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no. 9

Smith, Stephen

PRINCIPLES

OF

HOSPITAL CONSTRUCTION.

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At a meeting of the Trustees of the Roosevelt Hospital, held March 28, 1865, it was

Resolved, That it be referred to a Special Committee, consisting of Dr. Delafield, Mr. Trimble, and Mr. Muller, to prepare or have prepared, and to report to this Board, a plan for the Hospital Building of this Institution ; and that the sum of \$1,000 be appropriated for the expenses of said Committee.

In accordance with the above resolution, the Committee requested Dr. Stephen Smith, of this city, to prepare a Report on Hospital Construction ; authorizing him to visit all the principal hospitals in this country, and to obtain the best works on the subject, whether published at home or abroad. The Committee felt assured that in this mode alone could they expect to obtain all the knowledge which was absolutely requisite to have such a plan for hospital buildings as was contemplated by the Trustees of the Roosevelt Hospital.

At the regular meeting in November following, the Committee presented an elaborate report, by Dr. Smith, on the subject of hospitals, with descriptions, plans, and elevations of a number of the most approved hospitals in different parts of the world ; and, also, an abstract of the report, presenting in distinct propositions the several principles of hospital construction, which had been set forth in Dr. Smith's valuable work.

Whereupon it was ordered, that 250 copies of the Abstract should be printed for the use of the Board.

PRINCIPLES

OF

HOSPITAL CONSTRUCTION.

I.—A Civil Hospital, designed for the treatment of acute diseases, both Medical and Surgical, should be located so as to be easily accessible by that class of people who will seek admission to its wards, and by the attending medical officers.

Conditions of location.

II.—When a country site can be selected which will fully answer the foregoing requisites, it should be preferred to a location within the limits of a populous town.

Country site preferred.

III.—But if these conditions can not be fulfilled, except by locating the hospital within the corporate boundaries of a town, a district should be selected as far removed from populous suburbs as a due regard to accessibility and availability will permit.

Site—when the choice is limited to the city.

IV.—Within the limits finally fixed upon, a site should be chosen which will secure the following advantages :

Advantages to be secured in location.

1. A sufficient amount of ground.
2. Freedom from the immediate neighborhood of present and prospective nuisances; as manufacturing establishments having foul and unhealthy emanations, a crowded tenant-house population, depots for cattle and swine, etc., etc.
3. Sufficient elevation to render the surface and subsoil drainage perfect, and to give to the hospital grounds proper exposure to the currents of air.
4. A subsoil porous and self-draining, and as free as possible from organic matter; hence avoiding old grave-yards, cattle-yards, etc.

5. A large and constant supply of fresh water.

6. Easy transportation of the sick.

Preparation of
the grounds.

V.—In the preparation of the grounds the grading should have special reference to the surface and subsoil drainage, in order to render the soil and foundation work of the hospital dry. All sewers leading from the grounds should be provided with ample means of flushing, and the interior should be so arranged as to be inspected without difficulty on the grounds. Drain-pipes should be tapped outside of the building. No drain or sewer should pass under any building, but should lead as directly from the grounds as possible.

Separation of the
sick from the
administration.

VI.—In the arrangement of the hospital buildings, there should be a complete separation of the sick from the administration. For this purpose it is necessary that there should be properly constructed and independent buildings devoted exclusively to the sick, and others devoted exclusively to the administration.

Aggregation of
the sick disap-
proved.

VII.—It is important that the sick should be distributed over as large a surface area as is compatible with efficient management, and that excessive aggregation under one roof should be avoided. Hence the necessity of several independent buildings for the sick, and of a sufficiently large area, to constitute an improved hospital.

Pavilion hospi-
tals.

