of the chamber above the roof, or through five ventilators, each 2 feet in diameter, on the top of the ridge. The side openings are closed in winter,

PLATE Nº 6.



SECTION OF 3 STORY PAVILION,

SHOWING ALTERATIONS OF BASEMENTS AND FRESH AIR SUPPLY, ETC.

B. BRICK DRAIN.
R. RADIATOR.
S. SOIL PIPES.
V. VENT. SHAFT OF W. CLOSETS.

when also the openings in the floor of the chamber can be partly or wholly closed, and the ventilation aided by the flues, 14 in number, in the outer walls of the building. The ventilating-chamber is warmed, when necessary, by the steam-pipes shown in the drawing.

With the fresh air entering the ward at an average velocity of 160 feet per minute, which, the air-meter indicates, is easily obtained, there are given to each patient 6,000 cubic feet of fresh air per hour, and the whole volume of air in the ward, about 47,600 cubic feet, or 1,700 cubic feet per patient, is changed between three and four times hourly. The average of many observations has given a velocity of the inflowing air of over 200 feet per minute, without discomfort from draughts, equal to about 8,000 cubic feet per hour to each patient. Artificial heat is only occasionally applied to the ventilating-chamber.

In cold or windy weather, when the movement of air is rapid, the volume of warm air passed through the ward is very largely increased, and partial closure of the inlets and outlets is required. The experience of a winter's use of the one-story pavilions proves the heating and ventilating arrangement to be very controllable, and with proper care a very uniform temperature and freedom from draughts has been obtained with the very generous air supply. In general, it can be said that the peculiar arrangement of the apparatus, so that it cannot be interfered with by persons not appointed to adjust it, removes entirely the usual uncertainties and complications of such appliances, while it simplifies them and makes them easily managed.

Reconstruction.

The faults of the former system of heating and ventilating by impulsion, and the alterations of the older pavilions because of errors of construction, especially of their basements, have been mentioned. These defects are illustrated, in Plate No. 6, by a section of the three-story surgical pavilion, which shows also the new method for furnishing the fresh-air supply, etc. The basement-floors, as already

described, were about 3½ feet, and the bottom of the fresh-air ducts about 7 feet below the ground level. The fresh air being warmed just before entering the building, the duct was then divided so that the warm and cold air passed separately into the wards (see page xxv.), where its delivery was controlled by the mixing-valves to produce the desired temperature.

While the floor of the air-duct was cemented, the soil was left loose and uneven in the other sub-basement spaces. Lying upon this loose earth, the soil-pipes traversed these spaces from many directions to enter a sort of brick chimney. Of these chimneys there were several, each receiving a number of soil-pipes, and from these the drains passing through the foundation-walls conveyed away the sewage. The walls of the basement story were covered with sheathing, and lath and plaster finishing, behind which were spaces where vermin was harbored, and foul air could rise from under the floors.

The soil-pipes from the stories above were encased behind the sheathing in the corners of rooms, as shown in the plan. Certain steam-pipes, water-pipes, etc., necessarily passed along the warm-air duct, and gave off branches passing into the sub-basement air-spaces, so that there was more or less free communication of air through the openings in the wall between the duct and these spaces. The results of such arrangements have been the cause of much criticism of the hospital, and much anxiety in its management. Efforts were made, in 1873, to counteract the evils. In the annual report of the superintendent of the hospital for 1873–74, the writer states that "some extra labor has been employed during nearly all the year in the process of cleansing places difficult of access in and about the institution. The spaces under the basement-floors of all the buildings were thoroughly 'policed,' the surface of the earth was removed, and replaced with clean material; the connections of soil-pipes with the drains were carefully inspected, and the drains repaired in many places to stop the escape of air from the sewers into the buildings, and all the surfaces of these hidden places, and of the main air-ducts and cellars, were whitened with

lime-wash. The flues for fresh and foul air, of which there are many, and which require such attention every year, were also carefully and thoroughly cleansed of their accumulated dust, etc. The importance of constant attention to these matters cannot be overestimated; and the annual expenditure of a few hundred dollars in this way will certainly improve the sanitary condition of the hospital, and must even exert an appreciable influence upon the death-rate.

