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Contributors

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Baltimore, Maryland.

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HOSPITAL PLANS.

FIVE ESSAYS

RELATING TO THE

CONSTRUCTION, ORGANIZATION & MANAGEMENT

OF

HOSPITALS,

CONTRIBUTED BY THEIR AUTHORS

FOR THE USE OF THE

JOHNS HOPKINS HOSPITAL

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Professor of Chemistry and Clinical Medicine, Medical Department University of Louisiana; Visiting Physician of Charity Hospital, New Orleans; Formerly Surgeon in the Provisional Army of the Confederate States 105

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Wm. Hopkins,
Francis White,
Lewis N. Hopkins,
Alan P. Smith,
Charles J. M. Gwinn,
Joseph P. Elliott,*
George W. Corner.†

* Elected in the place of Richard M. Janney, deceased.

† Elected in the place of Joseph Merrefield, who was chosen Treasurer.

ADVERTISEMENT.

THE occasion which has called forth the following essays is made sufficiently plain by the letter addressed to their distinguished authors; but the reason of their publication may justify a word of explanation.

That motive will be found in the fact that so valuable a mass of information as is embodied in these instructive papers, though intended for the personal use of the trustees of "The Johns Hopkins Hospital," ought not to be withheld from the whole public, now so much alive to the important questions therein discussed. Hence, they have considered it in entire consonance with the beneficent designs of the founder of their charity, whose enlarged views embraced the relief of human suffering wherever found, that the essays should be published without stint of illustrative drawings, and at a cost not probable to be returned by any expected sale of the volume. Besides the good likely to be done by this publication, the philanthropic subject to which it relates will be further benefited by the intelligent and liberal criticism to which the special views of the essays may be subjected by learned medical writers. The subject will thus be fully developed, and all who seek the alleviation of suffering disease through the instrumentality of the well-constructed and properly managed hospital, will find in the result as sure guidance as the present state of knowledge will afford.

To these essays, which treat the subject in the light of medical learning and experience, it has been thought expedient to append a sketch of a pavilion from an architectural point of view; and they have accordingly presented a study of an octagon plan, embracing some features of novelty and probably of merit.

From the diversity of views which these plans present, it will

be obvious that the trustees of The Johns Hopkins Hospital are not yet committed to any of them, but that, like the reader, they are seekers after knowledge, and that their search is further accompanied with a high sense of their responsible duty to find and to execute the best plan they can.

Besides the duty of building a hospital, the trustees have had also confided to them the task of providing a home for destitute colored orphan children. As, in many respects, such an institution demands the observance of sanitary rules of construction and the application of the principles of hygienic management, in common with hospitals, they have thought it not inappropriate to publish, in the same appendix, the plan of separated buildings they have provisionally, and will probably finally, adopt. In the meantime it is open to such well-considered modifications as its publication may call forth.

GENERAL HOSPITAL SOC. LIBRARY NEW HAVEN, CONN.

LETTER ADDRESSED TO THE AUTHORS OF THE ESSAYS.

OFFICE OF THE JOHNS HOPKINS HOSPITAL,
BALTIMORE, March 6, 1875.

DEAR SIR:—The late Johns Hopkins, a rich citizen of Baltimore, bequeathed to trustees a munificent foundation for the building and support of a hospital, mainly intended for the benefit of the indigent sick of the City of Baltimore and its environs.

The letter which, some time before his death, he addressed to his trustees, will best describe the object he had in view, and a copy of it accompanies this communication.

The execution of this munificent charitable purpose has been entrusted to a body of trustees, none of whom, with a single exception, belongs to the medical profession, and, apart from the injunction which the founder's letter imposes upon them, "to obtain the advice and assistance of those at home and abroad who have achieved the greatest success in the construction and management of hospitals," they would have distrusted their own ability to cope with a subject so strictly scientific and professional, without first resorting to the best sources of information within their reach.

To this end the Board of Trustees has authorized their Building Committee "to confer with five distinguished physicians, chosen from different parts of the country, who have made hospitals their special study, and obtain from them such advice as they may need, and to compensate them for it." It is in execution of the authority thus conferred that this communication is addressed to you, and you are invited to make such response to it as your fulness of information, stimulated by the importance to humanity of the subject, may prompt you to.

Besides the information afforded you by the letter, some addi-

tions are needful to be made, and some corrections which altered circumstances require.

You will observe that the site of the proposed building is there designated; and, as we assume that you are not acquainted with it, it is proper to add, that it consists of an eligible piece of ground situated in the eastern part of the city; that it is fourteen acres in extent, in the form of a parallelogram, 709 × 856 feet; that it is very elevated above the general level of the city, and commands an extensive view in all directions; that it is healthy, with complete surface drainage, whilst underground drainage may be accomplished to tide water; and that it is easily accessible by street railway and by paved streets, which bound the four sides of it.

It is also proper to state that the endowment, which in the letter is spoken of as amounting to two millions of dollars, is now, by subsequent additions made to it by the founder, at least three millions of dollars, yielding an annual revenue of $180,000.

Out of this income, the hospital building proper, an establishment for convalescent patients, and a home for colored orphans are to be erected, after which the income will be applied to their support, as indicated in the letter. The means thus available we believe will be ample to execute the trust with as much speed as a due regard for doing it carefully will justify.

You should also be told more fully than is done in the letter, that the founder of the hospital, by his will, provided for the establishment of a university, upon a site also devised by him, distant about a mile from the hospital. To the uses of this institution he has also dedicated over three millions of dollars of his fortune, and he looked to the hospital as furnishing a most desirable aid to medical education in the university.

These preliminary statements are made in order that you may have a full view of the subject about which we now seek your advice.

It will readily occur to you that the subject most prominent at this day, in the professional consideration of the Hospital question as applicable to cities, is the choice between the *pavilion* system, which admits buildings of two or more stories in height, permanently constructed, of which the Herbert Hospital in England and several in this country may be considered good modern types; and the *barrack* system of one story structures,

destructible in whole or in part, which were so successfully used in the late war, but of which no extensive and prominent example is now in operation. In determining the claims of these systems respectively, as applicable to us, careful regard should be had to the character of patients intended to be the subjects of our nursing, so as to avoid the error of building an institution which shall prove not to meet the requirements demanded in the care and cure of women and children, and the generally enfeebled inhabitants of the sheltered lanes and alleys of a city, however much such a structure may have been a success when applied to the uses of hardy men in the field.

We presume there must be some general principles of hospital hygiene and of hospital treatment fixed and immutable in their character, the discovery and proof of which are the result of close, careful recorded observation and judgment. If these principles can be best applied through the agency of the pavilion system, we wish to adopt that; if by the barrack system, then we will avail ourselves of that form of construction, and if the true rule for our guidance shall be found in the selection of the good features of each, and the combining of them all into a harmonious middle course, then we desire to make that selection and combination.

In whatever plan may be adopted, we presume there will be no departure from the now very general method of a central administration building, with wards for the treatment of the sick as carefully separated therefrom and from each other as practicable. To the details of this building we especially invite your attention:—the objects to be accommodated in it, the amount of room to be given to each, and their location with respect to each other for convenience of use.

Comprehended within these details will be the consideration of the accommodations needed for the training school for nurses, and whether they should be within the Hospital building or separated from it; and as the Hospital will be used for clinical teaching to the medical classes of the University, it will be needful to consider what accommodations that subject will require, and how and where they should be provided.

As closely connected therewith we should be glad to have your advice as to the most judicious location of the medical school buildings of the University; that is, whether they should be in

close proximity to the Hospital, or whether they can, with equal profit and convenience, be erected with the other buildings of the University, a mile distant.

In the same general category of things to be provided would be included suitable appliances for promptly and efficiently caring for accident cases, so numerous in a large city, and a dispensary for out-of-door relief, both by the dispensing of medicines and the giving of medical advice.

In the treatment of these subjects, it is not to be expected that you will present architectural drawings, but if your views can be illustrated by such suggestive sketches as your pen or pencil can throw off in aid of your thoughts, they will be gratefully received and placed in the hands of our architect for more elaborate expression.

Certainly not second in importance to any of the matters you are invited to instruct us upon, are those of ventilation and heating, and the kindred subjects of light and sunshine, as curative agents. The various methods of heating, combined with ventilation, form professional problems about which the most experienced and best informed medical minds seem to be far from being united. Whether *heating* should be accomplished by steam or hot water pipes radiating their heat directly into the room, or by the same agency imparting heat to air in chambers, to be thence sent into the apartment to be warmed ; or by open fires in the angles or sidewalls ; or by ventilating stoves in the centre of the ward, or by a combination of these methods, are subjects upon which opinions widely differ ;—and whether *ventilation* should be accomplished by what is called the natural method, through doors, windows, and unavoidable leakages ;—or through flues and ducts acted upon by the differing temperature of the outer and inner air, or by enforced currents set in motion by fans, blowers, or other mechanical contrivances, are points which have equally learned advocates and opponents. To solve for ourselves these difficult problems, we invoke the aid of your experience and thoughtful judgment.

The location of the kitchen and its appurtenant offices is a subject of great practical importance, upon which new and, so far as we know, hitherto untried suggestions have been made. Whether it should be in a separate building from those devoted to administration or to the nursing and care of patients, or in

the basement of some one of them, or in the upper story of any, are points open to discussion and to be carefully considered.

Upon the subject of *management*, with its numerous details of medical attendance, resident and occasional, nursing, domestic service, police regulations, etc., etc., we should be glad of any advice, and, indeed, with reference to the whole matter, our wish is to put you in our place so far as to learn from you how you would execute the trust we are now seeking to be instructed about, if it were confided to you.

We beg you to consider what has been said as mere suggestions of some of the topics to be considered, and not as limitations either upon the subjects to be treated or upon your mode of treating them, and we ask your zealous co-operation in this humane subject to which it is understood you have given great attention.

It is right that you should also know that besides the request now made to you, a copy of this letter has been addressed to four other distinguished members of your profession, whose communications in reply, together with yours, will be printed in a volume for our private use, and for such useful distribution as so valuable a contribution to medical literature will be well entitled to.

It only remains for us to add, that if you will kindly serve us and the cause of suffering humanity, in the way we have indicated, we shall hope to receive your paper by the 1st of May.

Please acknowledge the receipt of this, and oblige

Very respectfully yours, etc.,

FRANCIS T. KING,
President of Board of Trustees.

LETTER OF JOHNS HOPKINS TO THE TRUSTEES.

BALTIMORE, March 10, 1873.

TO FRANCIS T. KING, *President, and* JOHN W. GARRETT, *Hon.* GEORGE W. DOBBIN, GALLOWAY CHESTON, THOMAS M. SMITH, WILLIAM HOPKINS, RICHARD M. JANNEY, JOSEPH MERREFIELD, FRANCIS WHITE, LEWIS N. HOPKINS, ALAN P. SMITH, and CHARLES J. M. GWINN, *Trustees of "the Johns Hopkins Hospital."*

GENTLEMEN:—I have given you, in your capacity of Trustees, thirteen acres of land, situated in the city of Baltimore, and bounded by Wolfe, Monument, Broadway and Jefferson streets, upon which I desire you to erect a Hospital.

It will be necessary to devote the present year to the grading of the surface, to its proper drainage, to the laying out of the grounds, and to the most careful and deliberate choice of a plan for the erection and arrangement of the buildings.

It is my wish that the plan thus chosen shall be one which will permit symmetrical additions to the buildings which will be first constructed, in order that you may ultimately be able to receive four hundred patients; and that it shall provide for a Hospital, which shall, in construction and arrangement, compare favorably with any other institution of like character in this country or in Europe.

It will, therefore, be your duty to obtain the advice and assistance of those, at home and abroad, who have achieved the greatest success in the construction and management of Hospitals.

I cannot press this injunction too strongly upon you, because the usefulness of this charity will greatly depend upon the plan which you may adopt for the construction and arrangement of the buildings.

It is my desire that you should complete this portion of your labor during the current year, and be in readiness to commence the building of the Hospital in the spring of 1874.

It will be your duty, hereafter, to provide for the erection, upon other ground, of suitable buildings for the reception, maintenance and education of orphan colored children.

I direct you to provide accommodation for three or four hundred children of this class; and you are also authorized to receive into this asylum, at your discretion, as belonging to such class, colored children who have lost one parent only, and, in exceptional cases, to receive colored children who are not orphans, but who may be in such circumstances as to require the aid of the charity.

I desire that you shall apply the yearly sum of twenty thousand dollars, or so much thereof as may be necessary, of the revenue of the property which you will hereafter receive, to the maintenance of the Orphan's Home intended for such children.

In order to enable you to carry my wishes into full effect, I will now, and in each succeeding year during my life, until the hospital buildings are fully completed, and in readiness to receive patients, place at your disposal the sum of one hundred thousand dollars.

In addition to the gift, already made to you, of the thirteen acres of land in the city of Baltimore, upon which the Hospital will be built, I have dedicated to its support and to the payment of the annual sum provided to be paid for the support of the Orphans' Home, property which you may safely estimate as worth, to-day, two millions of dollars, and from which your corporation will certainly receive a yearly revenue of one hundred and twenty thousand dollars; and which time and your diligent care will make more largely productive.

If the Hospital and Orphans' Home are not built at my death, it will be your duty to apply the income arising from the property so dedicated to their completion. When they are built the income from that property will suffice for their maintenance.

The indigent sick of this city and its environs, without regard to sex, age, or color, who may require surgical or medical treatment, and who can be received into the Hospital without peril to the other inmates, and the poor of this city and State, of all races, who are stricken down by any casualty, shall be received into the Hospital, without charge, for such periods of time and under such regulations as you may prescribe. It will be your duty to make such division of the sexes and patients among the several wards of the Hospital as will best promote the actual usefulness of the charity.

You will also provide for the reception of a limited number of

patients who are able to make compensation for the room and attention they may require. The money received from such persons will enable you to appropriate a larger sum for the relief of the sufferings of that class which I direct you to admit free of charge; and you will thus be enabled to afford to strangers, and to those of our own people who have no friends or relations to care for them in sickness, and who are not objects of charity, the advantages of careful and skilful treatment.

It will be your especial duty to secure for the service of the Hospital, surgeons and physicians of the highest character and greatest skill.

I desire you to establish, in connection with the Hospital, a training school for female nurses. This provision will secure the services of women competent to care for the sick in the Hospital wards, and will enable you to benefit the whole community by supplying it with a class of trained and experienced nurses.

I wish the large grounds surrounding the Hospital buildings to be properly enclosed by iron railings, and to be so laid out and planted with trees and flowers as to afford solace to the sick, and be an ornament to the section of the city in which the grounds are located.

I desire that you should, in due season, provide for a site and buildings, of such description and at such distance from the city as your judgment shall approve, for the reception of convalescent patients.

You will be able in this way to hasten the recovery of the sick, and to have always room in the main Hospital buildings for other sick persons requiring immediate medical or surgical treatment.

It is my especial request that the influences of religion should be felt in and impressed upon the whole management of the Hospital; but I desire, nevertheless, that the administration of the charity shall be undisturbed by sectarian influence, discipline, or control.

In all your arrangements in relation to this Hospital, you will bear constantly in mind that it is my wish and purpose that the institution shall ultimately form a part of the Medical School of that University for which I have made ample provision by my will.

I have felt it to be my duty to bring these subjects to your

particular attention, knowing that you will conform to the wishes which I thus definitely express.

In other particulars I leave your Board to the exercise of its discretion, believing that your good judgment and experience in life will enable you to make this charity a substantial benefit to the community.

I am, very respectfully, your friend,

JOHNS HOPKINS.

EXTRACTS FROM JOHNS HOPKINS' WILL AND THE CODICILS THERETO.

"I give, devise, and bequeath unto 'The Johns Hopkins Hospital,' a corporation formed at my instance, under the laws of Maryland, by Certificate recorded among the Records of Baltimore City, all the real and leasehold estate, not hereinbefore specifically disposed of, and wheresoever the same may be situate, of which I may die seized, or possessed, and also all the Bank stocks, owned by me, at my death, in Banks located, or doing business within, or beyond the limits of this State, to be held, used, and applied by the said 'The Johns Hopkins Hospital,' in and for and to its coroprate purposes, in accordance with the provisions of its existing Certificate or Charter of Incorporation, or with the provisions of such Act, or Acts of Assembly, amending its Certificate or Charter of Incorporation, as the Trustees thereof, acting upon my recommendations hereinafter made, may see fit to procure to be passed and accepted.

And as I am of the opinion that the ward, or building, to be under the control of the said Hospital, which is to be erected for the reception and care of colored orphan children, ought also to be opened for the reception and proper training of destitute colored children, and that said ward ought, moreover, to be separated wholly, and built at a distance from, the wards, or buildings intended for sick poor white persons, or sick poor colored persons, I do recommend the trustees of the said 'The Johns Hopkins Hospital,' to apply to the Legislature of Maryland for authority to build the ward, or building, intended for the reception and care of the orphan colored children, in a locality different from that selected for the use of the wards for sick poor white persons, or of sick poor colored persons; and also for authority to receive and care for destitute colored children, in such building, erected for the reception and care of orphan colored children; but it shall be the duty of the said trustees of the

said 'The Johns Hopkins Hospital,' to supervise the concerns, interests, and wants of all the several wards, or subdivisions, of the said 'The Johns Hopkins Hospital,' wherever the said wards, or subdivisions, may be located, in such manner that the interests and wants of each of said subdivisions, or wards, may be fully and impartially protected and promoted.

"And I desire that the said trustees of the said 'The Johns Hopkins Hospital,' shall make ample provision out of the property, real and personal, by this my last will and testament devised and bequeathed to the said 'The Johns Hopkins Hospital,' not only for the ward, or building, intended for the use of sick poor white persons, and for the care of such inmates, but also for the ward, or buildings intended for the use of sick poor colored persons, and for the care of such inmates, and for the ward, or building intended for the reception and care of colored orphan and destitute children, as aforesaid."

* * * * * * * * * * *

"I do further declare that it is my wish that the trustees of 'The Johns Hopkins Hospital' shall apply to the Legislature of Maryland for such additional authority as they may require to enable them to educate the orphan and destitute colored children by them received into their charge, and shall use and employ such portion of the nett income of the property (not exceeding one-fourth part thereof, however) devised and bequeathed to them by me, as may be necessary to enable them to perform the duty of receiving, caring for and educating such orphans and destitute colored children; and I do further direct that, when such authority is obtained, the same trustees shall expend such portion of the said one-fourth part of said income as may be necessary in the reception, care, and education of said orphan and destitute colored children.

"And I also declare it to be my wish that my said trustees shall also apply for such additional authority as they may require, to enable them to provide proper and respectable employment for such orphan and destitute colored children so by them received and cared for, when such children shall arrive at a suitable age."

* * * * * * * * * * *

"Now I do hereby revoke the said devise and bequest so made of all the rest, residue and remainder of my estate, and I do hereby give, devise, and bequeath all the said rest, residue, and

remainder of the estate, real and personal, of which I shall be seized, or possessed at my death, of whatsoever nature and description the same may be, to 'The Johns Hopkins University' and to 'The Johns Hopkins Hospital,' as tenants in common, and not as joint tenants, to be equally divided between them, share and share alike; the share of each corporation in the said rest, residue, and remainder of my real and personal estate to be held, used, and applied by such corporation in, for, and to its corporate purposes, in accordance with the provisions of its existing certificate, or charter of incorporation, or with the provisions of such Act or Acts of Assembly amending its certificate or charter of incorporation, as the trustees thereof may procure to be passed and accepted."

HOSPITAL CONSTRUCTION
AND ORGANIZATION.

JOHN S. BILLINGS,
Bvt. Lt.-Col. and Asst. Surg., U.S.A.

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HOSPITAL CONSTRUCTION
AND ORGANIZATION.

JOHN S. BILLINGS,
Bvt. Lt.-Col. and Asst. Surg., U.S.A.

I. RELATIONS OF THE MEDICAL SCHOOL TO THE HOSPITAL.

In attempting to prepare a plan for the organization and construction of a Hospital at Baltimore, under the provisions of the Johns Hopkins' Trust, it is necessary first to consider the probable organization of the Johns Hopkins' University, for the reason that the plan of the Hospital must depend upon the extent to and the manner in which it is to be used as an instrument of medical education, and upon the more or less intimate connection which it is to have with the Medical School.

If the course of medical education proposed is to be that usually given in this country, and to the class of students which form the majority of those now attending our medical colleges, it will be extremely difficult, if not impossible, to devise a Hospital which shall equally subserve the best interests of the patients and the convenience and wishes of the students and professors.

I am decidedly of the opinion, however, that we have at present in the United States not only enough, but too many of the ordinary sort of medical colleges, and that the opportunity which is now presented of forming an institution for medical instruction which, being entirely independent of students, can therefore afford to consult their welfare instead of their wishes, is one of which an attempt should be made to take the fullest advantage, and such, I have reason to believe, is the intention of the trustees.

It seems to me that this school should aim to produce quality,

and not quantity; and that the seal of its diploma should be a guarantee that its possessor is not only a well-educated physician, in the fullest sense of the word, but that he has learned to think and investigate for himself, and is therefore prepared to undertake, without danger of failure from not knowing how to begin, the study of some of the many problems still awaiting solution.

It is not desirable that the classes should be large. In fact, as the results of such a school become manifest and the value of its diploma is understood, they may become too large for convenience in practical clinical instruction. A class of half a dozen such as I would wish the graduates of this school to be, would be a more satisfactory result for a year's labor than as many hundred turned out on the ordinary pattern.

The means of attaining this end are sufficiently well known: a high standard for admission; a four years' course; rigid and impartial examinations, preliminary, intermediate, and final; and practical work in the laboratory and apothecary's department, the microscope and photograph rooms, and the dispensary and wards of the Hospital.

If this be the sort of Medical School intended, there are no difficulties in connecting the Hospital with it. It would really belong more properly to the Hospital than to the University, and while, for hygienic and business reasons, the school building should not be on the hospital grounds, it should not be far away.

An important feature of the school should be a first-class Physiological Laboratory, with ample facilities for chemical and microscopical work. This should be connected with the Pathological Department of the Hospital, and the assistance rendered will be great and mutual. If we are ever to advance in accurate knowledge of the laws of health and disease, it will be by the application of instruments of precision and of graphic measurement to the secretions and motions of the body, healthy and morbid, and for this purpose we must have the apparatus and the patients near each other.

The Professors of the Medical School should furnish the medical and surgical advice required for the Hospital and Dispensary; the Resident Physicians should be graduates of the Medical School, selected by competitive examinations (the Physician-in-Charge, of whom I shall speak presently, should be a member of

the Examining Board, as the representative of the interests of the Hospital); and the students should be employed as much as possible in the Pharmacy, Dispensary, Wards, and Pathological Department.

The true interests of the Hospital and of the Medical School seem to me to be not only perfectly compatible but inseparable.

The objects of the Hospital as indicated by its founder are, first, to properly care for the sick poor; second, to aid in the education of Physicians and Nurses. Such an institution may have a third object, to which I wish to call special attention—namely, to promote discoveries in the science and art of medicine, and to make these known for the general good. In this country it is too much the case that scientific and medical men who are qualified and have the desire to make original investigations, and thus increase our stock of knowledge, want either the means or the time to do so, and it is to young and energetic men, qualified and selected as I have above indicated, and working under the direction of such men as it is hoped the Professors of the school will be, that we must look for the scientific observation and information so much needed to increase our power of healing or comforting the sick.

I must remark, however, that if the Attending Physicians, or the Resident Physicians, or both, be expected to attend to, and advise as to the hygienic management of the Hospital, the result will probably be a failure. Their thoughts and studies will be for the most part directed to other subjects, and the minute supervision which is necessary to insure the continued healthfulness of the institution cannot be obtained from them.

The supervision I refer to must not be occasional and partial, but must include an almost daily inspection of the entire establishment, with power to remove and remedy nuisances and evils promptly and effectually.