VIII.—The practical application of these principles to hospital construction gave origin to the pavilion plan, now universally adopted throughout Europe as the only method of securing the proper sanitary conditions of these institutions. Miss Nightingale thus describes a pavilion: "By a hospital pavilion is meant, a detached block of building, capable of containing the largest number of beds that can be placed safely in it, together with suitable nurses' rooms, ward sculleries,

lavatories, baths, water-closets, all complete, proportioned to the number of sick ; and quite unconnected with any other pavilions of which this hospital may consist, or with the general administrative offices, except by light airy passages or corridors. A pavilion is, indeed, a separate, detached hospital, which has, or ought to have, as little connection in its ventilation with any other part of the hospital as if it were really a separate establishment miles away."

IX.—The pavilions should be arranged on parallel lines running nearly north and south. The two long walls of the buildings will thus receive the full sweep of the prevailing winds, and also the direct rays of the sun, during the larger portion of each day. They should be separated from each other a distance so great that the intervening court will be exposed to the unobstructed sunlight and air. Miss Nightingale gives the following rule : "The distance between the blocks should not be less than twice the height of the blocks." Recent English hospital pavilions are separated 100 feet ; but it is evident that the distance should depend much upon the elevation of the site and its natural exposure to sunlight and the currents of air. In exposed positions, where the winds constantly sweep the sides of the building, and the direct sunlight falls upon both sides of the ward the greater part of the day, a separation of 75 or even 60 feet may be sufficient.

Arrangement of
pavilions on
the grounds.

X.—It is advised by some writers, as Miss Nightingale, that the hospital should never have more than two stories of wards. But in the pavilion plan, which admits of such wide distribution of the sick, there is no sufficient evidence against three stories of wards. Certainly, in a town like New York, where land is expensive, it is desirable to concentrate the buildings upon as limited an area as is compatible with the healthiness of the institution ; and there is no satisfactory

Number of
stories.

proof that a pavilion with three stories of wards may not be as healthy as one of but two stories, provided each ward has an independent and effective ventilation.

Construction of pavilion.

XI.—The length of each pavilion should be proportionate to the size of the ward and of the accessory rooms. The fundamental principles to be observed in its construction are, *first*, such separate and independent methods of ventilation, by natural means, of the wards, halls, stairways, water-closets, bath-rooms, and other apartments, that each will be constantly flushed with pure air, and the emanations of one can not by any possibility escape into another; *second*, the materials of the internal portion of the building should be as nearly as possible non-absorbent; *third*, such distribution of the sick as will give to each patient proper surface area and air space; *fourth*, facility of nursing and administration.

Width of ward.

XII.—The width of the ward portion should never be more than 30 feet, in order that the opposing windows may be brought sufficiently near to each other for complete through-and-through ventilation.

Size of wards.

XIII.—Small wards complicate the administration by adding to the number of attendants and the ward appliances, and can not be as thoroughly ventilated and disinfected as large wards, owing to the increase of walls, wood work, dead corners, furniture, etc. The ward should be designed, therefore, to accommodate as many beds as is compatible with efficient nursing and administration, and a due regard to the cubic air space and surface area to each patient.

Amount of air space.

XIV.—The amount of cubic air space necessary to each patient depends upon the freedom and effectiveness of the ventilation; but in a hospital located within a large town, the allowance should be for not less than 1,800 feet. In the civil

hospitals of Paris, it is fixed at 1,700 ; in those of London, at 2,000 ; while in some of the most recent hospitals it is raised to 2,500.

XV.—It is a well-established fact that the impure air emanating from the person or excretions of the sick diminishes as the square of the distance, and hence the necessity of a sufficient separation of the beds to prevent the injurious reaction of the sick upon one another. As a rule, each bed should have a space of 8 feet on the average, with 12 feet between foot and foot. Beds should be at least 3 feet apart. One hundred square feet to each bed is now recommended.

Surface area to each bed.

XVI.—In accordance with the foregoing principles, the number of patients to each ward is now generally fixed at from twenty-five to thirty-two.

Number of patients to a ward.