"These things are mentioned here also to invite attention to the peculiar difficulty of maintaining a proper condition of things in this respect, owing to peculiarities of arrangement and construction of the buildings. It is hoped that this can be remedied when improvements now proposed are made.

"The evils of occupying the basements of the pavilions, as wards for the sick, cannot be too strongly urged; and not only is it absolutely impossible to properly ventilate them, as well as their sub-basements of perfectly confined air-space, but the influence of this state of things upon the sick people in the three stories above must be positively pernicious. It is not the least of the present dangers that new defects in the drains and leakages from the soil-pipes may occur unobserved from time to time in these underground places, to be followed by noxious exhalations from their contents partially absorbed in the soft earth.

"The proposed transformation of these basement-wards into open cellars, with free air-space, cemented floors that can be frequently cleansed, and bare walls that can be whitened with lime-wash several times a year, will overcome evils of great and increasing magnitude."

Subsequently there was published, in the annual report of the State Board of Health of Massachusetts, some criticisms of the sanitary condition of the hospital, in a paper on "Hospitals," by Dr. George Derby, who ascribed the evils to the common failure of all artificial systems of ventilation. In an article on "Ventilation of Hospitals," in the "American Journal of the Medical Sciences," for October, 1875, defending artificial ventilation, Dr. Isaac Ray also criticised

the hospital; but ascribed its evils to recognized defects of construction, holding the fan to be blameless.

An examination of Plate No. 6 will make plain the condition of the sub-basements, and what influence it must have had upon the sick in the basement-wards themselves, and in the wards above.

A marked abatement of the evils followed the process of cleansing in 1873, and the repetitions of this process, but nothing short of radical reconstruction could prevent the danger of their recurrence. As soon as the occupation of the new buildings permitted the abandonment of the old basements as wards for the sick, the long-contemplated alterations were begun. The wood-work was all removed, gravel filled in, and a floor made of concrete and cement, provision made for altering the water-closet system, as already described, and the method of introducing and controlling the fresh-air supply made to correspond to that adopted for the new buildings.

In the drawing, the cold-air box leading from the basement window to the steam-radiator is represented as partly cut away, to show the water-closet ventiduct beyond in the farther end of the building. The capacity of the inlet-flues for fresh air is considerably increased, but it now remains to replace the old arrangement for the outlet of foul air by constructing aspirating-chambers or flues.

The fresh-air supply of the isolating-wards, instead of being forced by the fan from the cellar of the building through small flues, — equivalent to about 36 square inches for each room, — is now admitted through openings in the outer wall under the window and near the floor in each. A steam-radiator is placed in front of these openings and surrounded by a casing of wood, lined with tin, having a register in front, and covered with a wide marble slab forming a table on a level with the window-sill. These are shown in the plans of the buildings in Plates 1 and 2. A simple arrangement of sliding-valves within the casing controls the temperature and volume of the entering air, and the placing of steam-pipes in the originally ample and well-arranged ventilating chamber in the roof makes the heating and venti-

lating of the building efficient and controllable. With an area of inlet-opening of one square foot and an inflowing velocity of 200 feet per minute (it has often been found by the air-meter to be more than 5 feet per second) the air of the room is entirely changed from three to four times per hour. It is believed that this result is attainable at all times.

The observations that have been made with the air-meter, etc., were only experimental, and simply to test the general efficiency of the heating and ventilating apparatus; and it is believed that a properly conducted series of observations will certainly show results no less favorable than are indicated in the data given.

In what has been said of the use of the fan it is not intended to imply any condemnation of the system it involves. Local difficulties in properly carrying out such a system were, perhaps, sufficient to account for its failure here. If the fresh-air duct could be made air-tight, and properly accessible for purposes of cleansing of dust, etc., it must be admitted that the fan might be used with advantage for at least the two older pavilions, which now lack all artificial ventilating force.

The hospital was built upon well and carefully considered plans, and its general arrangement was excellent, though having some deficiencies which only actual experience in its management could point out and supply. The special defects of construction in some parts of the hospital are not noticed as exceptional, for it is lamentably true that they are too common in private dwellings as well as in public buildings.