I consider this more important than almost anything connected with the Hospital, and the plan of the institution must depend upon its probable presence or absence. If the management of the details of such an establishment is to be entrusted to non-professional hands, or to physicians who have, or ought to have, other duties and interests, it is desirable to prepare a plan in which the evil results which may be expected shall be as little permanent and expensive as may be.

II. ORGANIZATION AND GENERAL PLAN OF MANAGEMENT.

I recommend that the organization of the Hospital shall be on the Military or Railroad plan, *i.e.*, that it shall have one head, and only one, who shall receive his directions from, and be responsible directly to the Board of Trustees, and that all orders and instructions which the Board may make relative to the discipline and internal management of the Hospital shall be issued through him. This Officer should be a competent medical man, and a man of executive ability. He should have charge of the Hygiene of the Hospital in general and particular, should assign and prescribe the duties of the employees, assign patients to their places, and remove them to other places as he may deem necessary. The subjects of temperature, light, air supply, and disinfection should be his special charge; in short, he should be the Health-Officer of the Institution, as well as its official head. He should not appoint employees, or make purchases, nor should he be connected with the Medical School. All requisitions for supplies of any kind should be approved or signed by him, and all accounts should pass through his hands. I shall call this Officer the "Physician-in-Charge."

I further recommend that this Officer shall be selected as soon as possible in order that he may advise during the construction of the Hospital as to the many details concerning which questions will arise, and all of which cannot be foreseen. He should confer with the Managers and Superintendents of the principal hospitals in this country, and prepare a plan for the management of the Hospital, including a full set of rules and regulations, to be submitted to the Board with all the information he may obtain on the subject. It would also well repay the Board to send this Officer at such time as he could best be spared, prior to the completion of the Hospital, to personally examine the various systems of management and discipline of the principal hospitals of this country and of Europe, and while in Europe he should select certain instruments, books, and apparatus for the institution, and should make a complete collection of the rules, regulations, blanks, records, etc., in use in the various hospitals.

If a suitable man be obtained, the plan which he will submit to the Board, with the accompanying documents, will be of much

more practical value than any set of rules which can now be presented.

Nevertheless, it is necessary to refer to some details under this head, in order that the plan for the construction of the Hospital may be understood.

I would recommend, then, that there be one Resident Physician to every fifty (50) patients, one or two for the Dispensary for Out-door Relief, and one in the Pathological Laboratory. To each of these physicians I would allow two students, to be changed in rotation according to the number available. The Apothecary should also have two students. When the Hospital is completed there would thus be 22 students employed, and it will probably be some time before the school will have a much larger graduating class than this.

The separate branches of administration will require a steward, charged with purchases and property responsibility; a wardmaster, charged with the execution of orders relative to disinfection, isolation, etc., and with the supervision of male employees; a superintendent of female nurses, an engineer, an apothecary, and a chief cook. All of these report to the Physician-in-Charge, or through him to the Board.

Inasmuch as the Training-School for Nurses is to be connected with the Hospital and will be controlled by the same authority, the greater part of the nurses should be females. They should have a separate building, which may be on or near the hospital grounds.*

A number of clerks, messengers, ward orderlies, and laborers will be required, for whom accommodation must be provided.

As a very important part of the training of a nurse consists in teaching her how to prepare and serve food properly, it may be a question how far they should be employed in the main kitchen of the Hospital. If a suitable woman can be obtained for chief cook, the main kitchen would be a valuable aid to the Training-School. I have never seen such a woman, and my personal experience in large hospitals is that it is better to employ as chief cook a first-class man, in which case the instructions of the nurses in cooking will be mainly given in the diet-kitchens attached to the wards.

* [NOTE.—Attention is invited to an account of the Dresden Nursing Association by Dr. Fleming, in the Glasgow *Medical Journal* for April, 1875, and especially to the mode of instruction there indicated for female nurses.]

I recommend that no Chaplain be appointed, although a chapel should be provided.

We now have to consider the rules and regulations which should govern the admission of patients.

By the terms of the letter of Mr. Hopkins explaining the design of the trust, it appears that patients of all colors, both sexes, and all ages are to be admitted, provided in the case of any applicant that his admission shall not imperil the other inmates. It is probable that this last phrase was intended to apply to cases of specific contagious disease, such as Scarlatina, Small-Pox, etc. But what shall be done in cases of Diphtheria, Erysipelas, Gangrene, Typhoid Fever, Puerperal Cases, and others, of the danger of which there is little doubt, under certain circumstances? To reject all cases which might possibly be a source of danger to the inmates would greatly restrict the usefulness of the charity, and would leave unassisted precisely those which have the greatest need of aid, not only for their own sake, but for that of the health and welfare of the community.

It should be remembered that not even the most careful selection will entirely prevent the appearance of contagious disease in the Hospital, and if Erysipelas or Diphtheria appear the cases must be provided for. If we could be assured that no contagious or infectious diseases would occur in the Hospital, it might be worth while to consider the question of excluding all applicants affected with them, for the problems of construction would be greatly simplified by so doing. As we cannot have this assurance, we must make provision for such cases, and, having done this, I would recommend that they should be received in all cases where it shall appear that suffering to the patient and danger to the community will result from rejecting them. I advise this without hesitation, because I am well satisfied that it is possible to receive and treat such cases without special danger to the inmates of the Hospital, as will be explained hereafter.

It will probably be found desirable that the Board shall have a Central Office in the city, where orders for admission can be granted. This Office should be connected by telegraph with the Hospital. There should be two ambulance-wagons at the Hospital, or, if convenient, one may be kept, at least during the day, near the Central Office. The bodies of these ambulances should be iron skeleton frames, with linings of wood and leather which

can be easily removed, being divisible into several parts. The litters should be woven wire mattresses. Whenever an ambulance is used for a doubtful case, the whole lining of the vehicle should be taken apart and passed through the disinfecting chamber.

The Physician-in-Charge, or in his absence the Medical Officer of the day, should have the power to admit cases of emergency, or such as may be selected from the dispensary patients.

Upon his arrival at the Hospital the patient should be examined by the Medical Officer of the day, who in case of doubt will call upon the Physician-in-Charge for decision.

After the patient has been assigned to a numbered bed in a ward, he should be subjected to a bath and be furnished with a suit of clean hospital clothing before being taken to his bed.

When I say "subjected to a bath" I mean that in most cases a nurse, male or female, as the case may require, shall superintend the giving of the bath and see that the cleansing is thoroughly performed. At the same time the attendant should note the condition of the skin, especially as to the presence of sores, ulcers, or disease of any kind, for the information of the physician.

The patient's clothing should be disinfected, and cleansed before being placed in store, or be at once destroyed by fire if it seem proper to do so. Provision must be made for furnishing clothing in place of that destroyed, when the patient leaves the Hospital.

For the accommodation of pay and private patients special accommodations are to be provided. These should be of several grades.

For patients of means, who desire privacy and who are willing to pay for it, several suits of rooms should be provided, entirely separate from the wards, and near the administrative building.

Others of a lower grade are to be provided in connection with the wards.

The system of records of the Hospital, financial, historical, and professional, should of course be as complete as possible.

A perfect system of records should show not only the history of each patient, but of each ward and each bed. For instance, giving each bed a number and the furniture of that bed a corre-

sponding one, if two successive cases of septicæmia or erysipelas occurred in the same bed we should have some clew as to the causes of such diseases.

I recommend that as soon as the Hospital is completed and organized, there be undertaken the publication of an annual volume of reports similar in character and plan to those issued by Guy's and St. Bartholomew's Hospitals. This volume should contain accounts of the more interesting cases treated in the Hospital and Dispensary, and records of original investigations made by the Resident Physicians and Students. If every student graduating in the Medical Department were required to prepare a thesis which should contain some original observations or investigations, this volume would be a proper means of their publication. It should be edited by a committee of the Professors of the Medical School, to which should be added the Physician-in-Charge of the Hospital.

The Dispensary for Out-Door Relief should be connected with the building designed for the instruction of students, which should be entirely separated from the main administration building.

If the Medical School be organized upon the plan which I have indicated, the greater part of the clinical instruction will be given in the Wards and in the Dispensary; and not in the Amphitheatre which will be used mainly for surgical operations and for walking cases, that is, patients not confined to their beds.

It is very seldom that it is desirable to bring a patient confined to his bed into the Amphitheatre except for a surgical operation, and the Physician-in-Charge of the Hospital should have the power of preventing the taking of any given patient to the Amphitheatre.

For surgical operations it is usually much better that the patient should be taken to the Amphitheatre, not on account of the students so much as because of the special facilities of room, light, and apparatus there provided for such purposes.

For the Dispensary for Out-Door Relief there will be required two or three waiting-rooms for the patients, and several rooms for the Physicians' use. The more subdivision is made in this Department, by affording facilities for special branches, as for diseases of the Eye and Ear, the Throat, the Skin, diseases of

the Nervous System, etc., the better will be the results, and space and conveniences should be provided for such classification.

The only objection to removing the Dispensary from the administration building is that it makes it desirable, although not absolutely necessary, to have two Pharmacies. As this gives a place for another student or two, selected from those who have received a sufficient training from the Hospital Apothecary, and as the Dispensary Pharmacy will not require a large stock of drugs, or fittings, I do not think this objection of much weight.

It is moreover desirable that the accounts of expenses for the Dispensary should be kept separate from those of the Hospital, which will be made easy by the arrangement proposed.

In connection with this part of the institution, though not permanently in the same building, I think it is most important that there should be a Pathological Laboratory, with facilities for microscopic and photographic work.

The value of the Hospital with regard to the welfare of the patients, as an aid to the Medical School, and as a means of promoting improvement in the science and art of Medicine, will depend largely upon the perfection with which this part of the institution is equipped and organized, and upon the regulations which govern its use, and especially the recording of the work performed in it.

III. ON THE CAUSES OF HOSPITALISM, OR THE HURTFUL INFLUENCE OF HOSPITALS.

The air in a hospital ward is made impure and hurtful in two very different ways.

First, it is contaminated with gases derived from the lungs and bodies of the patients, from the decompositions of their secretions and excreta, and from the products of combustion. These gases are carbonic oxide, and carbonic acid, sulphuretted and phosphuretted hydrogen, and ammonia and its compounds and substitution products.

These gases seldom exist to a dangerous amount, and their sufficient dilution with fresh air prevents them from being injurious to health.

The second kind of contamination in a hospital consists of minute particles of solid or semi-solid insoluble matter, derived

directly or indirectly from the bodies of the patients, of which they once formed a part. Some of these particles, if placed in contact with a living surface, as of the mouth or lungs, or of a wound, will either grow and reproduce themselves, or they will change the mode of action of the part with which they come in contact, or they may do both, and in either event will affect the blood, and weaken or alter the natural process of life; in other words, they will cause or aggravate disease.

It is to these particles, known as disease germs, contagia, microzymes, micrococci, bioplasm, germinal matter, etc., according to the different theories which are held as to their nature and mode of action, that are supposed to be due the majority, if not all, of the contagious and infectious diseases, including those specially prevalent in hospitals and referred to in the term "Hospitalism."

In certain diseases of the skin and in a peculiar affection of the ear, we have strong reasons for believing that the causes or conveyers of the disease are certain minute fungi, but the majority of the contagia are probably rather animal than vegetable in their nature.

If subjected to warmth and moisture they rapidly decompose and lose their specific powers, but if partially dried, they retain their vitality (if the term may be used) for a long time, very much as dried yeast does, and after the lapse of weeks—or in some cases of years—will act in the presence of moisture and warmth very much as they would in the hour of their first separation from the body.

I am satisfied that I have seen scarlatina produced by some of these particles which had been preserved in a blanket carefully packed away for four years. They resist the action of cold and of weak alkalies, such as soap and water, to a surprising degree, indeed in some cases they seem to gain new powers in the latter fluid, which is not a desirable cleansing agent in a hospital. They are destroyed by a sufficiently high temperature, or if moist, by chlorine, sulphurous acid, and ozone; and by a number of agents known as disinfectants.

Whatever may be the opinions held as to the nature of these diseased germs, and their mode of origin and propagation, they are what we have to fear and to provide against in the construction of a hospital. They are on and in the dressings, the sponges,

the instruments and apparatus, the bedding and clothing of the patients, the persons and clothing of the physicians and attendants. The finger-nails of the latter are full of danger. Wherever there is a ledge, or projection, or crack in the ward, these invisible particles are liable to lodge, and becoming dried, to be displaced by currents of air. Under certain circumstances it is probable that a single one of these particles is sufficient to set up a morbid process if brought in contact with the living body. For some of them, as in Small-Pox, the results are the same, or nearly the same, no matter where or in what succession they are applied; for others, as in Erysipelas and septicæmic poisoning, or inflammations of mucous membranes, the results vary according to locality of affection, and to modifications of the germs by their parents. That is to say, an Erysipelas germ may give rise to puerperal fever, and this again to fatal septicæmia if inoculated through a scratch on the finger of the attendant.

It is very desirable that this subject of contagium should be clearly understood in this connection, and that the above statements should be considered not as theories, but as an account of facts which it is easy to verify.

It is particularly necessary to remember that one of these particles cannot be diluted.

We may by diluting the air remove a certain number of the germs, with the effect that in a cubic foot of air there shall be but ten instead of one hundred, and that therefore the probabilities of coming in contact with one are correspondingly diminished; but if it chances that one particle falls on the wound, the results will be nearly the same as if no dilution had been made.

If you are standing on a plain across which a file of men are firing, your chances of escape are of course better if there are but ten men shooting instead of one hundred; but if one of the ten does chance to hit you, the practical difference will probably not be appreciable.

The experiments of Chauveau, on the effects of dilution of the Virus of Sheep-Pox, show that when this is diluted with ten thousand (10,000) times its bulk of water, about one inoculation out of twenty will take effect, and the results will be the same as if undiluted matter were used (showing conclusively that the contagion cannot be soluble, but must consist of extremely

minute particles suspended in the liquid). I commend for special attention in this connection a most valuable paper on this subject by Dr. Burdon Sanderson, "On the Intimate Pathology of Contagion," in the twelfth Report of the Medical Officer of the Privy Council, 1869, and his supplementary Report on the same subject in the Report of the following year.

During the years 1867 and 1868 I was engaged in a series of investigations on the minute fungi, bacteria, and microzymes of various kinds as causes or carriers of disease; and I can from personal experience and observation confirm the majority of Dr. Sanderson's observations with regard to these minute organisms.

No system of diluting the air of an hospital ward will give absolute security from the action of contagion, and we can therefore understand why it is that the usual mode of ventilation can never afford perfect security against the hospital diseases, not even if we double the cubic space, and triple the air supply usually considered sufficient.

Furthermore, the ordinary processes of disinfection will not certainly destroy all these contagia under the conditions in which they are found in a hospital ward. The gaseous disinfectants, such as sulphurous acid, chlorine, and ozone, probably have little action on dried albuminoid matter such as forms a pseudo-membranous investment of these organic particles after a brief exposure to warm dry air. If a good, but dry vaccine crust were placed in a room, and that room were filled with sulphurous acid or chlorine gases in the ordinary way, I do not think that the specific vitality of the crust would be materially injured except by a very long exposure.

And if liquid disinfectants be used it is very difficult to apply them so thoroughly and universally as to give the desired security.

We know by experience that if a number of men affected with rheumatism, disease of the heart, organic disease of the stomach, paralysis, etc., are placed together in a ward, the danger of Hospitalism and infection arising among them is exceedingly small, not greater probably than would be produced by placing a like number of well men under the same circumstances. But if we place in that ward cases of fever, or of inflammatory disease of any of the mucous membranes, as of the throat, lungs, intestines, etc., we have introduced an element of danger. By ven-

tilation and thorough scientific cleanliness this danger may be almost wholly averted, and this is the theory of good hospital management as usually taught.

It will no doubt occur to any one reflecting on this matter that it would be well to isolate these dangerous elements, and that the old proverb about the "ounce of prevention," etc., may be properly applied in such a case. And there is no doubt that it would be well, so far as the patients are concerned at least, to carry their classification and corresponding separation to a much greater degree than is done in the majority of hospitals.

IV. TEMPORARY VERSUS PERMANENT HOSPITALS.

A number of large, carefully planned, and costly hospitals have been erected within the last twenty years, in which all the recommendations of those who have given most attention to the subject have been carried out, including isolated wards or what is called the pavilion plan, with impervious walls and floors, abundant air space, and careful provision for ventilation.

But with all this, it is believed by many, and is confidently asserted with appeals to statistics, that the results given by these institutions have not been commensurate with the labor, money, and ingenuity expended upon them.

After a time in many of these Hospitals, and in some of them very soon, some of the ill effects which physicians usually attribute to impure air and contagion, such as Erysipelas and puerperal diseases, or a tendency to slow and imperfect recovery in ordinary maladies, have made their appearance, in which case attempts at purification and disinfection have not always been successful.

The results of the experience of military surgeons with Wooden Barracks and Tent-Hospitals, especially in the late war in this country, and in the more recent contests in Europe, led to the recommendation that similar structures should be adopted for all hospitals, not only for the reason that such structures are more easily ventilated and disinfected, but on the ground that any building continuously occupied by sick or wounded men will become contaminated, that its walls and floors will themselves become sources of infection, that it will be better to destroy or abandon them when this occurs, and therefore, for

economical reasons, that they should be built cheaply with reference to such destruction.

A formulization of this doctrine was given in a "Report on the Barracks and Hospitals of the Army," Circular No. 4, War Department, Surgeon-General's Office, Washington, D. C., 1870, 4to, pp. XXII.–XXIII., in the following words: "Our hospi-"tals approach more nearly in size and character the so-called "Cottage-Hospitals of England than any others. They are satis-"factory in one respect, that they are almost all temporary hos-"pitals. This I consider a decided advantage, as I believe that "no hospital should be constructed with a view to its being used "as such for more than fifteen years. If the money required to "put up such structures as the New York Civil Hospitals, the "Rhode Island Hospital, or the Cincinnati Hospital were divided "into two equal parts, one-half being used to erect frame hospi-"tals of the same capacity as the stone and brick hospitals "actually built, and the other half being put out at interest at "six (6) per cent., a complete new hospital could be furnished "every twelve years for an indefinite period to come."

At the time when I wrote this, *i.e.*, during the years 1869–1870, I was on special duty in the Treasury Department, advising with regard to the reorganization and reform of the Marine Hospital Service, which at that time was in bad condition. One of the reforms which was most urgently needed in that Department was in the mode of constructing hospitals, which up to that time had been very expensive, and with one exception, the new Marine Hospital at Chicago, were built on very improper plans.

I was therefore urgent and persistent in recommendations to the Secretary and to the Architect of the Treasury in favor of the temporary plan, using especially the argument for economy given above.

I have given this brief history in order that the motives which prompted the recommendation of this temporary plan may be understood.

It is certainly one way of solving the problem, and for certain kinds of hospitals I believe it to be the best plan which can be pursued.

But the statement that this temporary character should be adopted for all hospitals, and especially all parts of hospitals, was, I am now satisfied, too sweeping. That is to say: I do not

think it necessary that all the buildings of an hospital should be destroyed or removed at certain regular intervals, in order to prevent infection, and there are some things to be taken into account in favor of more permanent structures under certain circumstances to which I did not give sufficient consideration.

Barrack Hospitals are best suited for Government purposes, for contagious and infectious diseases, and in general where much subdivision of patients is unnecessary, where number of attendants and cost of fuel is not taken into account, and, as I have above remarked, for hospitals which are liable to be mismanaged.

It must be remembered that Military Hospitals can usually be placed where there is ample room for separating the numerous buildings which are essential to the Barrack plan, they receive adult males only, and these of a better class than those entering Civil Hospitals, in their management the interests of no Medical School or other institution need be consulted, and above all they are under the direct charge of a medical man selected for the purpose, whose responsibility for and interest in their proper condition is direct and personal, and whose power is very great.

It is an error to suppose that a Barrack Hospital will prevent Hospitalism.[1] Certainly in our large Army Hospitals we had the Hospital Diseases, as every surgeon of experience knows, and I have myself emptied a Barrack ward, and placed the men in tents, on account of the appearance and persistence of septic disease.

I have seen a decided tendency to erysipelas and pyæmia appear in a most characteristic Barrack ward, an unplastered building, with excessive ridge ventilation, within six weeks after it was first occupied. The weather was warm and for a week there was little wind, so that the process of natural ventilation was unsatisfactory.

And I think that the experience of most Army Surgeons will agree with my own, that for cases of wounds or acute fevers Tents are better than Barracks, and in warm weather that open sheds are better than closed tents. The great advantages of a

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(1) Dr. Day (Australian Med. Journ., Aug., 1874) considers that wooden structures are directly disinfectant by reason of their action on the Oxygen of the Air, producing "Peroxide of Hydrogen." (Ozone ?)—Such power of this kind as they may specially have is due to the resins in the wood, and must be very small.

Barrack Hospital are: First, that it costs less, and will therefore be abandoned, destroyed, or modified with less hesitation than a more costly structure; second, that the wards being but of one story, it is easier to arrange the ventilation.

The question as to the number of stories is, however, totally distinct from that of the permanence of the structure, and will be considered hereafter.

All the arguments in favor of a Barrack Hospital apply with still greater force to one composed mainly of Tents.

There is little doubt that if all the wards of the proposed Hospital be made temporary structures the result would be satisfactory in all respects except as to cost and appearance. There need be no fear as to the possibility of properly warming and ventilating Wooden Barracks or even Tents in the coldest weather; the real difficulty in ventilation will occur in warm, still weather.

Two Barrack wards have been in use, winter and summer, at St. Petersburg since 1871, and the results have been entirely satisfactory, so far as warmth and fresh air are concerned. The secret of properly heating such structures, or tents, consists in placing the heating apparatus not in the room to be warmed, but below it.

The objections to such hospitals are their inflammability, the large space and increased number of nurses, attendants, and laborers which they require, the amount of fuel necessary, and the difficulty of enforcing proper discipline among and supervision of the employees and the patients, especially in the location proposed.

These objections are serious ones, and their full force can only be appreciated by those who have had practical experience in the management of such hospitals.

I am of the opinion that all the good qualities of a Barrack or Tent Hospital can be combined with those of a permanent structure, in such a manner as to secure both the healthfulness of the one and, to a considerable extent, the convenient and economical administration of the other, and such a plan I will attempt to indicate. I shall again refer to the temporary plan, and give a sketch of how it may be arranged, after describing the several buildings which will be required under either system of construction.

V. HEATING AND VENTILATION.

With regard to heating, it is necessary to keep in view the peculiarities of the climate of Baltimore.

I append a table (A) showing the average annual temperature of Baltimore, with maxima and minima, for the last 45 years; also a table (B) showing the monthly means, maxima and minima, for the last five years. Also table (C) giving the mean direction of the winds for the same period.*

From these tables it will be seen that we have to provide for temperatures varying from zero to about 100° F.

For at least three months in the year special provision against cold will be needed, and this, if ventilation is allowed, can only be effectually secured by warming the air before it is admitted into the wards, which can best be effected by the use of hot water or steam, in what is known as the method of indirect radiation.

The use of hot water on the low pressure system as a means of heating is specially satisfactory in hospitals, for the reason that the air is warmed by a large surface at a comparatively low temperature, which in the heating coils rarely need be over 150° F. in this locality, and air thus warmed is much more agreeable and salutary than when heated to over 200° F., as it must be by furnace or steam radiators. The principal objection to the hot-water apparatus is that in the rapid changes of temperature which occur in this climate in spring and autumn, amounting sometimes to 40° F. in a few hours, it is less manageable than steam, requiring a much larger time to heat and to cool.

In the plan of hospital which I shall recommend, an essential feature of which is that the pavilions shall be totally separated, and therefore cover a larger space than is usual, it is a question as to whether it will be advantageous or possible to centralize the heating apparatus, especially if hot water is used, so that the supply may all come from one or two boilers, or whether it will not be better that the heating apparatus shall be divided into several sections, even to the extent of giving one to each building.

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* [For these tables I am indebted to the courtesy of the Chief Signal Officer of the Army.]