XVII.—If twenty-eight patients to a ward be taken as a medium, and 1,800 cubic feet of air as the average, which is nearly the standard adopted in Paris and London, the following proportions of the ward might be adopted : Length, 110 feet ; breadth, 28 feet ; height, 17 feet. This would give about 1,800 cubic feet to each patient. If there are three stories of wards, the height of each may vary, that of the first being greatest, and that of the third being least, owing to the difference of exposure to air and sunlight of the different stories. The following table exhibits the proportion of wards in the most recent hospitals of France and England :

Proportions of wards.

| PROPORTIONS OF WARDS. | FRENCH. | | ENGLISH. | |
|-------------------------------------|---------|-----|----------|-----|
| | Ft. | In. | Ft. | In. |
| Length of ward..... | 111 | 6 | 128 | 0 |
| Breadth..... | 30 | 0 | 30 | 0 |
| Height..... | 17 | 0 | 17 | 6 |
| Space between end wall and windows. | 5 | 0 | 6 | 4 |
| Breadth of windows..... | 4 | 8 | 4 | 8 |
| Space between windows..... | 9 | 2 | 11 | 4 |
| Height of windows..... | 13 | 0 | 13 | 6 |
| Cubic space per window..... | 1,760 | 0 | 2,100 | 0 |

Height of ceiling.

The height of ceiling should not be less than fourteen, nor more than eighteen feet. An excess of cubic air space above the sick is not available, and too often furnishes a stratum of foul air, which is not sufficiently moved by the currents of air.

Number and size of windows.

XVIII.—The windows should be multiplied to as great an extent as is compatible with the safety of the wall. There should be at least one window to every two beds. A window to every bed is the rule in many recent hospitals. The windows should extend from within three or four feet of the floor to near the ceiling; the upper part of the windows should be square instead of oval, and they should be arranged opposite to each other. Stained glass may be used, or outside blinds. Double windows, so arranged as to secure ventilation, are important, as they serve to retain heat.

Water-closets and sinks.

XIX.—The water-closets should be placed at the end of the ward, opposite the entrance, and be so isolated from the ward that emanations from the former can by no possibility penetrate to the latter. There should be between them a well-ventilated lobby, and the water-closet should have its own separate ventilation by opposite windows. The sink for the ward slops, expectoration cups, bed-pans, etc., should be in an apartment adjoining the water-closet, and should consist of a deep basin supplied with a vertical stream of water.

Baths and lavatories.

XX.—In the same end of the building, but in the opposite corner or angle, should be arranged the ward baths and lavatories, with an equally well-ventilated lobby as the water-closet.

Nurse's room, scullery, etc.

XXI.—At the end of the ward, corresponding with the entrance, should be arranged the accessory rooms. The nurse's room should immediately join the ward, with a window opening into it, so placed that at a glance she can survey the

entire ward. Adjoining this room should be the room of the assistant nurse. In immediate proximity should be the clothes room of the ward. On the opposite side of the hall should be the ward scullery, with conveniences for warming drinks, cooking light articles, washing dishes, preparing fomentations, etc. In immediate relation, a small ward dining-room should be arranged for patients not able to go to the general table; or, of sufficient size to accommodate the entire ward, when there is no general table.

XXII.—There must be provided in this part of the building, lifts for conveying articles to and from the wards and the basement, as food, coal, etc., etc. It is also desirable to have, separately constructed, a foul linen shoot, through which dirty and soiled articles of the beds can be sent to the basement without contact with any ward articles. Miss Nightingale says: "These should be built in the wall. The best materials for them is glazed earthenware piping, 15 to 18 inches in diameter. They should have an open mouth also of earthenware, with a door, opening not near a ward, but from a staircase or well-ventilated passage; and they should end below in a small closet, out of which the linen should be taken as soon as the change is completed, and removed at once to the wash-house."

Lifts and foul
linen shoots.

XXIII.—If there are three stories of wards, there should be a day-room on the second or middle floor, where the convalescent patients of the pavilion can pass their leisure hours in reading, conversation, and games. In many recent hospitals, a separate building is assigned to this special purpose.

Convalescents'
room.