The use of open fireplaces in hospitals has been strongly recommended as being a very effectual means of providing for the exit of air, as giving a cheerful appearance to the room, and because the direct radiant heat which they afford is specially agreeable, since it does not raise the temperature of the air directly, and it is better that the heating beyond a temperature of about 45° F. of the air inspired should be effected in the lungs. When cool air is breathed transpiration from the lungs goes on rapidly, thus favoring the removal of effete organic matter, for air breathed at 45° F. and expired at 95° F. will take up 50% more vapor than air inhaled at 60° F., if the previous relative saturation is the same.

If, however, the moisture in the air at 60° F. is not increased over that at 45° F. it will take up the same amount of watery vapor in rising to 95° F. through the action of respiration, but with this important difference, that the moisture in the former case will be largely derived from the lining membranes of the nose, mouth, and windpipe, while in the latter it will be taken from the smaller cells of the lungs, and with it certain organic matters and products of their decomposition which if not removed will produce discomfort, and if in excess, disease.

The objections to fireplaces are that they waste fuel, increase labor, cause noise and dust, and are somewhat dangerous. There is also always a liability that smoke and irritating gases will be driven in the room in certain conditions of the wind. The greatest objection is that a large room like a hospital ward cannot be heated satisfactorily by fireplaces alone when the outside temperature is near the freezing point, and any attempt to supplement their action by warming the fresh air supply in any way, destroys at once their special advantage and reduces them to ventilating shafts.

The usual intention in placing them in the wards of permanent hospitals, is that the general temperature of the ward shall be kept low to suit the febrile cases, while the convalescents and those who require special warmth can gather around the fireplaces.

As for reasons already given it is proposed to separate the febrile from the non-febrile cases, this reason for the use of fireplaces has no special weight.

The action of a fireplace in a corner of a ward as a means of exit for foul air, which is the only advantage it has worth con-

sidering, can be as well obtained if a coil of hot water or steam-pipes be substituted for the open fire, and this in my opinion would be much more satisfactory. As ventilating shafts give better results in the centre of the room than in the corners, partly because the air-currents to them do not cross patients' beds, and partly because the air in the shaft is kept at a higher temperature, I should prefer to have them in the centre.

In the smaller rooms intended for one or two beds, fireplaces may be used to much greater advantage, and especially in the room intended for febrile cases.

We have next to consider the difficult question of ventilation.

In the letter requesting the preparation of this paper it is stated that "The various methods of heating, combined with venti-"lation, form professional problems about which the most ex-"perienced and best informed medical minds seem to be far "from being united."

The truth of this statement is unquestionable, and it is due in part to the fact that while the knowledge of what it is desirable to effect in heating and ventilation may be possessed by the physician, he has usually no practical knowledge as to the means of doing it, and in part to the fact that an attempt is almost always made to combine three things which are incompatible, namely: satisfactory heating, ventilation, and economy. We can obtain without much difficulty any two of them, but I have not yet seen any plan which combines the three, if the word economy be understood in its usual sense.

A theoretically perfect ventilation implies that a man shall inhale no air or suspended particle which has previously been in his own body or in those of his companions. If, for instance, each patient were placed in a case open at the ends through which fresh air were drawn from his head to his feet at the rate of about one inch per second, and passed directly into the foul air duct, his ventilation might be said to be perfect, and if these cases were four feet square this would require 4,800 cubic feet of air supply per man per hour. All the usual systems of ventilation aim, not at this theoretical perfection, but at rapidly diluting the foul air.

I have already explained that while this is satisfactory for the gases it is not so for the suspended particles, and therefore have proposed that as far as possible there shall be no source of infec-

tion in the majority of the wards, and therefore no necessity for special and costly appliances for their ventilation.

Much as has been written on the subject of hospital ventilation, and many and diverse as have been the modes of obtaining it, which have been tried, there is singularly little positive information to be obtained as to the relative efficiency and cost of the different methods.

It will be found that those who have written on the subject usually give no positive data, and I have sought in vain in the large hospitals in this country for any precise information as to the amount of air heated and supplied, and as to the cost of effecting it. I can only say that I have never been in any large hospital ward, either in barrack or permanent structures, in which, when the ward was full, there was not a very perceptible and peculiar odor to one coming in from the fresh air—and while this test has, of course, none of the precision which an accurate air analysis would give, it is the only one which has been practically available.

As I have never seen a system of hospital heating and ventilation which was entirely satisfactory, the recommendations which I shall make must be to some extent founded on theory, and as the means of producing the effects desired and the question of cost pertain rather to the architect and engineer than to the physician, I cannot pretend to propose a system which shall be perfect in all respects, and as this Hospital must be considered as an experiment, to a certain extent, I should endeavor to so arrange it that the system first tried need not necessarily be a final one, but should admit of modifications as found necessary by careful, practical trial in the first one or two pavilions erected.

It must be remembered that to ventilate a ward, even in the ordinary sense of the phrase, it is not sufficient to pass into and out of it a large quantity of air. A thorough distribution and mixing up of the air must also be secured.

The mode of ventilation must differ in cold and warm weather. For winter use the methods may be classed as follows: first, introduction of fresh warm air at the bottom and its removal at the top of the room. On this plan, to secure satisfactory distribution, it is necessary that the fresh air should be introduced through numerous apertures at the floor and taken out at the ceiling, in the manner employed by Mr. Reid in the ventilation of

the House of Commons, and by Mr. Winans in his private residence in Baltimore.

This method aims to secure an uninterrupted flow of fresh warm air upwards with sufficient rapidity to remove impurities as fast as produced, and theoretically it is the most perfect system of heating and ventilation, if no regard be paid to cost, since the temperature at the floor is kept at least as high as in the upper part of the room, and since an enormous amount of fresh air can be passed through without perceptible current. The objection to this mode of ventilation is its cost, which would probably be not less than double that by the ordinary methods.

The second mode of ventilation is to introduce the fresh warm air at the top and draw it out at or near the bottom. This is the most economical method, and by proper arrangement of apertures secures a thorough mixing up of the fresh and foul air. The objections to it are that it is a system of dilution rather than of removal, that the upper parts of the room are kept warmer than the floor, and that it is extremely difficult to insure the proper working of the aspirating apparatus in all conditions of wind and weather.

A variation of the second method is to introduce the fresh warm air at the bottom, and also to remove it at the bottom, the apertures of exit and entrance being placed near to or remote from each other. Barker's patent ventilator, in use in the new University Hospital at Philadelphia, works on this principle. During cold weather this plan is satisfactory as to amount of air, though not, I should think, as to distribution. During moderate weather it is not satisfactory for hospital use. Better distribution and stronger aspiration would be obtained by carrying the tube for fresh warm air up inside the foul air flue, to the top of the room, and there making the opening into the room.

This second plan is the one ordinarily used, and the main point to be attended to in it is the mode of aspiration to be employed. This may be effected by fireplaces in the corners or centres of the ward, by flues passing upwards, or by flues passing downwards to a larger flue which is connected with an aspirating or ventilating chimney which may be warmed either by the waste heat from the boilers and furnaces connected with the administration, or may have a separate fire for that purpose. The placing of upward ventilating flues in outer walls does not, so far as

my experience goes, give satisfactory results in very cold weather, and they will vary in action with the direction and force of the wind. Other objections to them in point of view of construction, are given by General Morin, and will be familiar to the Architect. To rely entirely upon fireplaces placed in the corners of the ward as means of ventilation, will not, I think, be satisfactory, and so far as regards ventilation, I should prefer to have them in the centre and to use heating coils instead of open fire. But if a satisfactory aspirating shaft can be constructed which will take the air from the sides and corners of the room near or through the floor directly downwards to a horizontal duct beneath the ward, and thence to an aspirating chimney, I should prefer it to any other mode of effecting ventilation on the second plan.

Whatever be the plan adopted for heating and ventilating in cold weather, if a satisfactory temperature and amount of air supply be attained it must be at a comparatively large expense, and the amount of fuel consumed will appear excessive. This is a universal complaint as regards hospitals, and the surprise and disapproval which are usually expressed by those who have to pay the bills are due to the fact that they compare the cost with that for heating other buildings of about the same size.

In this Hospital, when completed, the fuel consumed must not only heat the buildings, but must do mechanical work to the extent of lifting more than one ton weight of air per minute, to a height of from 50 to 100 feet.*

So long as proper ventilation is secured, no matter by what means nor what form of heating apparatus is employed, it will take between two and three times as much fuel to keep the wards comfortable in cold weather, as would be required for the same rooms furnished with only the ordinary amount of window space and used for ordinary purposes.

To secure proper ventilation of a ward in warm weather, by what is called the natural system of ventilation, it is desirable that the ceiling shall not be flat, and it is owing to the fact that an arched or peaked ceiling can be so much more readily obtained

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* A cubic foot of air at temp. 60° and 30' Bar. weighs about 532 grains if perfectly dry, and 528.6 grains if saturated with moisture. In the first case, 13,157.9 cubic feet will weigh about 1,000 lbs., and in the second, 13,242.5; or as a mean result, one pound of air measures 13.2 cft., and a ton of 2,000 lbs., 26,400 cft.

in a room which has not another over it that is due the superiority of one-story over two-story buildings for hospital wards during warm weather. On the other hand, rooms with high or peaked ceilings are much more difficult to heat, and in our one-story barrack hospitals with ridge ventilation, it was found necessary to take extra precautions to close all apertures, in order to keep them moderately comfortable, with the outside temperature at or below the freezing point.

Natural ventilation, as I have said, cannot be relied upon in warm, still weather. The use of a fan under such circumstances will be found to give powerful assistance, and admits of cooling the insufflated air to a certain extent. It is also a valuable means of regulating and controlling the supply of fresh air and of supplementing defective action of the aspirating flues in certain conditions of the weather; and I recommend its employment in this Hospital. The maximum amount of air to be supplied may be estimated for the ordinary wards at one cubic foot per man per second. The fan should have a capacity of about 600 feet per second. It will be seen that the selection of the mode of heating and ventilation is largely a question of money. For instance, the increased cost of the first over the second method of ventilation above described, if applied to all the wards of this Hospital, may roughly be estimated at $10,000 per annum, and as it seems to me that this amount of money can do better service in other ways, I recommend the employment of the second method, except for a few of the smaller wards, or perhaps for one pavilion, for purposes of comparison and experiment.

The sizes of the ventilating flues and chimneys required may be readily calculated by the formulæ given by General Morin in his "Études sur la ventilation," and his "Manuel du chauffage et de la ventilation," using his maximum air supply of 100 cubic metres per hour. If one large central aspirating chimney is to be employed, it must be about 8 feet in diameter at the top, and not less than 130 feet high. An aspirating chimney for one pavilion must have a flue of not less than 8 square feet area.

I think that the most satisfactory results will be obtained by giving to each pavilion its own heating and ventilating apparatus.

VI. BUILDINGS.

I give in Figures 1 and 2 (Plate I.), floor plans of such a pavilion as I would recommend:

Plan No. 1 is intended for a two-story pavilion, and an essential feature of it is that the two floors are entirely cut off from each other, as the stairs, dumb-waiter, and lift open only to the outer air.

If the pavilion has its own heating and ventilating apparatus the main flue would come between the dining-room and kitchen, and should have about 8 square feet area, with extra grate surface below.

Plan No. 2 is the same applied to a one-story pavilion, and also shows a variation in the number of windows. I do not think it desirable to have one window to every bed in two-story buildings, as it increases the difficulty of heating and ventilation in cold weather, without giving corresponding benefit.

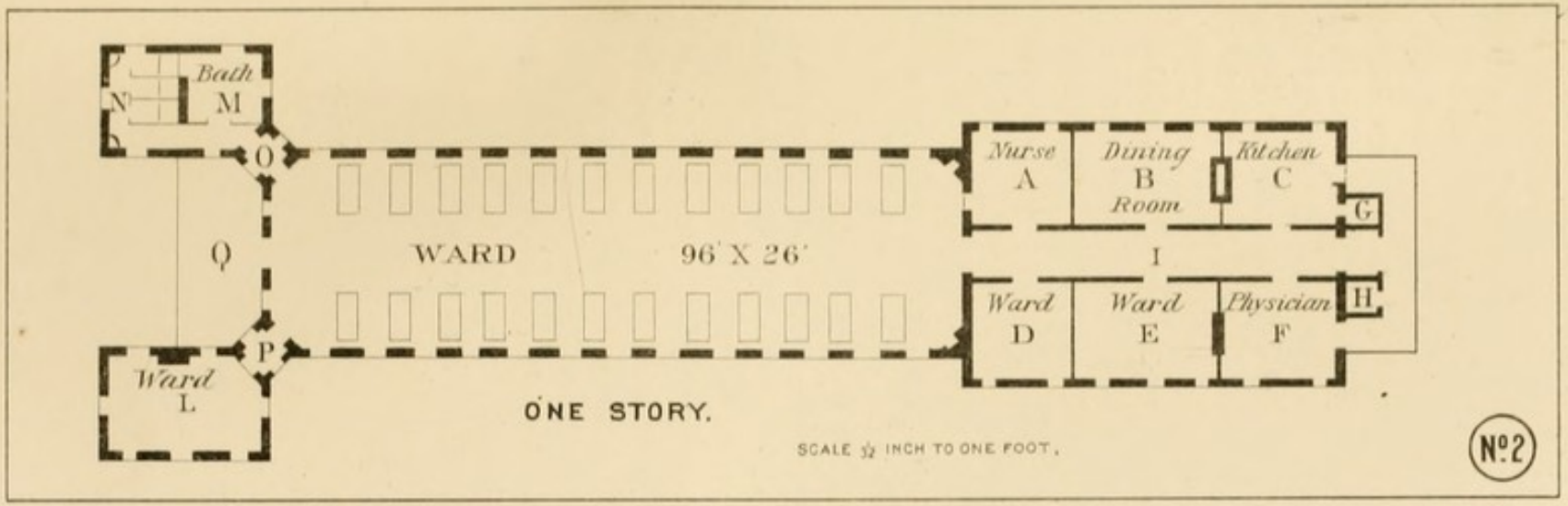
There are no dust flues or clothes shoots in the pavilion. I would have galvanized iron boxes with tight-fitting covers to be moved about the ward on cars with large, rubber-tired wheels. When bedding is to be removed, one of these boxes should be taken to the bed, the clothing placed in it, the cover fastened, and the box wheeled off to be sent down the lift to the basement, and thence on another car to the centre building, where its contents can be treated as may be desirable.

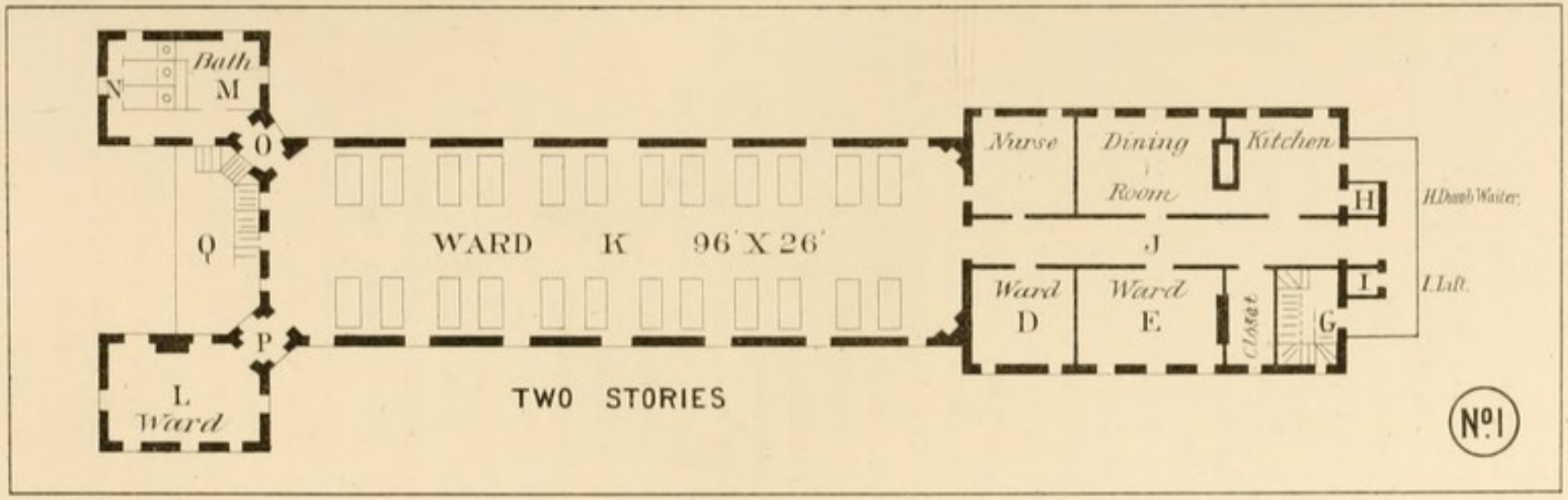
The small wards D and E are for patients who may require separate rooms, not on account of acute or dangerous disease, but because of nervousness or irritability, weak eyes, etc., etc. When not occupied, and in certain wards, D would be used by the physician as an examining-room, etc.

L is a ward for acute, febrile, and doubtful cases, in which special modifications of light and temperature are desirable. No case of contagious disease is to be admitted to any part of these pavilions, and if any case appear it is to be promptly removed, with bed and bedding. If a second case appear soon after the first, the ward is to be emptied and disinfected.

The plan given is not intended to apply literally to all the pavilions, but only to give a general outline of arrangement.

I have placed the width of the main ward at 26 feet. If it be made wider, up to 30 feet, it will be better, but the length must not be diminished.





No. 1.
SKETCH PLANS OF PAVILIONS
PROPOSED FOR THE
JOHNS HOPKINS HOSPITAL
BY DR. J. S. BILLINGS U.S.A.

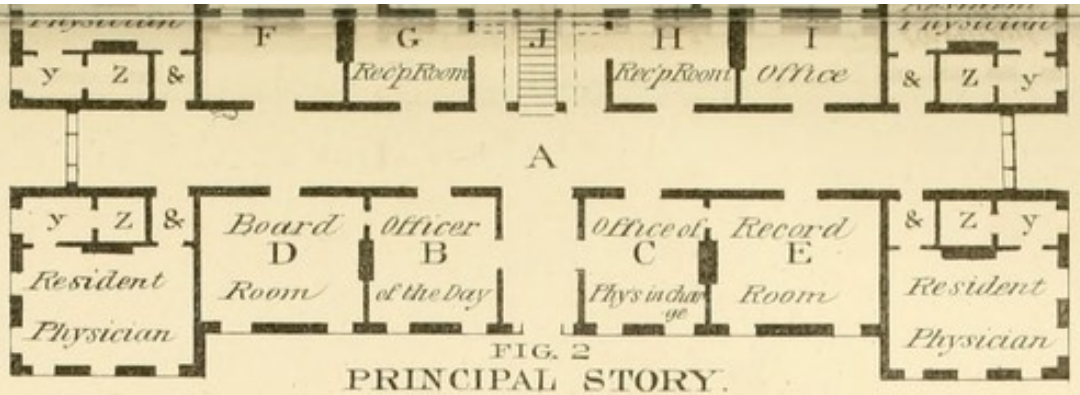


FIG. 2
PRINCIPAL STORY.

No. 2.
SKETCH PLAN FOR
MAIN ADMINISTRATION BUILDING
FOR JOHNS HOPKINS HOSPITAL
BY DR J. S. BILLINGS U. S. A.

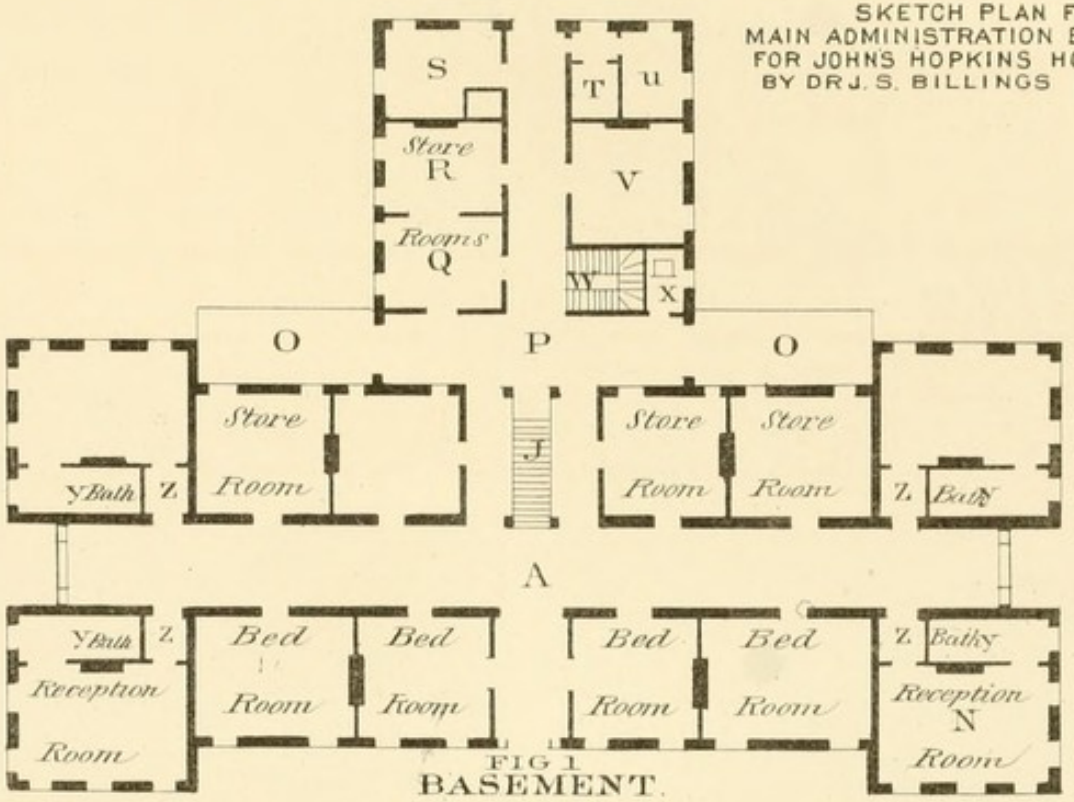


FIG 1
BASEMENT.

ADMINISTRATION BUILDING.

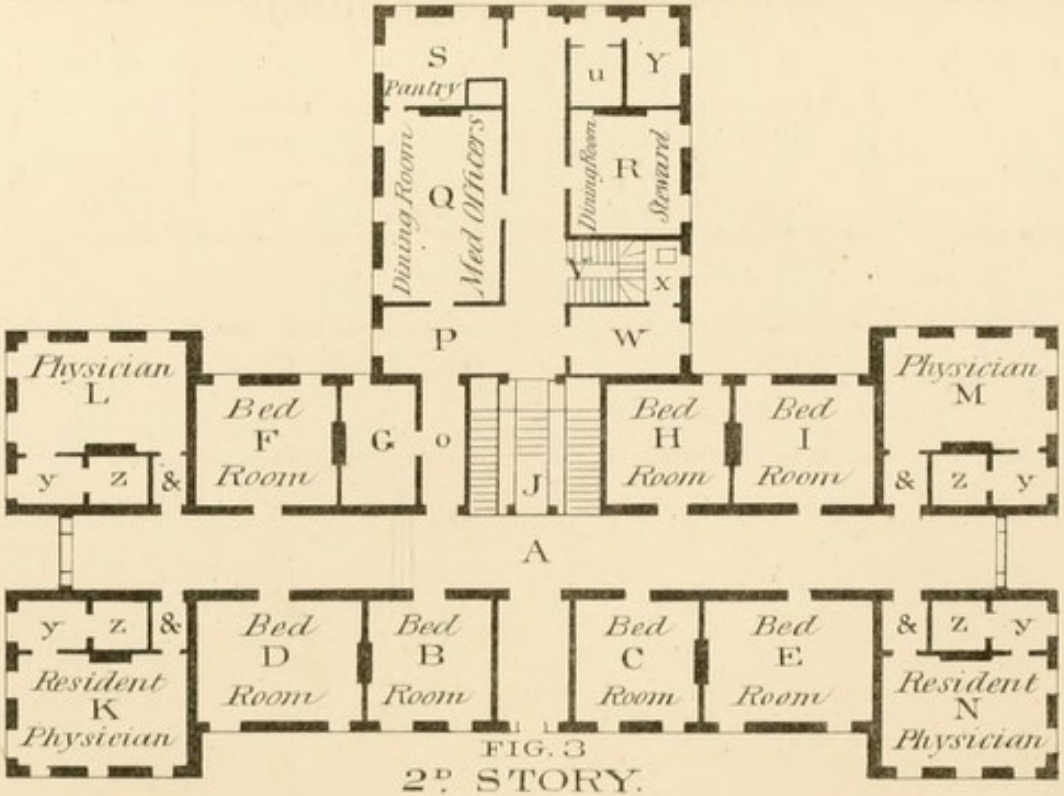
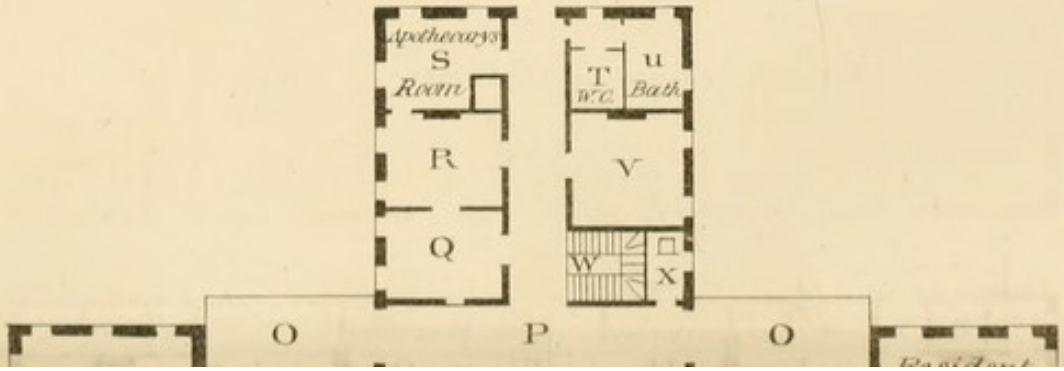


FIG. 3
2D. STORY.



In the plan each patient has a little over 100 feet of floor space, and each bed has about 8 feet wall space. This last must not be diminished, so that if the ward is made 28 feet wide each bed must have 112 feet floor space.

In some of the pavilions it will probably be desirable to have the main ward shorter, *i.e.*, for 18 or 20 patients, and the isolation wards increased.

The one-story pavilion for surgical cases should be larger, for each patient should have 10 feet of wall space.

These pavilions are to have basements about 9 feet high, entirely above ground, and floored with asphalt, which are to contain nothing but heating and ventilating apparatus, and are to communicate with the central building by a closed corridor 10 feet wide. The top of this corridor may be an open corridor leading to the ward floor.

It is to be noted that with the pavilion thus elevated, and by the use of iron gates, etc., a very considerable amount of control is given over the movements of patients, and of visitors to them. The corridors leading to the central building divide the grounds, while, being entirely below the level of any ward, they do not interfere with ventilation.

The question as to the relative advantages of one and two-story pavilions is totally distinct from that of permanence, and no authoritative answer can be given as to the advantages of one-story structures, for the reason that there are no trustworthy observations as to their relative healthfulness.

The arguments in favor of one-story pavilions are sufficiently well known and are well summed up by Dr. Geo. Derby in a paper on Hospitals, in the Fifth Annual Report of the State Board of Health of Massachusetts for 1874, the main reason being that it is easier to secure good ventilation in them.

Although the most satisfactory wards which I have seen practically tested have been in one-story barrack structures, I must say that I have not found any reliable evidence as to the unhealthfulness of two-story buildings, on account of their height, even as usually constructed, and I have never seen a two-story pavilion, or a plan of one, in which the upper story was entirely cut off from the lower, which can be easily effected, and removes one of the greatest objections to this plan.

With the limitations of classification of patients which should

be made, I do not think that the employment of two-story pavilions to contain about 75 per cent. of the patients would produce any difference in results so far as healthfulness is concerned, while in economy of construction and management, and in the control of patients which they afford, two-story pavilions present advantages which should not be overlooked.

It must be remembered that, in an institution of this kind, we have to provide not only for the care of the sick, but to some extent for the restraint of the vicious.

Much of the disease which will be treated in this Hospital will be due directly or indirectly to Alcohol and Venery, and it is desirable to prevent patients with depraved appetites from perpetuating or renewing their maladies by recourse to the original cause.

It is also very desirable to make the wards inaccessible to visitors and to patients and attendants from other wards who have not proper authority to enter them. This is much easier to effect in two-story buildings than in those of one, which last would occupy nearly the whole ground.

I advise, therefore, although not without hesitation, that a part of the pavilions be constructed of two stories, but the decision of the question must turn upon the manner in which the buildings are to be arranged with reference to each other, which will be considered hereafter.

I doubt very much the advisability of attempting to make the walls and ceilings of the wards impermeable, by the use of cement, silicates, paint, or paraffine. The amount of transpiration which goes on through an ordinary brick and plastered wall is very considerable, and to make it impermeable is somewhat like varnishing a man's skin to keep his underclothing from being soiled.

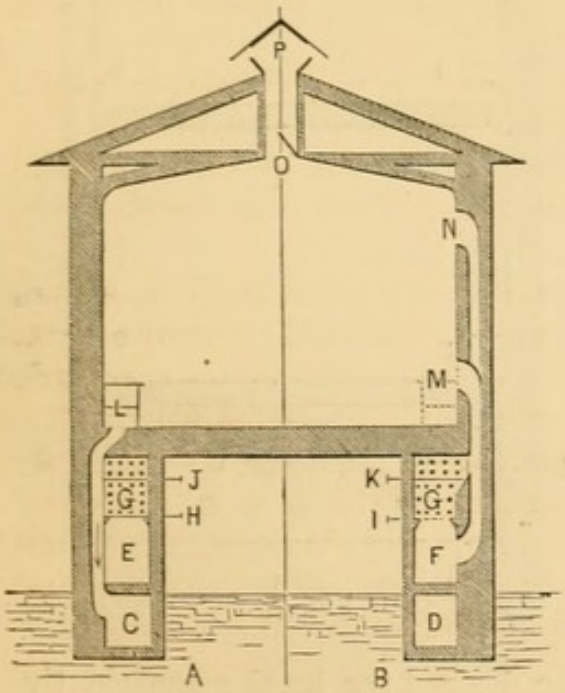
While not prepared to speak positively on this subject until the results of the two processes can be compared, which will be done in a hospital now in process of construction near this city, I should prefer a good ordinary hard finish, with the space between the plaster and the wall, or in the hollow wall, so constructed that it can be filled with a disinfecting gas such as chlorine or sulphurous acid, when desirable, as suggested by Dr. Stephen Smith, bearing in mind that moisture must precede the application of the gas; and to rely upon this, periodical scrapings and whitewashings, leaving the room empty occasionally, etc. One soiled blouse of an attendant, or stuffed chair, or baize screen, is

more dangerous as a source of infection than many square feet of plastered wall. All corners in all wards should be made segments of circles instead of right angles.

All gaslights in the wards, water-closets, and bath-rooms should contribute to the ventilation, the products of combustion passing off through tubes connected with the foul air ducts.

Doors should be as plain as possible. Those in the new ward of the Presbyterian Hospital in Philadelphia are the most satisfactory I have ever seen. The window-sills should be of slate or marble, and the windows should be in three parts, with square tops, and be glazed with plate glass. The woodwork of the pavilions should be picked hard pine, all joints, including floors, to be put together with white lead saturated with oil and resin, but not painted or varnished.

The general plan of heating and ventilation recommended is shown in Fig. 1.



A. Side, showing ventilation.
B. " " heating.
M, N. Fresh air register.
O, P. Ridge ventilation.
I, K. Valves.
L. Foul air closet.
C, D. Foul air ducts.
E, F. Fresh air ducts.
G. Heating coils.

FIG. 1.

An arrangement for a two-story pavilion is shown in Fig. 2.

What are called foul air closets in the above will be better understood by reference to Fig. 3.

The upper compartment B, is to be used to contain a spit-cup or other thing which might be offensive, but which it is desirable to keep near the patient. These closets should be made of iron,

be movable, and be passed through the disinfecting process about once a month.

During cold weather the fresh air passes from the fresh air duct upwards over the heating coils and thence through large flues into the ward. These flues should extend to within one foot of the top of the room, and should have two openings, one just above the floor, the other at the top, which openings should have tight-fitting registers.

A. Foul air ducts.
B. Fresh air ducts.
C. Fresh air flues outside of coils.
D. Lower register.
E. Upper register.
F, G. Valves.
H. Foul air closet.
I. Foul air duct.
K. Ridge ventilator.
O. Heating coils.

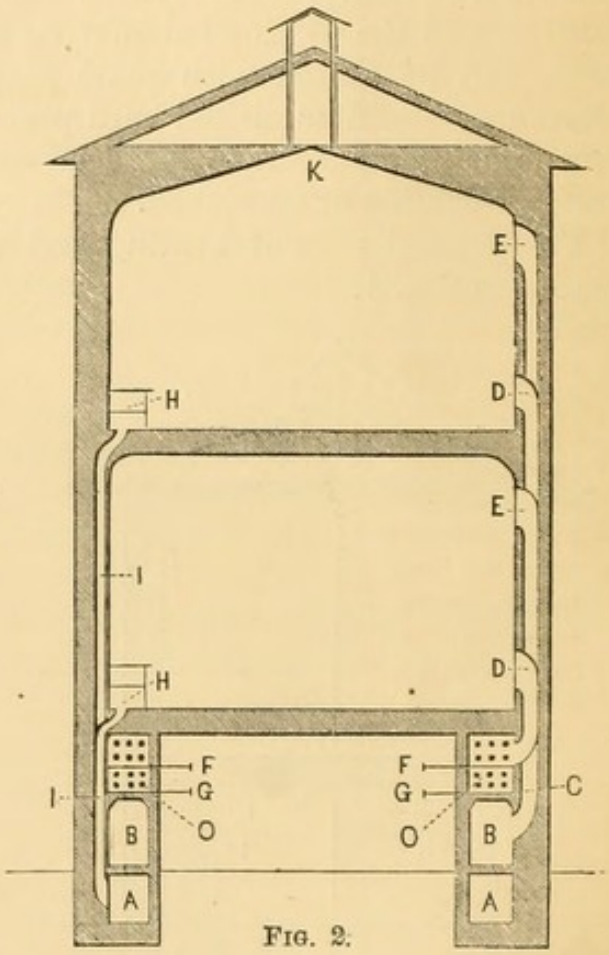


Fig. 2.

During warm weather, or when desired for local purposes, the fresh air is made to pass outside the heating coils. By this arrangement the fresh air can be introduced either above or below, and by the lower registers, through which in cold weather warm or cold air can be obtained at pleasure, and by the use of screens of varnished wood or glass, a very considerable amount of local variation in temperature and amount of moisture of air supply can be obtained for any given bed. The foul air is to be

removed by aspiration downward, either by means of one central aspirating chimney or by smaller ones for each building, which

A, foul air closet, 20 inches high, and about 12 × 18 inches in surface, divided by a shelf into two compartments, B and C, the upper one of which has a door, D. The top, front, door and shelf are perforated registers, through which the foul air is drawn down to the foul air duct, D′.

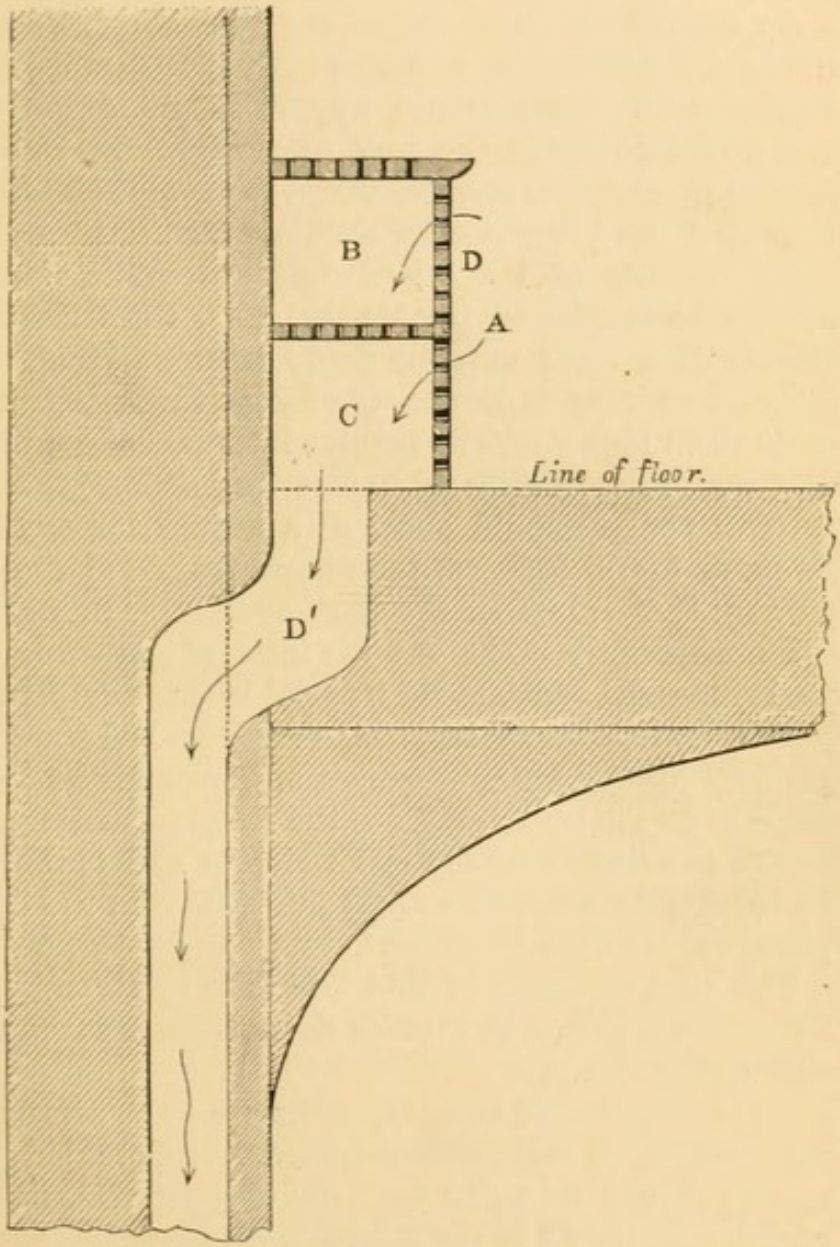


FIG. 3.

last will be the most satisfactory. In warm weather the windows and ridge ventilation are to be used. If a fan is employed, this will be found satisfactory at all times; but if the fan is not available, aspiration will be desirable occasionally, in warm, damp, still weather.

The difficulty which exists in ventilating the lower ward of a

two-story pavilion is seen in the above sketch. This will occur more especially in summer from the flat ceiling and dead air-space at the top of the room, and the only remedy would be to carry shafts from the ceiling of the lower story straight up through the roof. About four of these, each 18 inches in diameter, would be desirable. They would appear as pillars in the upper ward, and would not be in the way or unsightly. If they are used, special precautions must be taken to make their junction with the ceiling of the lower room absolutely air-tight by elastic packing.

By the use of Dr. Sternberg's automatic valves, or by the apparatus employed by Mr. Winans, the temperature and air supply of a ward may be made self-regulating, or if these are allowed to vary it is possible by galvano-electricity to register their variations either at regular intervals or continuously.

It would not be difficult to arrange in the Central Office a series of dials which should show at a glance for any given ward or room, or for all of them, the temperature and the amount of air passing through either the fresh or foul air ducts, or both.

I need hardly point out the interest and value of such an apparatus, and I recommend its trial in one pavilion.

The ventilation of the single and two-bed wards is to be independent by fireplaces in winter, and from the ceiling by air-shafts passing on the inside walls to the ridge in summer.*

The ventilation of the water-closets and bath-rooms is also to be independent by the central flue shown in the floor plan of the pavilion. (Fig. 1.)

The motive-power in this flue is to be given by a stove in the basement, which is to furnish the hot-water supply by means of a circulating boiler.

The water-closets and slop sinks are to be arranged around this flue, and are to ventilate downwards. The majority of the water-closets should be fitted with a Bidet attachment, and this is especially desirable in the female wards.

Over each bath-tub should be placed a shower not over five feet six inches above the bottom of the tub, and this shower should be fitted with both hot and cold water supply. Arrangements for special baths are to be provided in a separate place.

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* It is in these small wards that the experiment of direct upward ventilation can be best tried. It can be arranged in any of them, but most easily in the ward L, where also it would be most advantageous.

Administrative Buildings.

As already indicated, the advantages of dividing the administrative building into three distinct parts appear sufficient to warrant the recommendation of such a mode of construction.

The first building, which may be called the Administration Building, should contain the offices, reception-rooms for patients and visitors, apothecary's establishment, sleeping and dining rooms for medical officers and students, and store-rooms for *new* articles of furniture, bedding, and clothing. The rooms required in such a building are shown in Figures 1, 2, 3 of Plate II.

The plans of this building given are simply rough sketches, intended to indicate in a general way only, the number and relative size of the rooms which will be required.

It will be observed that a large number of bath-rooms are provided. This is done for the purpose of inducing all who have direct communication with the sick or with their bedding, clothing, etc., to bathe frequently, and for this purpose every convenience should be provided. I would remark in this connection, that the usual mode of fitting up a bath tub with a shower bath placed eight or nine feet above the tub is unsatisfactory. The shower should be placed not more than five feet six inches above the bottom of the tub, should be supplied with both hot and cold water, and should be so constructed as to swing aside and be out of the way when not in immediate use.

Taken in connection with the pavilions on each side intended for private patients, this building admits of such variations as the taste and skill of the architect may dictate, as will be more plainly seen by reference to the general plan of the Hospital given hereafter.

As lateral wings to this building are to be placed pavilions containing rooms for private patients and for special cases, which pavilions may be of either one or two stories.

A floor plan of one of these pavilions is shown in Fig. 4.

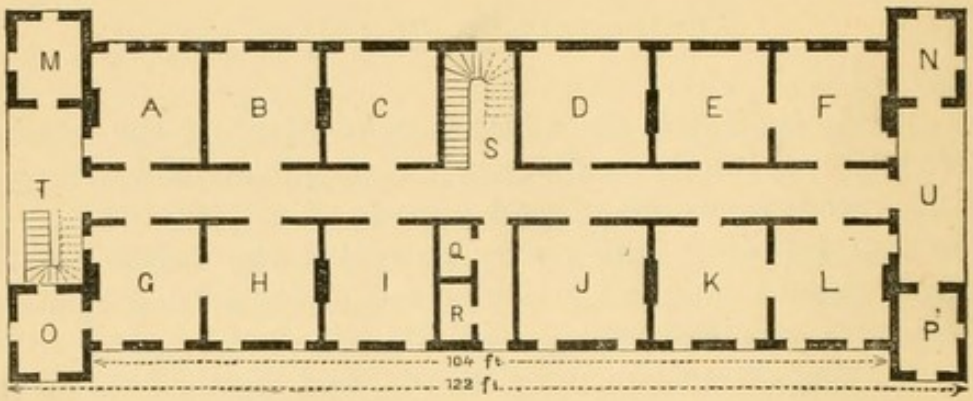


FIG. 4.

E, F. ; K, L.	Sets of two rooms with water-closet and bath-room, N, P, to each.
D, J, C, I, A, B.	Patients' rooms.
H.	Nurses' room.
G.	Dining-room.
O.	Kitchen.
M.	Water-closet and bath-room.

The new isolation ward of the Massachusetts General Hospital is also a good general model for these buildings, and their ventilation, like that of all buildings with a central corridor and inside walls in which flues can be carried and false ceilings placed in the intermediate passage, is easy to arrange for both summer and winter.

The second building required is to be detached from all others, and is to contain the main kitchen, laundry, store-room, etc.

If it is considered desirable to centralize the heating apparatus, and to employ one large central aspirating chimney, these should be placed in connection with this building.

If hot water be used as the heating medium—and I strongly recommend its employment—it will probably be better not to attempt centralizing, either for heating or aspirating, for the reason that it will increase the cost too much.

I give in Figures 1, 2, 3, and 4 (Plate III.) a sketch of the arrangements of such a building, on the supposition that the heating will not be centralized.

No. 3.

SKETCH PLAN OF ARRANGEMENT OF CENTRAL BUILDING FOR KITCHEN, LAUNDRY, ETC. FOR JOHNS HOPKINS HOSPITAL BY DR. J. S. BILLINGS. U.S.A.

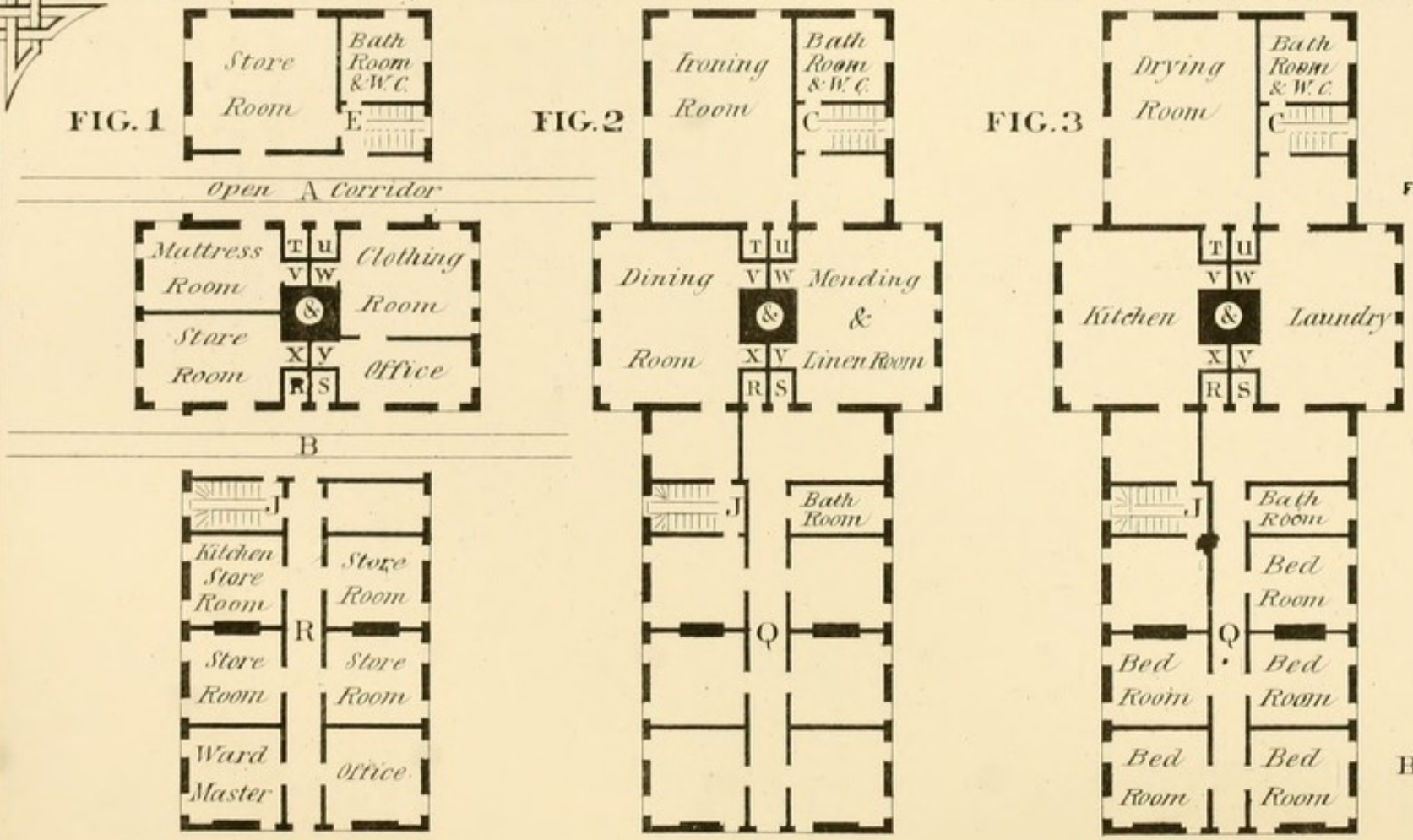
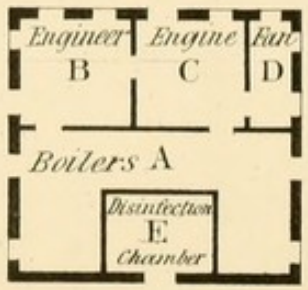


FIG. 10.