XXIV.—On the first ward-floor, at the main entrance to the pavilion, and near the stair-way leading to the several wards, the rooms for the resident medical officers of the

Medical officers'
room.

division should be arranged, with speaking tubes, or other means of immediate communication with the wards and other departments of the hospital.

Construction of
the extremities
of the pavil-
ions.

XXV.—For the accommodation of these accessory rooms of the wards, a greater or less extension of the building is required, according to the number and size of the rooms. In general, the two ends of the pavilion are made considerably wider than the central or that devoted to the wards, and those rooms are located in the extensions. Occasionally, also, the buildings terminate in towers, and then the accessory rooms are placed in them. Whatever plan is adopted, the principle should not be lost sight of, that angles, corners, jutting walls, etc., are to be avoided as far as possible; and, also, that as few accessory rooms should be provided as will serve the purposes of good and efficient administration. Towers are always very expensive, and are more ornamental than useful.

Basement.

XXVI.—The basement should be elevated, at least half the height being above ground; it should be constructed on arches, and be supplied with large windows for the purpose of free ventilation. As it is to be devoted to the administration, care should be taken in its subdivision to render every part accessible and well adapted for its particular service.

Heating.

XXVII.—The wards should be heated by open fireplaces, placed along the sides of the wall; the adjacent rooms may be heated by stoves. If any artificial method of heating be adopted it should be subordinate to the open fireplace, and not the principal means.

Ventilation.

XXVIII.—Natural ventilation, as by windows, doors, and fireplaces in use, should be adopted and enforced. All artificial methods of ventilation have failed when practically applied to hospital buildings, and if employed in any form, should be subsidiary to natural ventilation.

XXIX.—The exterior walls may be built of brick. The interior walls should be of the most non-absorbent material obtainable. Parian cement is much used abroad, also stucco. There should be as little wood-work as possible; and the wood, both of the floors, windows, and doors, should be treated with beeswax and turpentine, to render it non-absorbent. Georgia or Florida pine, or oak, is the most suitable wood.

Materials of building.

XXX.—The administration building is designed to accommodate the apartments of the resident officers, the offices of administration, etc., etc. It should be central, and arranged on a plan best adapted to secure the rapid and efficient discharge of all the details of administration. Subordinate offices, as that of clerk, steward, apothecary, etc., etc., should be in immediate communication with the chief office.

Administration building.

XXXI.—The kitchen is generally located in the basement of the central building; but when the extent of the ground permits, it should be in a separate building or wing.

Kitchen.

XXXII.—The operating theatre is usually constructed in the upper story of the central building; but when practicable, it should be near the surgical wards, in order to avoid the transportation of the wounded or injured, as well as those who have been recently operated upon.

Operating theatre.

XXXIII.—The steam apparatus should be confined to a separate building, but so central as to waste but little heat in the passage of water and steam through the tubes.

Steam apparatus.

XXXIV.—The wash-house should be separated as completely as possible from other departments, as it is the receptacle of the foul linen. When practicable, it should be removed from the hospital grounds.

Wash-house.

Corridors.

XXXV.—All the buildings should communicate by means of corridors, which should be but one story high, with a basement. The basement should communicate directly between the kitchen and laundry, and the basements of the pavilions. By means of lifts the wards communicate with this passage-way, and receive from and send to the appropriate building, food, clothes, coal, etc., etc. A railway may run in this part of the corridor so quietly as to be unobserved. The first story of the corridor is intended to be the passage-way of officers to the pavilion; it should be completely open in the summer, but with provision for closing it, if required, in winter.

Fire-Proof.

XXXVI.—It is extremely desirable that all the buildings should be fire-proof throughout. The stair-ways should be of stone or iron, and wood-work be dispensed with wherever practicable in all parts of the building.

Wards for contagious diseases.

XXXVII.—Small wards for contagious diseases should be provided in a part of the pavilions farthest removed from the centre of the grounds.

Hot and cold water supplied.

XXXVIII.—Hot and cold water should be supplied in abundance to every part of the hospital.