BOILER HOUSE &c.

T. Coal Lift.
U. Foul Linen Lift.
R. Dumb Waiter.
S. Clean Linen Lift.
V. W. X. Y. Closets.
&. Central Ventilating Chimney.

PLATE III.

Fig. 4.—*Boiler House*.

A. Boilers.
B. Engineer's room.
C. Engine.
D. Fan.
E. Disinfecting chamber.

The question as to the desirability of placing the kitchen and laundry on the upper floors may here be considered. The usual recommendation is that they should be in detached buildings to prevent the heat and odor from becoming a nuisance.

Where hospitals are in such a limited space that outbuildings are inconvenient, I have recommended that vertical be substituted for horizontal distance. This is especially desirable with regard to the laundry, which is a source of peculiar danger and nuisance in a hospital.

Where steam power is to be employed, the use of lifts is easy, and does away with all inconvenience in placing these rooms above, and by connecting their furnaces with the central chimney we gain powerful aid for ventilation the year round.

An additional recommendation is, that they are thus less readily accessible to patients and visitors.

In this Hospital I recommend that they be placed as I have indicated.

There may be a question as to the advisability of having large central dining-rooms for convalescents and patients able to walk to their meals. The advantage of this plan is that it effects a

saving in labor and to some extent in space, to have the dining-rooms as near the kitchen as possible.

The classes or subdivisions of patients in this Hospital are more numerous than usual, and probably four (4) central dining-rooms would be required if this plan were adopted.

By the use of felt boxes and other well-known contrivances, there is no difficulty in serving the food hot at any distance, and as a certain amount of food must be carried to the wards it takes very little more time and labor to serve the food for all the patients in a dining-room attached to each ward.

There should be no communication from the kitchen and laundry on the same floor.

The ceilings of the kitchen, laundry, and drying-room should slope upwards towards the central chimney into which they are to be ventilated.

One lift for the kitchen is for coal, ashes, and slops, the other is for food; one lift for the laundry is for soiled and the other for clean articles. All these lifts should be ventilated at the top into the main chimney.

The mattress-room is for the hair mattresses and for remaking them, which should be often done.

Thin hair mattresses on others of woven wire will be found most satisfactory.

The clothing and bedding should be stored in slatted racks, detached from the wall, and all these store-rooms should have good ventilation by the central chimney. New clothing and bedding are to be stored in the basement of the administration building.

The building for boilers, engine, and fan is disconnected from this building, is but of one story, and it may be desirable to place it entirely under ground, in order to obtain the proper level. In this building may be placed the disinfecting chamber, which is a most important feature in connection with the hospital, and should be carefully arranged and made much of. It is intended for the application of hot steam, disinfecting gases, and hot, dry air, to articles of bedding, clothing, and furniture, and is to be connected with the flue from the boilers into the main chimney. It should be made as nearly air-tight as possible, and have a cauldron or iron box in it in which a small quantity or a single article of clothing can be disinfected by itself.

In connection with this building large underground coal vaults should be constructed.

The open corridors (A, B, Fig. 1), ten (10) feet wide, are intended to be on a level and have direct communication with the basement corridors leading to the several pavilions, and to admit of the easy access of small hand-cars to the several lifts.

The third building required is to contain the amphitheatre, outdoor dispensing-rooms, dead-house, and pathological laboratory.

I give a sketch plan of an arrangement for this building which, however, admits of much modification, and for which many special fittings and contrivances will be desirable which I shall not attempt to indicate.

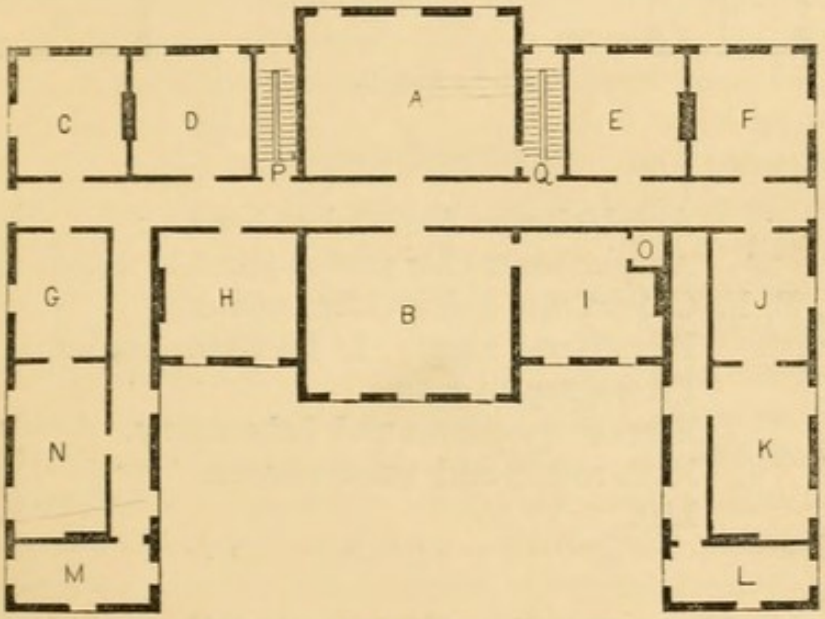


FIG. 5.

First story:

G.	Apothecaries' room.
N.	Laboratory.
M.	Bath-room and water-closet.
J.	Waiting-room.
K.	Dead-room.
O.	Lift.

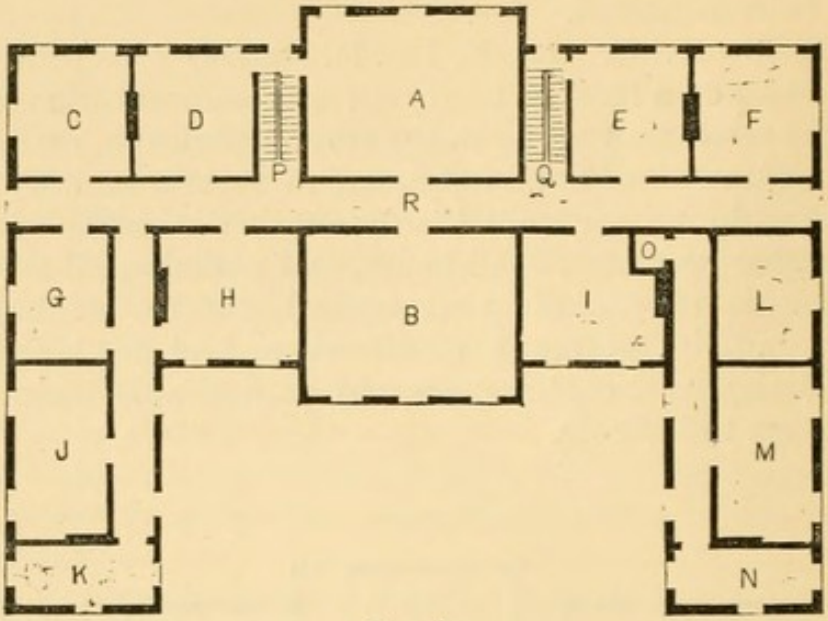


FIG. 6.

Second story:

A.	Amphitheatre for clinical lectures.
B.	Amphitheatre for pathological lectures.
C, D, E, F.	Chloroform and waiting rooms.
H.	Physicians' room. I. Post-mortem room.
L, M.	Photograph-rooms.
G, J.	Microscope-rooms and Laboratory.
K, N.	Bath-rooms and water-closets.
O.	Lift.

When the Hospital is completed to its full capacity, and the Medical School is in successful operation, it will be preferable to have the pathological department in a separate building, but I would recommend the above plan as a temporary one, to serve for the first ten years, at the end of which time experience will have shown just what is required.

With regard to other buildings I recommend that the Physician-in-Charge have a separate house, either on or in the immediate vicinity of the grounds.

The chapel may be either a separate building or be connected with the administration building. I should prefer it separate,

that it should be so arranged as to separate the sexes, and that it be used as a reading-room during the week.

Tanks or cisterns will be desirable to serve as reservoirs in case of any accident to the water supply from the city pipes. I do not recommend that the water from rain-fall should be collected and preserved. The amount of water which will be required by this institution will be about 22,500 gallons per day, and storage for at least 50,000 gallons in underground cisterns would be desirable.

VII. GENERAL PLAN OF HOSPITAL.

Keeping in view what has been stated with regard to the causes of the unhealthfulness of hospitals, I propose to prevent these causes from being present in the greater part of the buildings, and to confine them to certain structures, which may be purified or destroyed when necessary.

This is to be effected by a careful classification of the patients, by a methodical system of isolation, and by destruction of the causes of disease as they occur.

Referring to the closing remarks on the subject of the causes of Hospitalism, it is to be observed that an additional reason for a greater subdivision of patients than is usually employed, is that different patients, and the same patient at various stages of his malady, require very different degrees of heat and light.

A man suffering from acute fever, whether specific, such as typhoid, or due to local lesions, as from injury, cerebral rheumatism, etc., requires a much lower temperature than a case of chronic rheumatism, or diarrhœa, or of simple debility, as in convalescence, and it is difficult to furnish the proper conditions to these two classes of patients, if they are to be placed in the same room, because the apparatus necessary to effect it requires intelligence and constant supervision to produce the results required.

The same is true, though not to so great an extent, with regard to light. In the acute stage of most diseases bright light is unpleasant, and the instinctive desire of the patient is to have it greatly diminished.

Light is a powerful tonic and stimulant agent, with peculiar powers and modes of action, which as yet cannot be said to be

well understood. Nothing can compensate for its absence or insufficient supply in health, in many cases of disease, and in convalescence; but I am satisfied from observation that in many cases of acute disease the glare of a large, white-walled, many-windowed hospital ward does harm very much in the proportion in which it inflicts discomfort.

I therefore propose to separate acute from chronic and convalescent cases, and this being done, the question of mode of construction of wards for the latter class will not present special difficulties.

The first thing to be decided is the size and the number of the wards, bearing in mind that the larger the ward the more difficult it is to secure the isolation and classification of patients, and the smaller the ward the greater is the labor and cost of supervision and attendance.

For each sex of each color it is desirable that there should be at least two wards, viz.: medical and surgical, and children must also be provided for.

I give the following estimate of the proportion of patients in each class to be provided for, based upon the statistics of several institutions of a somewhat similar character in Baltimore and elsewhere.

White, Male, Medical	75
White, Male, Surgical	75
Black, Male, Medical	25
Black, Male, Surgical	25
White, Female, Medical	30
White, Female, Surgical	30
Black, Female, Medical	25
Black, Female, Surgical	25
Children, Male	25
Children, Female	25
Private Patients	40
Total	400

In view of the above figures, 24-bed wards should be the largest to be made use of in this Hospital, and numerous smaller wards will be desirable.

A maximum estimate of the number of acute cases at any one time requiring more or less isolation, is about 25 per cent.—that is, excluding the private patients, about 90 beds, when the Hospital is completed.

As each ward should be emptied in rotation, so that there may always be one vacant with the windows open, undergoing Nature's process of purification, the general distribution of beds may be represented by something like the following scheme:

12	24-bed wards, for chronic and not dangerous cases	288 beds.
2	24-bed wards, accident and surgical, dangerous	48 "
14	2-bed wards, acute cases, not contagious	28 "
14	2-bed wards, for not specially dangerous or acute cases, but for which special temperature, light, etc., is desirable	28 "
20 beds, acute, contagious, and dangerous diseases, in tents		20 "
Private patients, special rooms		16 "
	Total	428 "

The above is a maximum estimate, and under no circumstances are more than 400 beds to be occupied at one time.

The Convalescent Institution to be connected with the Hospital should contain about 100 beds, divided into at least six wards.

On account of the prevailing wind, and to secure equable exposure to light, it is desirable that the long axis of the pavilions should run nearly north and south. It is also desirable that the pavilions should be totally disconnected from each other and from the administration buildings.

If two-story pavilions are used, they should be not less than 100 feet apart; if one-story pavilions are employed, they should be not less than 50 nor more than 75 feet apart.

I furnish herewith ground plans showing an arrangement of the Hospital with two-story and with one-story pavilions. In either case, the pavilions connected with the amphitheatre should be of but one story, and as with the growth of the Medical School it is probable that increased accommodations may be required in this building in future years, I should recommend that

the amphitheatre building and the pavilions connected with it be at first cheaply constructed and temporary in character.

The relative merits of the plans submitted can be appreciated only by reference to the probable cost; either of them can be carried out on the temporary or permanent plan, and either of them will, in my opinion, be satisfactory, so far as the healthfulness of the institution is concerned.

Taking the plan of Plate IV., if the buildings be made of brick, I should estimate the cost as follows:

14 one-story pavilions, brick, at $14,000 each	$196,000
Administration building	60,000
Central building and machinery	90,000
Amphitheatre and one-story pavilions, wood	40,000
Total	386,000

If all the pavilions in this plan were made temporary structures they would cost about $8,000 each, the cost of the other buildings remaining the same. This would make the total cost $302,000.

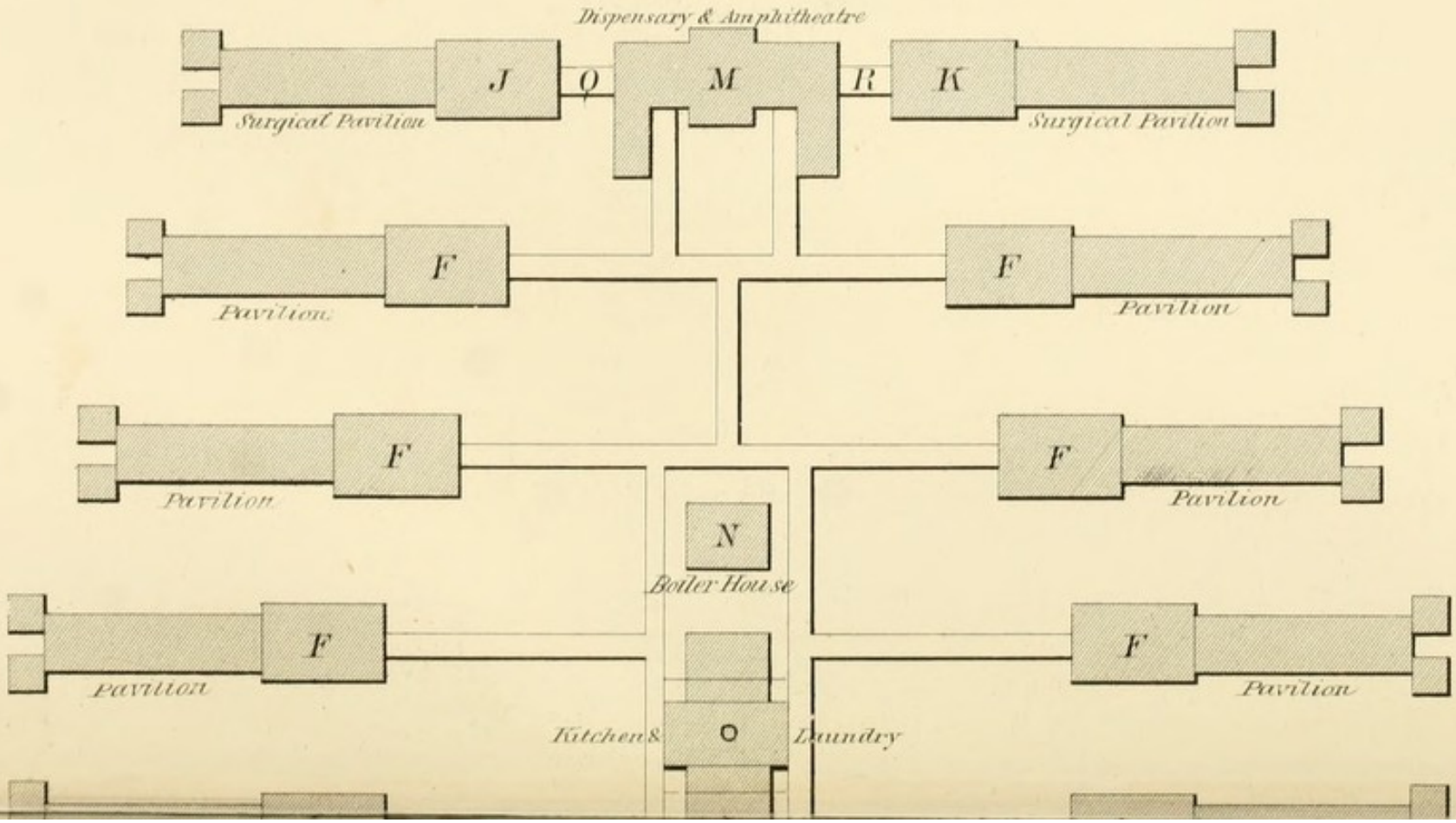
On plan of Plate V., the cost may be estimated as follows:

6 two-story pavilions, brick, $27,000 each	$162,000
Administration building	60,000
Central buildings and machinery	90,000
Amphitheatre and one-story buildings attached	40,000
3 pavilions for private patients, $20,000 each	40,000
Total	392,000

Taking all things into consideration, I should myself prefer the plan given in Plates V. or VI., as I think with proper administration it would give results the same as No. 1, while the cost of management would be not less than $10,000 per annum in its favor.

As the main approach to and view from the Hospital is to the west, the buildings are arranged with reference to that fact, and the architect will see that by breaking the lines of the administration building, either by central or end projections, or both, and repeating the composition in the lateral pavilions attached,

GENERAL HOSPITAL SOC.
LIBRARY
NEW HAVEN, CONN.


Dispensary & Amphitheatre
J
Q
M
R
K
Surgical Pavilion
Surgical Pavilion
F
F
Pavilion
Pavilion
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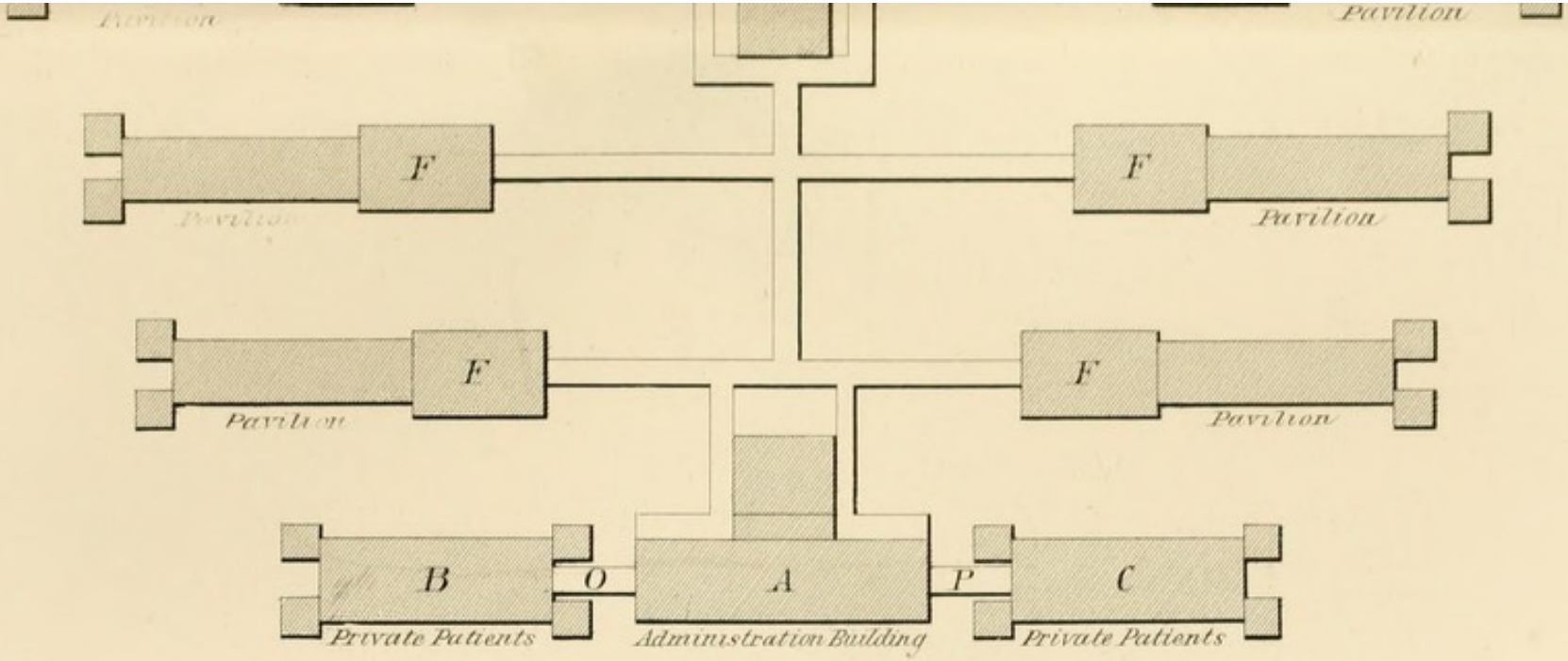
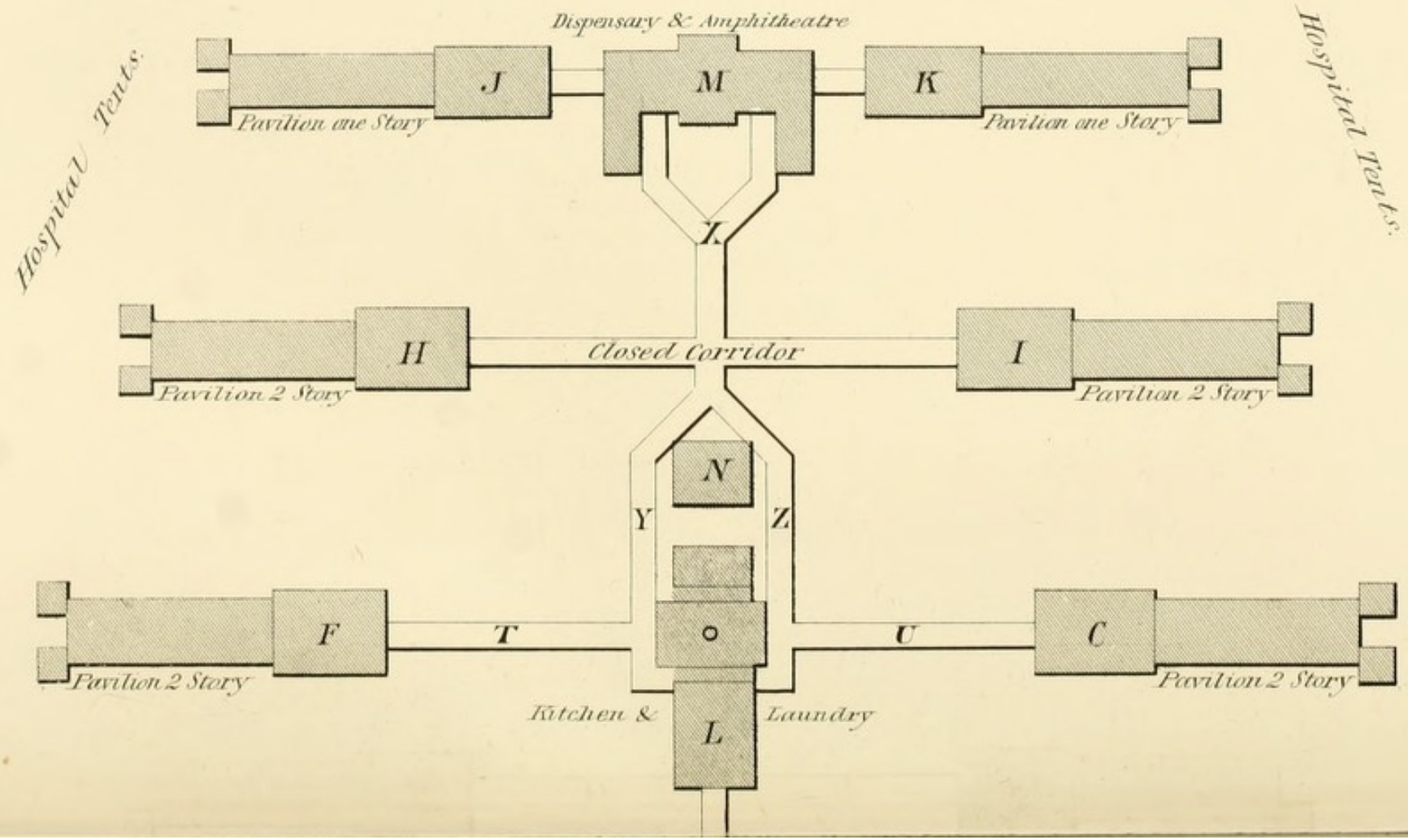
Pavilion
Pavilion
N
Boiler House
F
F
Pavilion
Pavilion
Kitchen &
O
Laundry

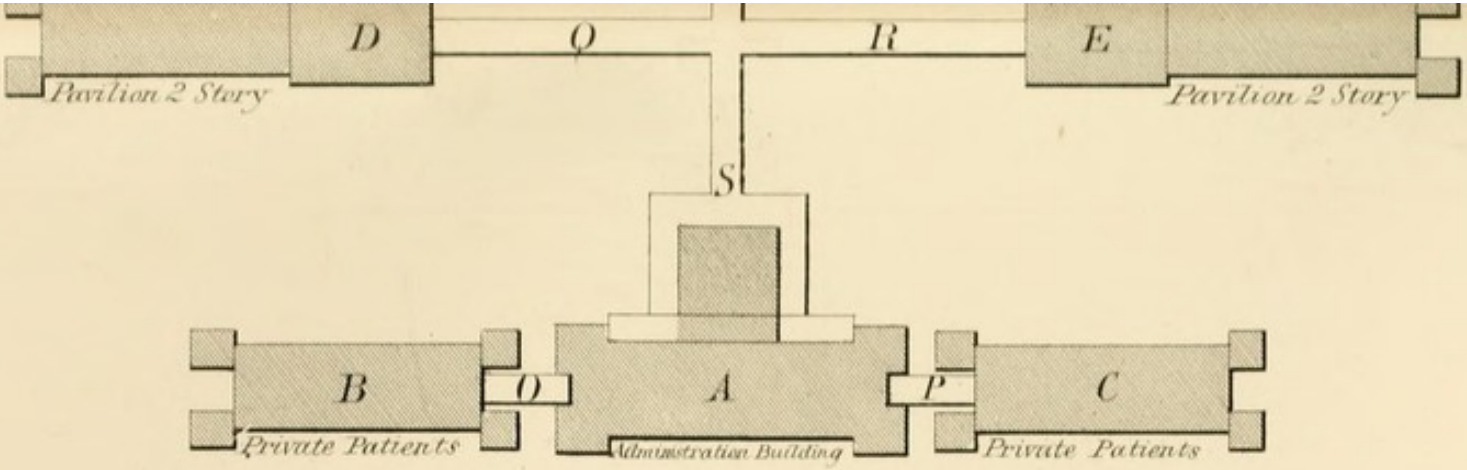


No. 4.

SCALE ONE INCH TO 100 FEET

SKETCH PLAN OF ARRANGEMENT.
FOR JOHNS HOPKINS HOSPITAL,
WITH ONE STORY PAVILIONS, TEMPORARY OR PERMANENT
BY DR. J. S. BILLINGS U.S.A.


Dispensary & Amphitheatre
Hospital Tents.
Hospital Tents.
J
M
K
Pavilion one Story
Pavilion one Story
Z
H
Closed Corridor
I
Pavilion 2 Story
Pavilion 2 Story
N
Y
Z
F
T
U
C
Pavilion 2 Story
Pavilion 2 Story
Kitchen &
Laundry
L



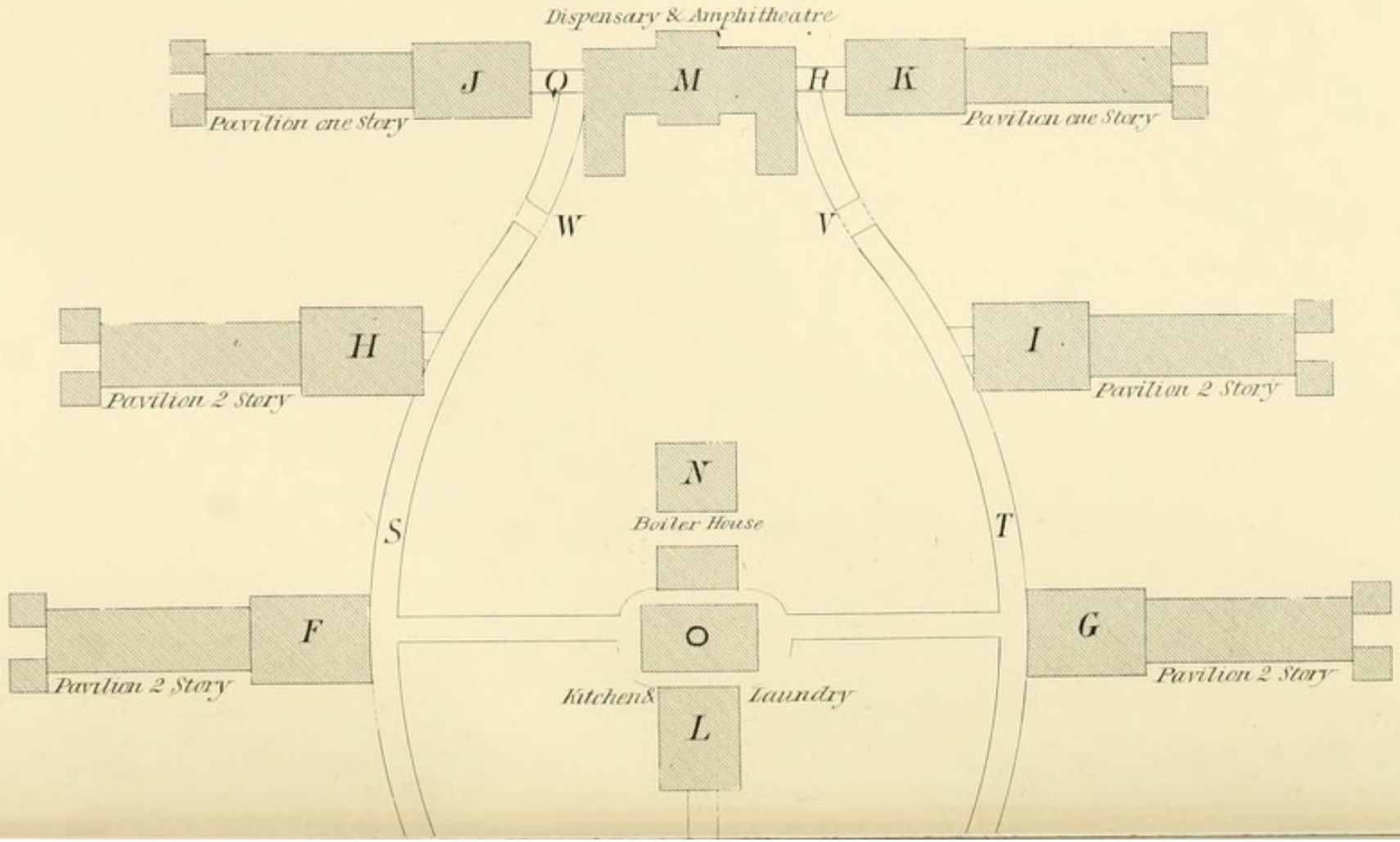
No. 5.

SCALE ONE INCH TO 100 FEET

SKETCH PLAN OF ARRANGEMENT.
FOR JOHNS HOPKINS HOSPITAL,
WITH TWO STORY PAVILIONS,
BY DR. J. S. BILLINGS U.S.A.

a
Residence
of
Physician in charge.

b
Building
for
Female Nurses.


Dispensary & Amphitheatre
J
Q
M
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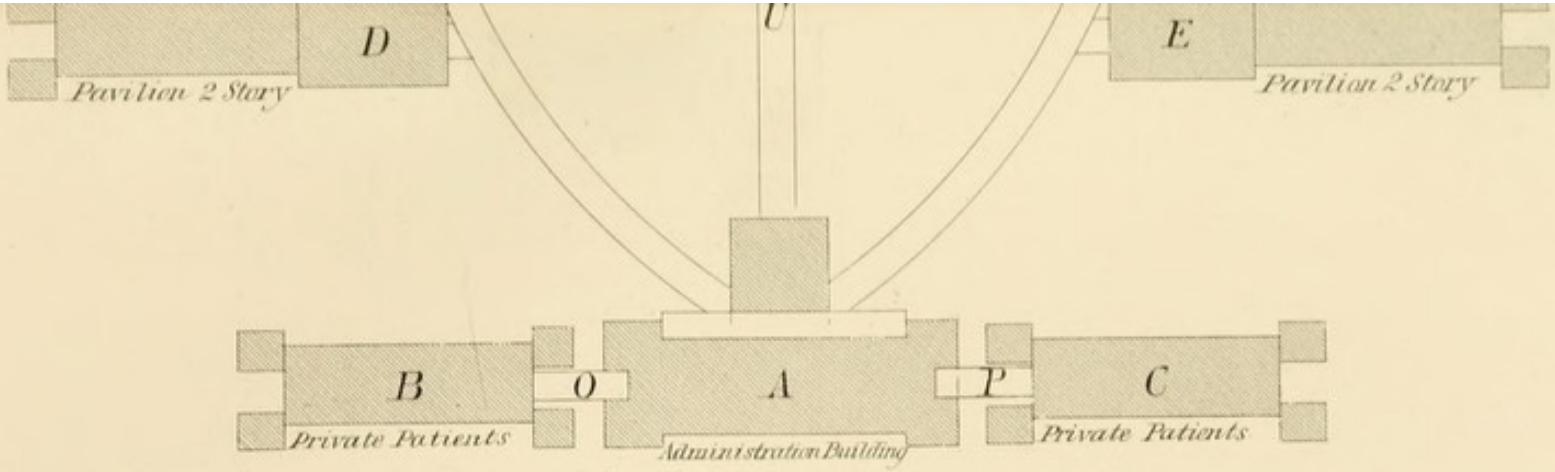
Pavilion one story
Pavilion one Story
W
V
H
I
Pavilion 2 Story
Pavilion 2 Story
N
Boiler House
S
T
F
O
G
Pavilion 2 Story
Pavilion 2 Story
Kitchen &
Laundry
L



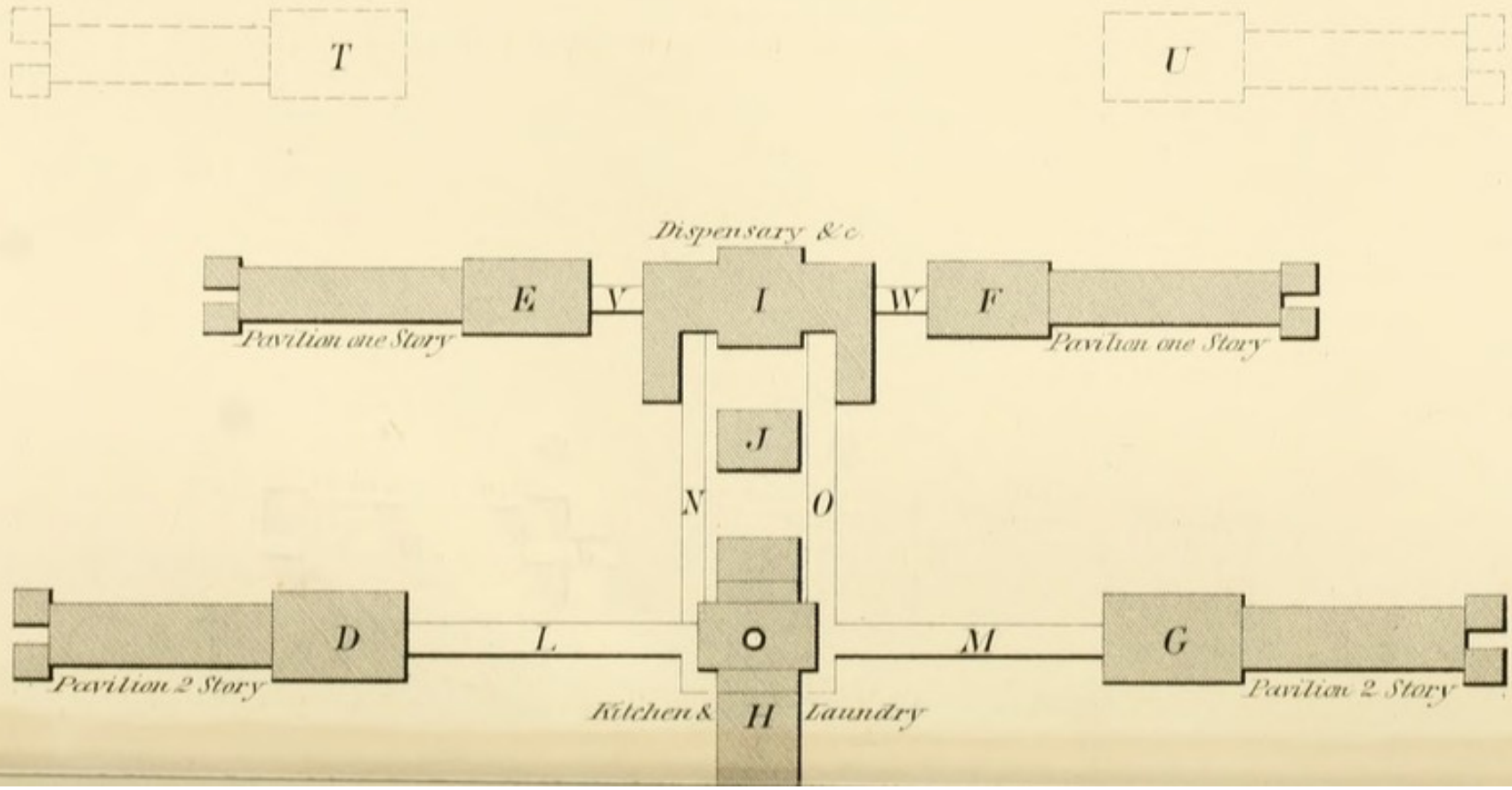
No. 6.

SCALE ONE INCH TO 100 FEET

MODIFICATION OF PLAN SHOWN IN PLATE V.

PROPOSED BY

BY DR. J. S. BILLINGS U.S.A.


T
U
Dispensary &c
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Pavilion one Story
Pavilion one Story
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D
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M
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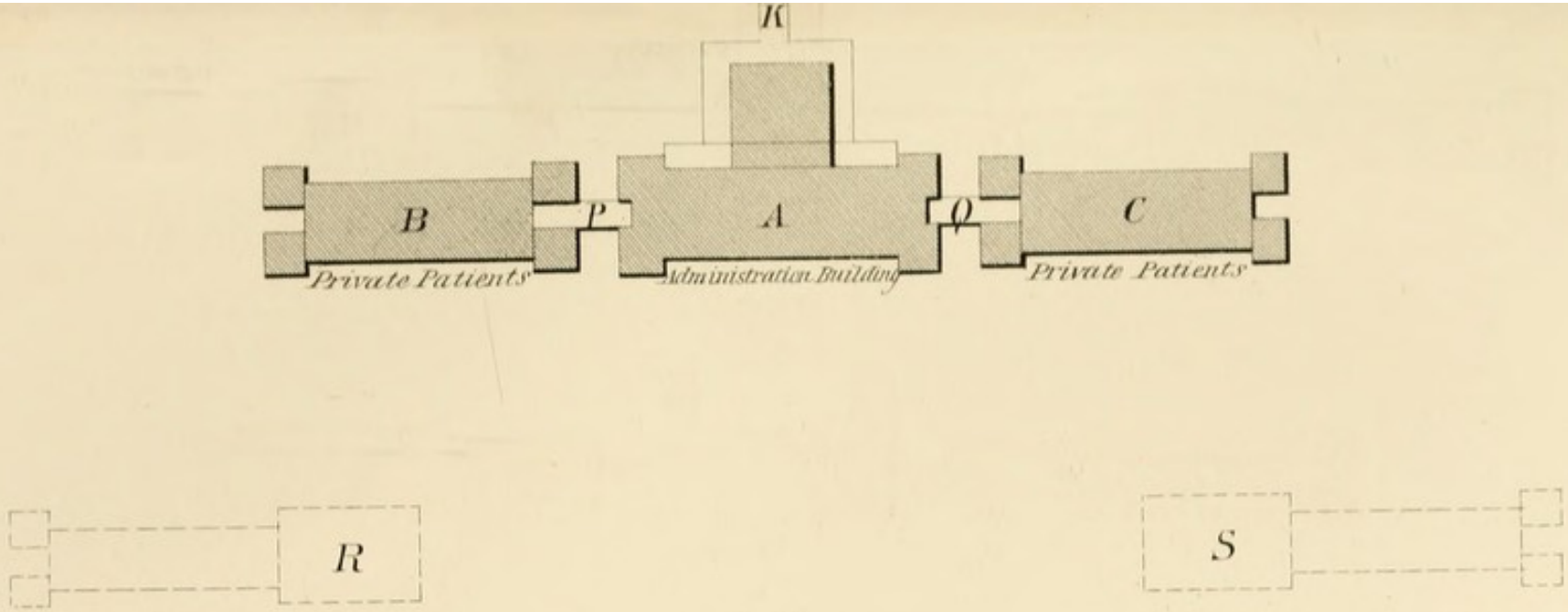
Pavilion 2 Story
Pavilion 2 Story
Kitchen &
H
Laundry



No. 7.

SCALE ONE INCH TO 100 FEET

MODIFICATION OF PLAN SHOWN IN PLATE V.

PROPOSED BY

BY DR. J. S. BILLINGS U.S.A.

the effect, in connection with the end towers of the other pavilions and the tall chimney of the central building, may be made very satisfactory.

At the commencement, any four of the two-story or eight of the one-story pavilions may be omitted.

Plate VII. is a variation of Plate V., which permits of more satisfactory arrangement with reference to constructing but part of the buildings at first.

In a hygienic point of view there is little difference, but in final appearance the plan of Plate V. would probably be preferable.

Whatever may be the plan adopted, I strongly recommend that about 15 hospital tents, United States army pattern, be kept constantly on hand, and made methodical use of as isolation wards. Each of these tents is 14 by 15 feet; height at walls, 4½ feet; in the centre, 11 feet. French floors and heating apparatus for these tents should be kept ready. The heating may be either by stoves, on the plan used in our tent-hospitals during the war, or by a connection with the hot-water apparatus of the nearest pavilion.

Where a tent is vacated it should be thoroughly disinfected, first as it stands, and then again in the disinfecting chamber.

Each tent, as it would be used in this Hospital, would last between two and three years, and would cost, complete, not over $100.

The location chosen for the Hospital is such that there will be no difficulties as to drainage and sewerage.

Care must be taken to ventilate the sewer by one or more shafts passing to a height above the buildings, but these shafts should not be connected with any of the aspirating chimneys.

There are many contrivances and pieces of apparatus which I should wish to see provided for in the plan of this Hospital, such as for the use of compressed and rarefied air, sun baths, electricity in all forms, a bathing-house in which all forms of baths can be administered, etc., etc.; but I have not thought it desirable to describe or provide for them, as their position and arrangement depend so much upon the plan which shall be finally adopted.

So far as I can judge from my own experience and that which is recorded of others, no matter what plan is adopted, when the Hospital is completed and put into practical operation, it will

appear that it can be improved in some particulars, and a certain amount of funds should be reserved for this purpose.

The general principles which I have tried to state in this paper are in accordance with the present condition of our knowledge on the subject, but that knowledge is imperfect, and too much of the teaching of books on the subject of hospital construction is theoretical only.

I have endeavored to point out the effects which it is desirable to produce, but the means of obtaining these effects, so far as the construction of buildings and the apparatus for heating, etc., is concerned, come more within the scope of the studies of the Architect and Engineer than of the Physician, and I do not doubt but that there are better ways of planning both the individual buildings and their combination into one general plan than those I have indicated.

I sincerely hope, that whatever plan may be adopted will prove by its practical results that a hospital can be built and managed in such a way as not to produce any of the evils which are usually attributed to such institutions, and which have brought them into disrepute.

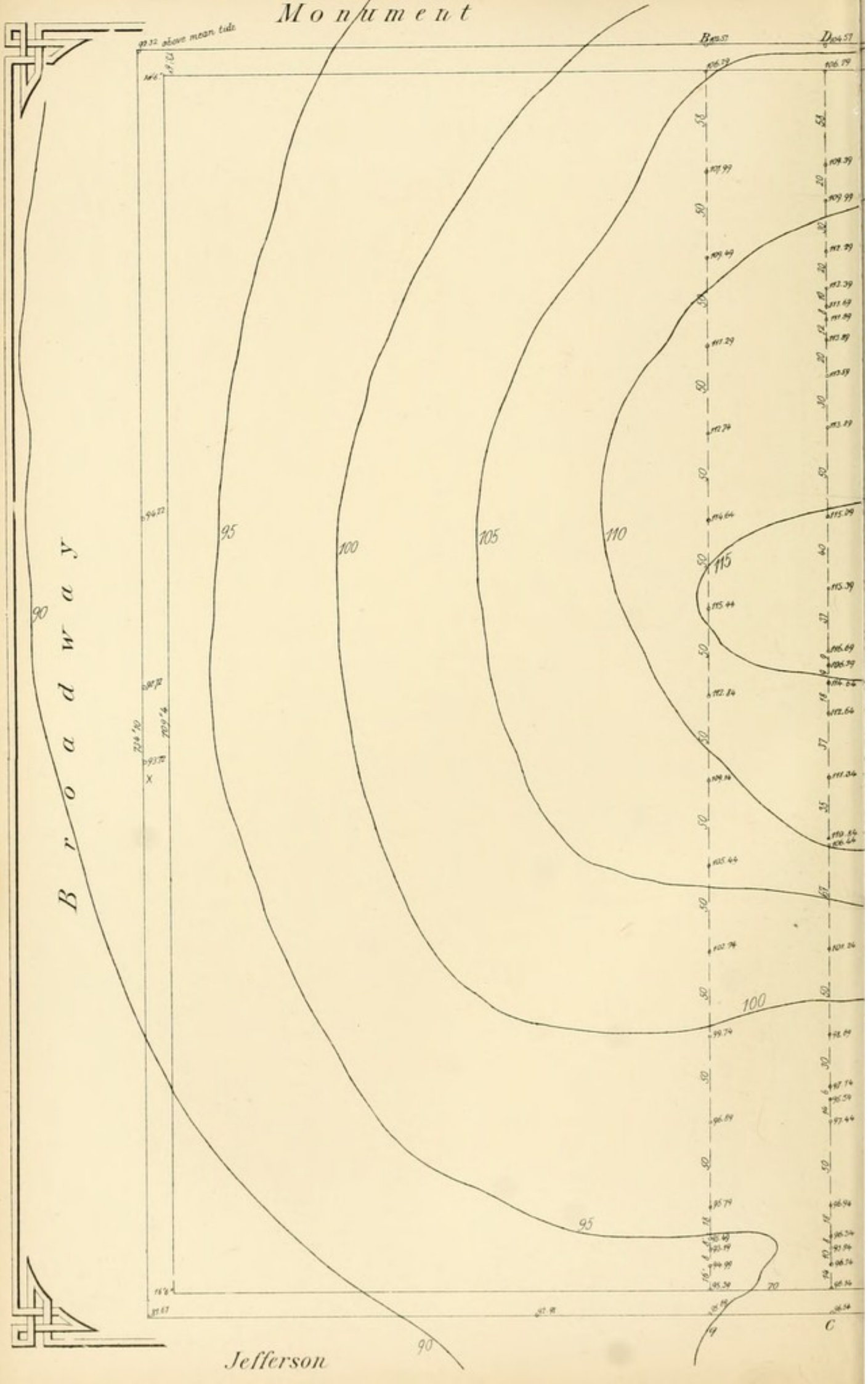
Meteorological Record of the Weather at Baltimore, Maryland, for 1871, 1872, 1873, *and* 1874.

	Temperature.													
	Mean Monthly.				Highest and Lowest.									
	1871.	1872.	1873.	1874.	1871.		1872.		1873.		1874.	
January.....	36.1	35.0	34.0	39.1	64°	11°	56°	11°	58°	–4°	69°	13°
February.....	40.8	36.0	35.5	37.3	67	8	61	14	62	2	78	15
March.....	49.7	37.0	40.3	43.7	71	29	65	9	68	5	72	23
April.....	58.9	56.0	51.9	46.9	85	40	88	38	75	38	68	27
May.....	66.0	68.0	62.3	63.1	92	47	89	48	89	44	89	41
June.....	74.7	75.2	73.9	75.9	93	59	94	58	95	49	97.5	54
July	75.3	81.2	79.4	77.3	93	60	97	68	96.5	62	95.5	62.5
August.....	77.7	79.3	76.3	72.8	92	63	96	62	94	57	97	52
September...	63.7	69.5	68.0	69.9	83	45	94	50	93	40	90	53
October.....	59.0	58.3	54.8	56.6	78	40	80	38	73.5	30	78	35
November....	45.0	43.6	41.0	45.3	69	28	63.5	17	64	22	71	24
December....	33.0	32.2	40.4	39.0	53	5	55	8.5	66.5	22.5	67	21
Yearly Mean..	56.6	55.9	54.8	55.5	78.3	36.2	78.2	35.1	77.8	30.6	81	35

	Moisture, Mean Monthly.				Wind, Mean Direction.			
	1871.	1872.	1873.	1874.	1871.	1872.	1873.	1874.
January	65.6	62.8	65.5	72.9	N.E.	N.W.	N.W.	W.
February	66.6	60.3	61.1	71.3	N.E.	N.W.	N.W.	N.W.
March	82.4	58.6	55.6	67.2	S.E.	N.W.	N.W.	N.W.
April	65.3	47.4	57.3	66.5	W.	W.	N.	N.E.
May	65.9	51.5	65.5	59.7	N.E.	N.W.	E.	S.E.
June	69.0	61.3	64.8	64.8	S.W.	S.W.	S.	S.E.
July	66.1	62.6	62 9	64.5	N.W.	S.W.	W.	S.W.
August	72.6	66.1	78.5	61.4	S.E.	S.W.	N.E.	N.
September	67.8	66.6	76.8	72.1	N.	N.	N.	E.S.E.
October	68.8	62.5	75.1	65.4	N.W.	N.W.	N.W.	N.W.
November	66.7	57.0	70.6	63.5	N.W.	N.W.	W.	N.W.
December	65.0	58.4	71.6	63.6	S.W.	W.	N.W.	N.W.
Yearly Mean	69.3	59.6	67.1	66.1	N.W.	N.W.	N.W.	N.W.

	Number of Days on which Rain fell.				Rain-Fall (for 50 Years).			Temperature.
						Extreme Fall.		
	1871.	1872.	1873.	1874.	Mean.	Max.	Min.	Mean.
January	5	8	13	12	2.85	6.10	1.02	32.0°
February	7	8	12	7	3.23	4.90	0.94	34.0
March	10	14	8	8	3.71	6.30	1.70	42.0
April	7	10	14	15	2.20	9.10	0.41	52.5
May	6	9	14	10	3.65	5.77	1.19	63.0
June	8	9	8	10	3.66	9.20	0.60	71.5
July	15	10	11	9	3.85	6.89	1.26	76.5
August	12	18	21	10	4.30	9.10	0.31	74.7
September	4	9	14	11	4.45	10.50	0.50	67.5
October	10	8	11	2	2.98	7.35	1.30	55.5
November	10	8	10	8	3.20	7.90	1.06	45.0
December	10	11	11	14	2.90	8.80	1.50	35.0
Total for the year	104	122	147	116	40.98			54.1
Mean of Spring					9.56	....	....	52.5
" " Summer					11.81	....	....	74.23
" " Autumn					10.63	....	....	56.00
" " Winter					8.98	....	....	33.66

	Rain-fall.	Temperature.		
	Inches.	Max.	Min.	Mean.
1817	48.55	92	−4	
1818	32.60	94	−2	
1819	28.75	98	10	
1820	42.50	98	−2	
1821	50.20	95	−6	
1822	29.20	92	8	53.3
1823	44.55	93	18	55.2
1824	42.28	90	11	56.4
1825	24.45	94	10	53.5
1826		96	Zero.	53.9
1827	26.39	98	9	52.1
1828	23.55	94	16	55.7
1829	43.09	92	8	52.6
1830		98	4	54.9
1831	54.15	93	Zero.	53.7
1832	53.05	91	Zero.	53.9
1833	55.24	94	10	53.7
1834	55.68	100	10	54.6
1835	52.99	91	−10	53.6
1836	51.55	92	1	51.0
1837	45.00	98	5	53.1
1838	47.10	102	10	53.1
1839	51.70	96	4	54.5
1840	37.50	91	Zero.	52.9
1841	43.90	95	Zero.	52.1
1842	35.10	92	10	54.0
1843	48.79	92	3	52.9
1844	32.46	94	5	53.3
1845	28.39	97	9	
1846	46.66	95	8	53.6
1847	33.01	98	10	54.6
1848	34.42	99	12	56.2
1849	30.63	100	6	55.2
1850	44.80	92	12	56.4
1851	38.10	92	7	56.2
1852	51.50	89	−5	53.9
1853	36.00	91	9	55.3
1854	59.02	98	14	55.6
1855	29.03	95	4	54.84
1856	22.09	92	−6	53.09
1857	38.04	92	−6	53.97
1858	40.10	94	10	55.78
1859	51.45	96	5	55.10
1860				
1861		90		55.66
1862				
1863				
1864		97	8	56.27
1865		96	5	57.16
1866				
1867		92	10	54.66
1868		97	5	54.33
1869		95	19	55.46
1870		95	12	57.53


Monument
Broadway
Jefferson
above mean tide
B
D
C
90
95
100
105
110
115
100
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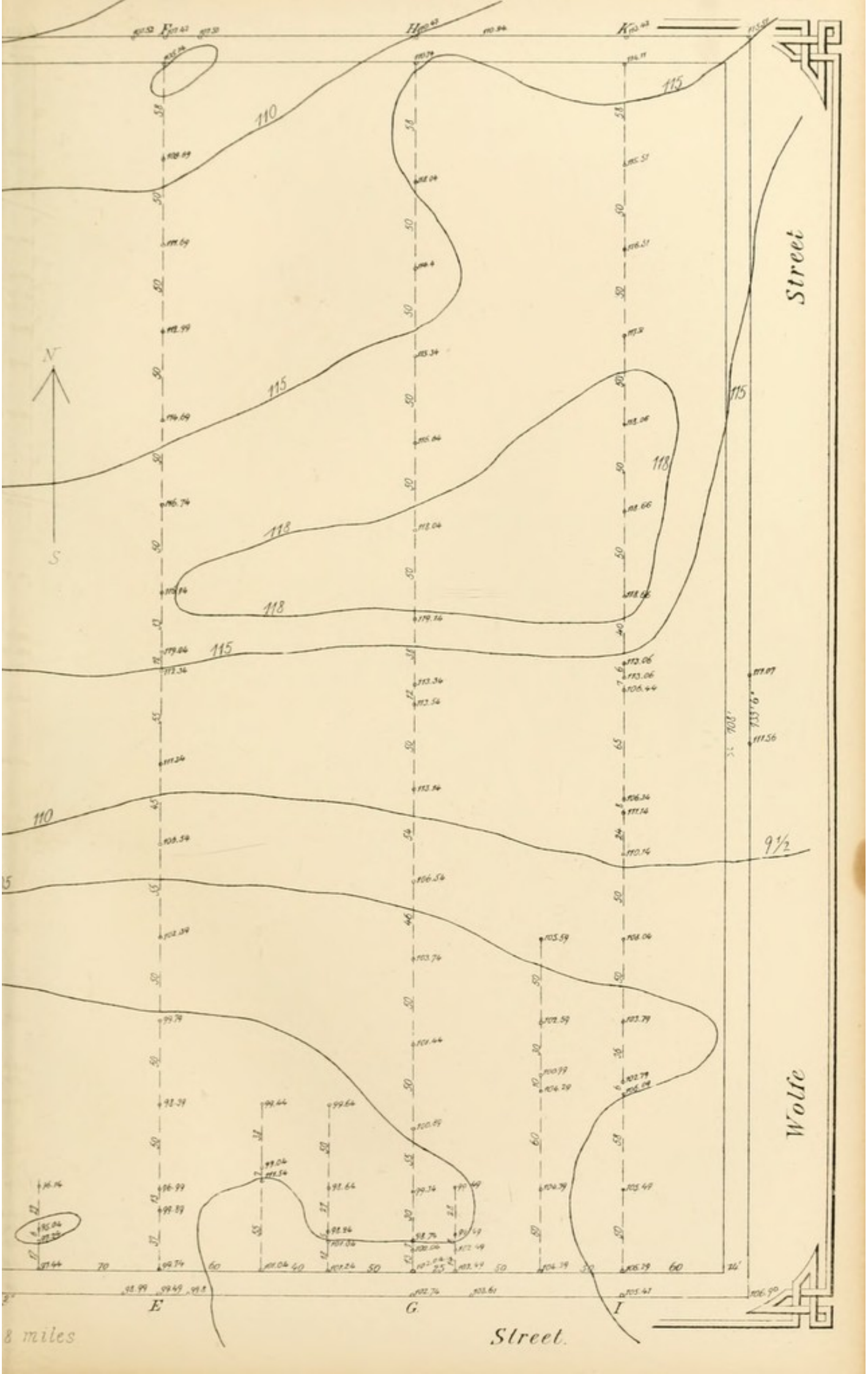

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HOSPITAL CONSTRUCTION

AND ORGANIZATION.

NORTON FOLSOM, M.D.

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HOSPITAL CONSTRUCTION

AND ORGANIZATION.

NORTON FOLSOM, M.D.

I PROPOSE first to consider the subjects brought to notice in the letter addressed to me as nearly as may be in the order in which they are there mentioned, adding what I can on matters which those subjects will lead to; and then to describe the Hospital as I think it should be constructed, with the aid of such drawings as time will allow me to supply.

If I enter at times into detail which seems disproportionate or trivial, it will be either because I feel especially sure of my ground from experience, or because I rate high the practical importance of the particular matter in hand.

I do not intend to discuss purely architectural matters, except so far as is necessary to give practical shape to my ideas. I believe, however, that ornament, and even to some extent symmetry in construction, should be subordinate, in a hospital, to usefulness and convenience; and that that building or part of a building which best serves the purpose it is designed for will look the best in the end; and that, indeed, the "finishing" or slight elaboration of the *necessary* parts of a building will usually prove more satisfactory than any amount of extrinsic or superadded ornamentation.

Simplicity has a beauty all its own; and the economical considerations, both as to original construction and inevitable subsequent repair, which would be likely to influence the adminis-

trators of a charity, are here most strongly re-enforced by the teachings of science and experience, especially with regard to all buildings permanently occupied by patients.

My attention has been early directed to the letter addressed to the Trustees by the honored founder of the Hospital; and I hope it is not unsuitable for me to express here my sense of its remarkable character. It evidences not only benevolence, but wisdom. It shows not only solicitude for the welfare of the poor and suffering, but a keen appreciation of their necessities, and discriminating skill in planning their relief. It is marked by *liberality* of views in the highest sense; yet its provisions are so pertinent as to seem almost to imply actual experience in administration of a hospital.

If any incentive to earnest effort, further than they already had, were needed by those chosen to aid the committee with their counsel, it would be found in this truly admirable instrument.

One of the first desires expressed in this letter is that the plan adopted may be one to allow symmetrical additions to the buildings first constructed; and this has been borne in mind by the present writer. But understanding that there is, at present, *no* free hospital in Baltimore, it seems probable that little delay will be desirable in completing the Hospital to the full capacity contemplated by the founder—namely, 400 beds. And in any case, true economy would seem to require the erection of all the administrative portions of the Hospital, and those for general use, at once, and of the full ultimate size. On passing them in review, I do not think the delay of any of these portions advisable. But it will be entirely practicable to erect the *wards* by degrees, and nearly symmetrically.

The size of the lot of land provided is ground for congratulation; and according to the English estimate of 80 patients to the acre, it would seem unnecessarily large; but I esteem it especially fortunate that the opportunity is thus given for a degree of lateral expansion seldom attainable in a metropolitan hospital. I have not failed to avail myself of so remarkable and advantageous an opportunity to *expand*, in making the plan which I submit.

A limit of a very few hundred has been suggested for the total capacity of civil hospitals, and if the models of past time were to be followed, certainly the smaller the hospital the better. But

with lateral expansion, free as I propose, I do not think any limit is necessary on sanitary grounds.

CLASSIFICATION OF PATIENTS.

The expansion to which I allude will render easier and more complete the *classification of patients*, which will need to be especially elaborate to fulfil the expressed wishes of the founder.

Provision is to be made for those who can pay for special room and attendance, as well as for the indigent—not that the latter class are to lack for anything requisite for their restoration or their comfort, but there are certain refinements, such as privacy of apartments and special service, which from force of habit are necessary to persons in easy circumstances.

It is certainly not *less* desirable to supply these special opportunities for restoration to health to persons valuable to society, by reason of their culture and means, than to provide for those whose places could be more easily filled. The founder's letter presumes that the receipts from those who can pay for especial privileges will aid in providing for those admitted free ; and if this does not prove to be the case, it can at least be arranged that they do not *increase* the expenses of the Hospital by their presence.

Male and *female* wards require to be entirely separate. The element of *age* does not necessarily enter into classification, as boys of tender years can be placed in female wards. The age of seven is a convenient place to draw the line. But if the number of children in the Hospital should be considerable, separate wards would be preferable for them. *Medical* and *surgical* patients *can* be treated in the same wards without serious inconvenience ; but it is more satisfactory to a visiting officer to have entire wards assigned to him than to share them with others, so that these two classes would usually require separate location. There is to be no restriction as to *color* in admissions to the Hospital, and this, I presume, implies the assignment of separate wards for colored persons.

The only class of cases excluded from the Hospital by the language of the founder's letter is that of *contagious diseases*. These will sometimes arise, however, in the Hospital, and temporarily require accommodation ; and as casualty always brings a certain number of cases of unpleasant character, either from the odor of sloughing wounds or from delirium, and as there are a

certain number of medical patients who, from similar causes, are offensive to others, separate wards are needed to provide for these elements. But as these wards will consist of an aggregation of separate single-bedded rooms, there is nothing to prevent their being held common to various classes, except with regard to sex.

The following is a recapitulation of the different kinds of wards required :

Private rooms, male, female, medical, and surgical, in common.
Male medical wards.
Female medical wards.
Male surgical wards.
Female surgical wards.

Colored male wards, colored female wards; both probably common to medical and surgical service, if, as I suppose, the number of colored patients will be relatively small.

Male isolating wards, female isolating wards ; common to medical and surgical service so far as circumstances require.

One of these wards of the ordinary capacity could readily be made available for colored patients of both sexes, by very slight modification.

Wards for children, when their numbers justify the appropriation.

RELIGIOUS MINISTRATION.

The founder's letter provides for the improvement of the portions of the grounds not occupied by the buildings ; and I shall make other suggestions on this point further on. A garden will not only be a source of refreshment and pleasure to people in health, within and without the Hospital, but likewise will be a remedy to the sick, some of whom will be carried out to enjoy its beauties, while others are cheered by the presence of flowers in the wards.

The idea has occurred to me, of a chapel for religious worship in this portion of the grounds ; but I have abandoned it for the following reasons. The fulfilment of the founder's wishes in regard to the influences of religion in the Hospital does not require that there should be stated gatherings of the inmates for worship. The general character of the institution will be such that but few patients would be physically able to attend ; and

in view of the diversity of religious beliefs, they and the employees would naturally go to the various churches of their choice in the vicinity. It is different in institutions whose inmates remain for longer periods, not confined to bed, and away from the city.

Every facility, compatible with the welfare and comfort of others, should be given, for the ministrations of religion according to individual belief, to those patients desiring it. I may here remark, however, that I have sometimes witnessed the mistaken zeal of ladies and gentlemen, who, with the highest motives, urged religious instruction and conference upon patients who were indifferent, or who lacked the strength to profit by it. This tends to bring what should be revered into contempt. The rules of the Hospital should define the relations between patients and religious visitors, and protect them from unwelcome interference.

CONNECTION WITH MEDICAL SCHOOL.

The Hospital will never fail to obtain the services of *attending officers* of the highest professional standing. One of the guarantees of this is the connection contemplated by the founder between the Medical School of the University and the Hospital. I am convinced, however, that the desire expressed at the close of his letter, that the Hospital shall form *a part* of the Medical School, should be so interpreted that this may be the case only so far as will conduce to the best interests of both institutions.

I am ready to admit that the Hospital may be regarded as a very essential part of the College in furnishing the opportunities for clinical and pathological teaching, absolutely and fundamentally necessary to medical education. But I believe it to be exceedingly important to both that *nominally* and *in organization*, they should be distinct.

In the Hospital organization the first consideration is the welfare of the patients. In the College, opportunities and advantages for the students are the main objects of solicitude. To harmonize, or rather to prevent all conflict of these interests, will be among the most delicate and important of the functions of the Boards of Management.

A certain prejudice exists among the uneducated, and indeed among those who have had better advantages, against going to a hospital. A fear of being "experimented on," and a sensitive-

ness about having their ailments openly investigated and spoken of freely before others, actually deters patients from applying for admission, who might obtain relief. It is necessary to deal with such prejudices very gently, and to avoid so far as possible any appearance which might justify them.

The whole Hospital should be imbued with the feeling that the interests of the patients are paramount; that the students are only allowed to visit as a privilege, dependent upon their orderly and considerate demeanor; and that even Professors, *as such*, have no absolute rights which patients are bound to respect against their will.

This will really work to the benefit of both Hospital and College, by doing away with the prejudices alluded to; bringing applicants for relief in larger numbers, and more promptly; greatly increasing the opportunities of the classes for observation of disease; and, by refining the relations between students and patients, doing something to prevent the relapse into *scientific coarseness* which is apt to temporarily obscure the progress of every young man in the profession.

COUNTRY WARDS.

The letter of the founder does not limit the scope of the Hospital to providing for acute or curable ailments; but I think a general rule should be established by the Trustees, limiting the stay of patients to a certain number of weeks, subject to modification in individual cases, on recommendation of the medical officers in attendance.

It is a question for the deliberate consideration of the Trustees, how far they will feel called upon to provide a home for disabled persons who cannot be cured, and who do not need the *daily* ministration of a physician, and skilled nursing. Certainly such persons should not be suffered to remain long in the Hospital in the city.

Since provision is to be made for convalescents at a distance from the city, presumably at less expense than will be necessary in the Main Hospital, I would recommend that chronic and incurable cases, not requiring much immediate treatment,—such as consumptives, for instance,—should be provided for, temporarily at least, at the same time.

There are other cases, of which scrofulous disease of the hip is

an example, where ultimate benefit or cure is probable, but where good food, fresh air, and rest are the principal remedies to be used. These cases should also be transferred to the country wards, returning temporarily to the Main Hospital when symptoms arise (such as the supervention of an abscess) requiring immediate treatment.

It will be desirable in arranging for these country wards, (which will prove to be a very important feature of the Hospital,) to make them readily accessible, by easy roads, at all seasons, so that no delay may arise in the transfer of patients. If they are many miles distant from the city, it will be well to place them near a railroad; and easy wagons or ambulances can be fitted with mattressed litters of a size to go through the door of an ordinary railroad car, so that a patient can be transferred from a country bed to a city bed, or *vice versa*, without change of position.

Economy of management would suggest the establishment of these country wards in connection with the Orphan Asylum, but this is a matter beyond my province to discuss. The buildings should be of simple construction, roomy, well warmed and ventilated, and might be of more than one story without detriment. Ordinary country houses with large rooms, with open chimneys or special ventilation, and *furnace heat in addition*, to secure a full supply of air, would serve the purpose. Water-closets would be needed on each floor, and might be added in a tower built at the corner or side of the house, connecting with each story by means of a little ventilated stem or lobby, which would keep the air of the house from contamination. A farm would be a natural appurtenance of such wards, where convalescents and others might profit by light labor in the open air, the products of which would partially supply the other parts of the institution.

A resident medical officer would be required, and the position might be filled by the house officers of the Main Hospital in rotation, a month or two at a time. If the distance from the city should be considerable, it would be desirable that one or more of the physicians in practice in the vicinity should be invited to act as visiting or consulting physician on call by the resident officer, in case of emergency. But cases requiring attention would be transferred promptly to the city; and there should be visits of inspec-

tion and examination at least as often as every week, by the Resident Physician of the Main Hospital, or his representative.

PROXIMITY OF MEDICAL SCHOOL.

The advantages derived by a hospital from connection with a medical school are comparatively few, and I have already alluded to the possibility of detriment, to be avoided by careful management. The careful, thorough, and exact, even laborious methods of investigating and treating disease necessarily employed by a professor in presence of a class of students, are, however, not only advantageous to the individual patient concerned, but the standard of thoroughness and care is raised for the whole institution, and every employee can be made to profit by the example.

But instruction in a hospital is an *indispensable* part of thorough medical education; and the advantages to the medical school of the connection are manifold, and would be much increased by close proximity of the institutions. Very few of the exercises of other departments of the University would be regularly attended by medical students under any circumstances; while hospital instruction will be likely to be given repeatedly during the day, and sometimes unexpectedly, on short notice. Besides the stated clinical lectures, illustrated by the cases of the inmates and out-patients of the hospital, the visits to the medical and surgical wards, and the attendance at surgical operations at regular times, there are accidents and emergencies sometimes occurring, such as cases of poisoning, or the rarer dislocations, whose treatment is so specially instructive as to justify the interruption of stated exercises to allow the students to witness it. The study of the appearance of the diseased organs of the body, after death, and microscopical investigation of their structure, is a branch which receives constantly increased attention in the medical curriculum. The opportunity to pursue this study must be seized at the time it occurs, often without reference to convenience of hours.

These matters are of the greatest importance to the students, but unless they can reach the hospital easily, they will neglect their opportunities; and apart from this, the time to get to the hospital, and back to the next exercise, must be taken from the busiest part of the day.

I have no hesitation, therefore, in recommending that the Medical School should be separate and apart from the Hospital grounds, but within a few minutes' walk. A mile, in my judgment, would prove to be an injurious distance, even with constant facilities for transportation by horse-cars.

TRAINING SCHOOL FOR NURSES.

The training-school for female nurses, to which the founder alludes, is a matter to which I have given special thought.

The varying success which has attended the efforts of sincerely philanthropical persons in establishing these schools in this country, has been largely due to the difference of the ground which they have invaded. In any field where reform in nursing is much needed, the managers of such a school, by devoting time and money to raising the standard of the service,—engaging a better class of women than were previously employed, and employing more of them to do the same work,—would be more likely to win the encomiums due to successful change, than where change was less needed. I am inclined to think little of didactic instruction for nurses, and much of practical experience; and that their duty should be so systematized as to bring each nurse into relation with the different classes of cases in the Hospital, successively, but without changing rapidly, or until entire familiarity with all details has been acquired in each situation.

I am strongly of opinion that the *Hospital* should be the *Training School*, and that a separate organization and management in a well-regulated hospital is more or less detrimental to the economies of the latter, and to the excellence of the nursing. The *esprit de corps* should be that of the Hospital, not of a separate educational body.

It must not be forgotten that the best hospitals in this country *always have been* training nurses, and although the number leaving the hospitals to do private nursing has not been large, the esteem and demand in which they have been held is proof positive of the value of the training received.

The first care of any hospital must be to supply *itself* with skilled nurses, and the amount of what can afterwards be done to supply the community outside can only be determined by trying. This would probably depend on the amount of money devoted to this particular end.

I am not aware of any advantage pertaining to the *name* of "Training School" in connection with a hospital, except, perhaps, that it would attract a greater number of applicants for places, and among them, presumably, more of the better class. I am inclined to think, however, that judicious advertising, directly from the Hospital, would be quite as effectual and better on other accounts.

The instruction of nurses should proceed from the officers of the Hospital, and should grow out of the daily experience of the wards, care being taken, as above stated, to secure variety of experience to each nurse. The Matron, under the authority of the Resident Physician, is the natural supervisor of nursing—and in a large hospital this duty might well be in the hands of a special subordinate. There are various matters in which systematic instruction is necessary, and this should be given by the Head Nurses of wards to the Assistant Nurses, as they come under their control, under the general direction of the Matron. The medical officers should also be expected to instruct the nurses so far as their demands and directions to them lead to it, and especially by holding them individually responsible for duties done in connection with particular patients.

Holding these views, I have made ample provision in my plan for the comfortable living of all the nurses likely to be employed or taught at one time in the Hospital, within the institution.

ONE-STORY WARDS.

While I am not prepared to deny that sick people will get well rapidly in buildings of several stories, I am strongly of opinion that one-story wards are better, and that these should be detached so far as circumstances will admit. I do not know that there are any statistics in existence which show that more patients recover, or that recovery is quicker, other things being equal, in such wards; but I believe it to be true. Economy of administration requires us to treat twenty or thirty patients in one room. That room should be high enough to allow a great body of air to be constantly entering and leaving it, without creating "*a draught*," or, in other words, chilling the skin of any patient by passing over it too rapidly. If another room of the same height is placed above, the whole building is so high that the next pavilion has to be placed at an inconvenient

distance to avoid mutual shade, and to secure *free external circulation of air*. The desirability of the latter is so universally acknowledged that I shall not discuss the merits of wards placed side by side in a continuous building, where light and air are necessarily partially excluded.

One-story wards are very convenient of administration. By omitting thresholds, and providing simple trucks with rubber tires to the wheels, one attendant can do the work of two in transporting patients and supplies; and *what can be done easily will be done promptly*.

The arrangements which I consider best, and have adopted in my suggestions for heating and ventilation, preclude the idea of a second story to any building occupied by sick. One of these features, ridge ventilation, modified to suit altered conditions, is derived from army hospitals. It was thoroughly tested and widely adopted during the war, and its excellence is acknowledged. I think the main dependence should be placed, in *heating*, upon very low pressure steam apparatus, with, *almost invariably*, indirect radiation. In this way, to give heat, you must give fresh air, and good ventilation is insured. Open fires are specially useful in mild weather, and are very efficient ventilators; and in their appropriate places special fireplaces are advisable, which supply fresh warm air, besides removing that which is foul. It will be seen that no special system has limited my suggestions; and though the "natural method" of ventilation may be relied on in some weather, when doors and windows are freely open, efficient means of constant supply and change of air of equable temperature has been provided for, both in winter and summer. Mechanical forcing by a fan has not been resorted to, as the application of the necessary amount of heat directly to supplying and ventilating shafts is simpler and more economical.

I do not consider destructible barracks, which are so excellent for military hospitals, at all suitable for a private, civil institution. I believe that careful administration will make permanent structures at least equally healthful with them, and, in a temperate climate, physical comfort is greater in a building with comparatively thick walls. I should consider the moral effect of barracks in a civil hospital, unless for temporary and exceptional use, positively prejudicial. If we provide for the renewal

or refreshment of the inner surfaces of wards, their entire destruction becomes unnecessary.

The character of the lot of land provided for the Hospital is exceedingly satisfactory, and it is needless to dwell on some matters which would demand early attention in *selecting* a site. Its elevation secures the free access of air to all the buildings, if care is taken not to obstruct it unnecessarily. No difficulty is to be anticipated about drainage or water supply. If the streets immediately around the Hospital can be paved with wood, it will prevent annoyance and detriment from the noise of passing teams. The difference of grade in these streets is not such as to interfere with any plan for building; for it would be practicable to make the greater part of the lot level. In the plan which I submit, however, the present general conformation of the land is respected.

SCHEME OF ORGANIZATION.

The following scheme of organization is proportioned to the full capacity of 400 beds:

Officers elected annually by the Board of Trustees.

A Resident Physician—the executive officer; in constant and confidential communication with the Trustees, and in professional sympathy with the medical and surgical staff, he is better able to regulate action, and harmonize various interests, and to control subordinates of varied position and character, than a non-medical superintendent. His duties include those of a steward, and admitting physician; but he should have an assistant, and one or other should be always at the Hospital. Under the direction of the Trustees, he has control of the Hospital in all respects, except the treatment of patients. He makes all purchases for the regular needs of the Hospital, and receives all moneys paid for board or otherwise, and his accounts are settled monthly with the Treasurer. His decisions as to the admission of patients, and their rate of board, shape the whole character of the charity. He appoints and discharges all employees not elected by the Trustees. He is responsible for the proper warming, ventilation, cleaning, and repair of the Hospital, and for the discipline of house officers, employees, patients, and visitors. He provides the diet and remedies ordered by the physicians and

surgeons, and keeps records of applications, admissions, discharges, etc. He has custody of all property at the Hospital. In case of emergency, in the absence of the visiting physicians and surgeons, he acts for them in regard to treatment, and discharges patients if discipline requires it. He assigns patients to the proper ward and bed, and directs removal or change, when necessary. He orders all autopsies in writing, under rules made by the Trustees. He makes an annual report to the Trustees of the doings of the year, and the state of the Hospital.

A Board of Consulting Physicians and Surgeons.

Eight *Visiting Physicians* and eight *Visiting Surgeons*, two of each serving at one time, for a term of three months. They have entire charge of the treatment of patients. They order, through the house officers, the medicines and stimulants required, and direct what grade of general diet the patients shall receive. If extra articles of diet are needed, they order them from an extra diet list, *daily*. They daily report to the resident physician, the names of patients suitable for discharge or removal to country wards. They dictate to the house officers the medical and surgical records.

Four *Physicians* and four *Surgeons* to *Out-Patients*, who shall also act as assistants to the visiting officers when required.

An *Ophthalmic* and an *Aural Surgeon*, who attend to cases in their special departments, whether out-patients or in the wards.

A *Dentist*.

A *Pathologist*, who makes all autopsies, preserves specimens of morbid structure in a cabinet, and examines diseased growths and secretions, of which he keeps record.

An *Assistant Physician*, the constant aid of the resident physician, and his representative when absent.

Sixteen *House Officers*—medical students or recent graduates, eight medical and eight surgical, eight resident and eight non-resident—to serve in all two years, and eight to be elected each year. The first year to be passed in the Out-Patient Department, and as junior ward officer, six months of each. The second year to be passed in the house, as senior ward officer, six months of male and six months of female service. They carry out the orders of the visiting officers. The non-resident officers *only* assist in making autopsies.

The importance of the *practical efficiency* of these officers in

the care of the patients is very great. An examination before appointment may be useful to secure a certain standard of scholarship, but it should not be competitive. They should be elected on the joint nomination of the visiting officers and resident physician, after thorough investigation, regard being had to general qualifications, maturity, and practical ability, as well as scholarship.

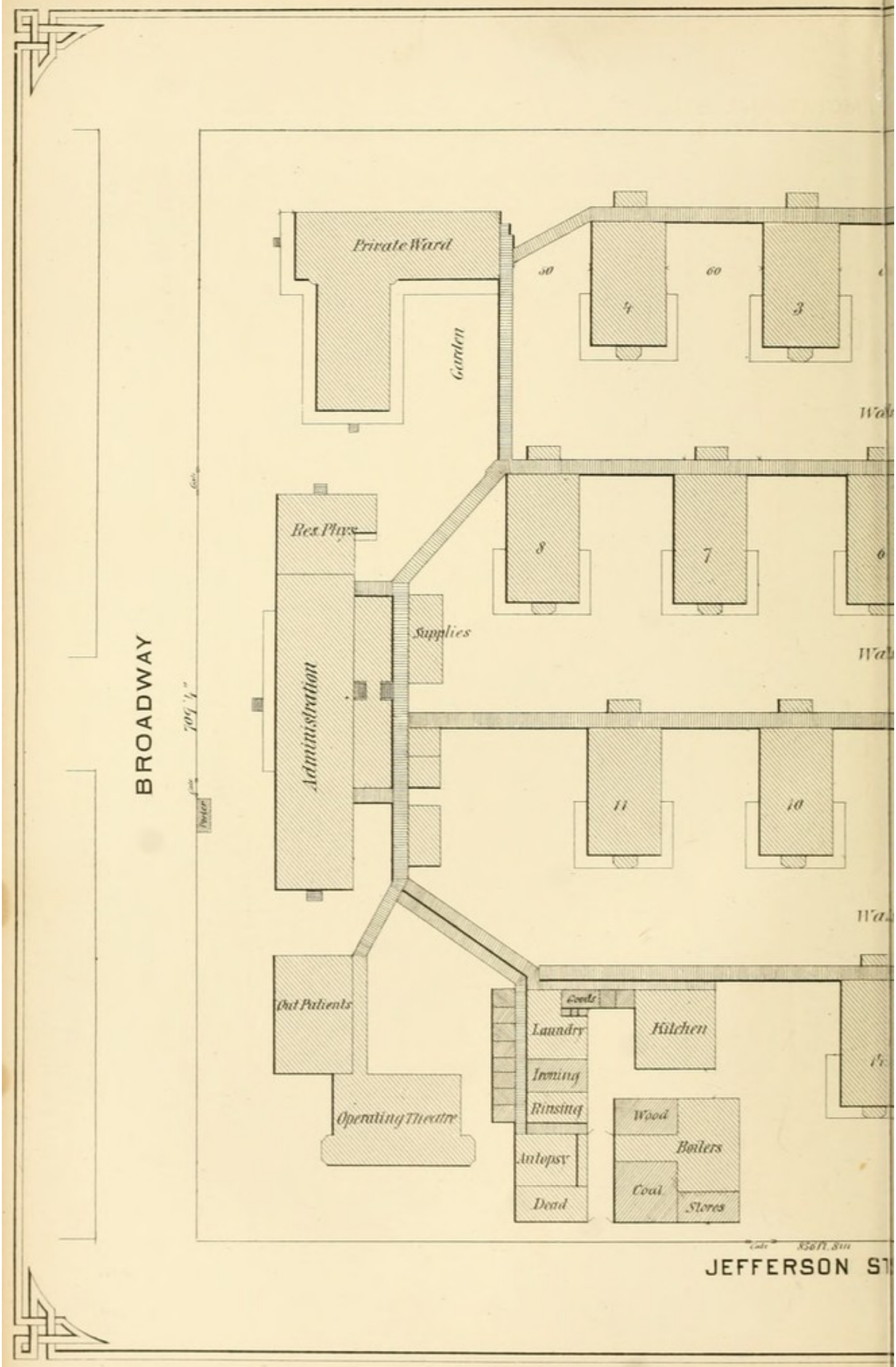
The *Apothecary*, who aids the Resident Physician in the purchase of drugs, etc., manufactures preparations, and dispenses the remedies ordered by the physicians and surgeons.

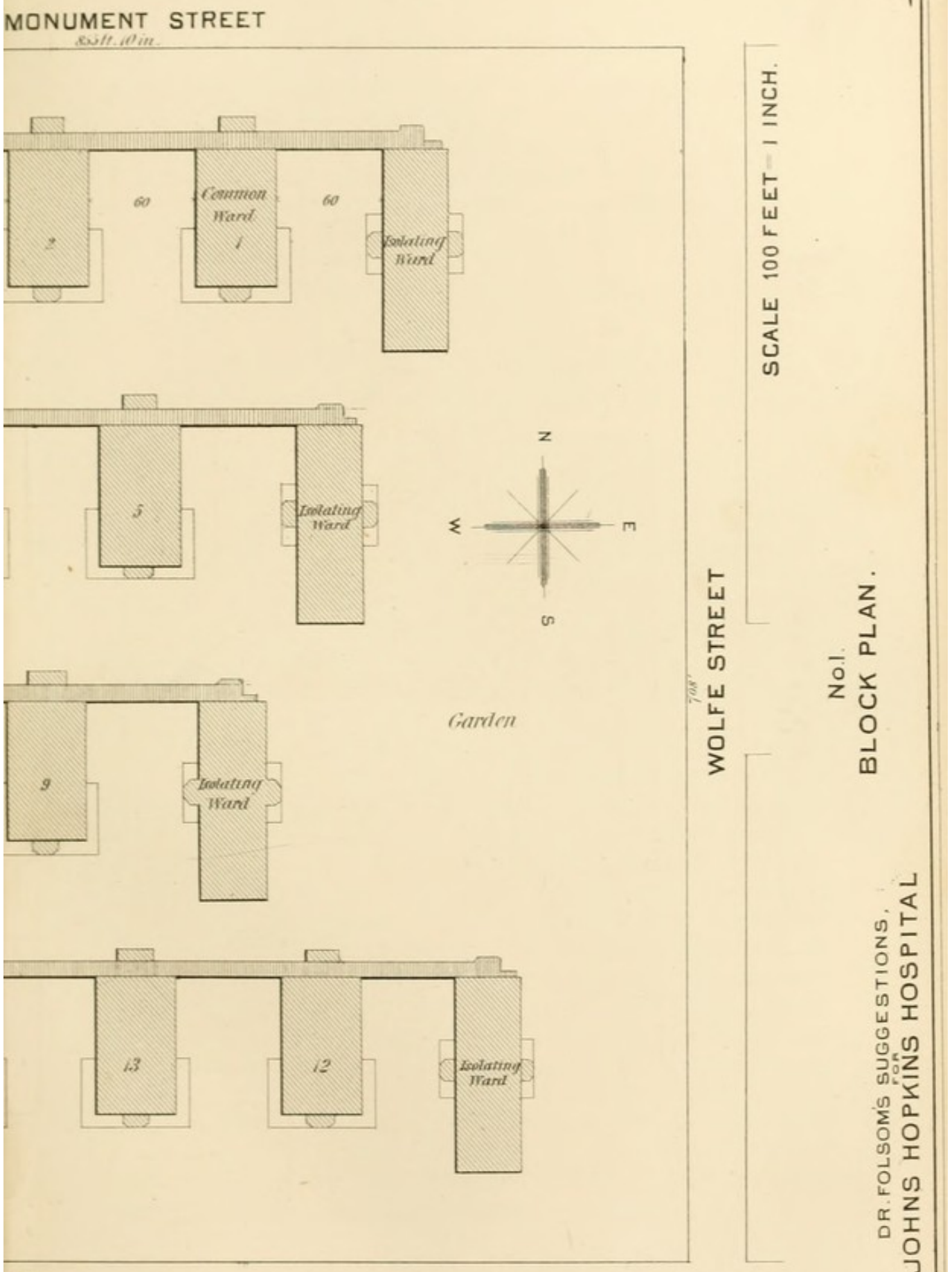
The *Matron*, who aids the Resident Physician in the purchase of household articles, supervises the housekeeping, cooking, and cleaning, and especially the nursing and training of nurses.

Persons employed by the Resident Physician.

A *Clerk*, to aid in book-keeping and correspondence.
An *Apothecary's Assistant.*
An *Engineer*, in care of all apparatus.
Two *Firemen.*
A *Store-keeper*, who regulates the kitchen, and receives and gives out supplies of food.
A *Kitchen Man.*
Five *Cooks.*
Four *Kitchen Maids.*
A *Head Laundress.*
A *Laundry Man.*
Eight *Laundry Maids.*
Four *Housemaids.*
Two *Parlor Maids.*
Four *Porters*, one to serve also as coachman, one for *Out-Patient Department.*
An *Assistant Matron* and *Librarian.*
Two *Seamstresses.*
Twenty *Head Nurses.*
Forty *Assistant Nurses.*
Twenty *Night Nurses.*
Five male *Ward Tenders.*

The aid of patients who are not physically disabled will be necessary in the care of the wards; and the moral effect of this is


Private Ward
Garden
50
60
4
3
Rest Place
8
7
6
Supplies
Administration
11
10
Out Patients
Operating Theatre
Laundry
Kitchen
Ironing
Rinsing
Autopsy
Dead
Wood
Boilers
Coal
Stores
BROADWAY
JEFFERSON ST


MONUMENT STREET
85ft. 10in.
60
Common Ward
1
60
2
Isolating Ward
3
Isolating Ward
N
W
E
S
Garden
9
Isolating Ward
13
12
Isolating Ward
WOLFE STREET
SCALE 100 FEET — 1 INCH.
No. I.
BLOCK PLAN.
DR. FOLSOM'S SUGGESTIONS, FOR JOHNS HOPKINS HOSPITAL
ET

good; and it will be found that the payment of board proportionate to their means, be the amount ever so small, will cause patients to better appreciate their advantages.

The manner in which this organization is proposed to be accommodated can be better considered in connection with the drawings accompanying this paper.

EXPLANATION OF PLATES.

GENERAL PLAN.

Plate No. 1 is a block plan, showing all the buildings proposed. Two ideas have been adhered to in this general plan of the Hospital:

First, that the wards should be *all on the same floor*, connected by low corridors with the first story of the other buildings; so that passage from one part of the Hospital to another might be unobstructed by steps; and no thresholds being used, trucks with rubber tires to the wheels, before alluded to, might pass everywhere without jolt or obstruction.

Second, that every room occupied by patients should receive direct sunlight during some part of the day.

The value of the convenience and cheerfulness thus secured can hardly be over-estimated.

The administration building occupies the centre of the *obvious front*,—the westerly end of the lot,—fifty feet from the street, a position of average grade, as regards the rest of the lot, and sufficiently accessible from all other parts of the Hospital. It is joined by two cross-corridors to the main or connecting corridor, twenty-five feet to the rear, on the east side of which are several low buildings, appurtenant to administration. This central region would at first glance seem to be the proper place for the source of steam-heat, and the kitchen and laundry; but the low-pressure boilers are to send steam to every part of the Hospital, by pipes which rise to the ceiling of the corridors, and descend to the various radiators, and the water resulting from the condensation of the steam is to constantly return to the boilers, by the force of gravity, through pipes beneath the surface of the ground; therefore, the place for the boiler house is at or near the lowest part of the lot, as near as may be to the main corridor, but also accessible from the street, so that coal can easily be put in.

The position fulfilling these conditions is found at the southerly part of the lot, and is convenient in every way. The kitchen and laundry, which are to be supplied with steam from a boiler of higher pressure in the same room and under the same management as the heating boilers, are placed as near the boiler house as is practicable. These points being settled, the other buildings for general use have been so placed as to have ready access to the main corridor, and yet not to obtrude unpleasantly upon the wards.

The beds of the Hospital are distributed as follows:

In one private ward of 20 separate rooms.....	20	beds
In fourteen general wards containing 23 beds each..	322	"
In four isolating wards of 16 separate rooms, with one bed in each.....	64	"
Total.....	406	"

The general wards are alike, and would be assigned to such various uses, at different times, as circumstances might require. The four isolating wards are also alike. Ample means of classification of patients are thus afforded, and the details of their distribution would be determined by the proportion in which different classes of patients would be found to present themselves. The corridors are all to the north of the wards which they connect, and therefore do not interfere with the southerly exposure of the buildings.

The private ward is placed at the north-westerly corner of the lot, out of the thoroughfares of the Hospital, on a high level, accessible from the front street, but fifty feet from it, near the house of the Resident Physician, with pleasant look-out from all the patients' rooms. It is reached by a corridor which leaves the northerly end of the main corridor, running first north-west, then north, to the entrance of the ward. From this corridor branch off *two* of the four cross-corridors which go to the other wards. Of the other two, one leaves the main corridor at its middle, the other at its southerly end.

As much distance is allowed between the wards as the size of the lot permits, reserving a moderate space for garden and airing ground at the easterly end. This distance between wards is sixty feet from east to west; and from the southerly wall of each ward to the cross-corridor of the row of wards to the south

of it, seventy feet. The wards, in each row, are placed opposite to the *intervals* in the next row, to facilitate the free circulation of air around them. The corridors are not necessarily level, but *follow the slope of the ground*, which is to be graded so that the foundation of the isolating ward at the north-east corner of the lot is a little higher than that of any other building. It follows that the wards are vertically *en echelon*, and will the more readily catch the prevailing winds. The isolating wards are placed one at the easterly extremity of each cross-corridor, so as to be the most out of the thoroughfares.

At the southerly end of the main corridor, a branch leads south, past the out-patient building to the operating theatre. From the same point two branch corridors side by side, with a thin partition between, with doors in it, lead to the corner of the laundry.

Here the most northerly branch itself becomes double, the north half being one of the cross-corridors leading to wards, while the south half leads to the kitchen, passing the following three rooms:

A goods-receiving room, ten feet by twenty-four, where bulky articles are received, unpacked, examined, and repacked, or conveyed by trucks to any part of the Hospital. Attached to this room is a lavatory, and a water-closet, for male employees.

A dust-room, ten feet square, containing receptacles for sweepings, paper, and dry rubbish.

A garbage-room, ten feet square, with water-tight receptacles for swill. The floor should be perfectly tight, and dished, with a trapped drain and strainer, and supplied with a water-tap and short hose; and the receptacles should be thoroughly cleansed after each emptying.

These three rooms open on the corridor, and also, by double doors, on the kitchen yard, where the teams drive in. The garbage-room also opens on the kitchen.

The most southerly branch corridor, at the corner of the laundry, turns south and runs between a row of horse-sheds, and the laundry, and rinsing-room, and beneath the seats of the autopsy theatre, to the dead-house.

The horse-sheds, for the convenience of the visiting staff, open on the corridor.

The laundry, about forty feet square, is fitted with soap-stone

tubs, boilers, rotary washing-machines, and a centrifugal wringer. It has a tight floor and drain. It communicates with the ironing-room, twenty feet by forty ; which contains a mangle, stoves for heating irons, and a steam-heated drying-closet. In the corner is a water-closet, for female employees. Next this room is the rinsing-room, twenty feet by forty, containing a large number of ventilated boiling and washing tubs, and a drying-closet; where all specially foul linen, bandages, etc., are conveyed from the wards, at the dressing hour, placed at once in water to soak, and thoroughly rinsed and deodorized before being conveyed to the laundry for final cleaning.

A steam engine will be required to carry the machinery.

Over these rooms and reached by stairs, is a bell-deck or roof arranged to be walked on, surmounted by a roof of glass and iron, supported by pillars and surrounded by a railing, but having no sides to obstruct the free passage of air. Here the clothes are to be dried in fair weather. A lift for raising them could be connected with the steam-engine.

Twenty feet from the kitchen, and fifteen from the autopsy building (from which it is separated by a covered way with gates at each end), is a building eighty feet square, comprising a boiler house, coal-shed, and wood-shed ; also a small stable, where are kept a horse and ambulance, and a vehicle to send for the attending staff in case of emergency. The use of the telegraph from various points in the city in connection with these vehicles will need consideration. Over some part of this building is a loft, where mattresses and pillows are aired after the departure of patients, before being used again. There should be a sufficient supply of these articles in the hospital to allow of their remaining in the open air a week.

A bed-room with a bath and water-closet attached, for the engineer, is also placed in the second story of this building.

The walls of all these buildings are recommended to be constructed of brick, with a closed air space, except in the corridors, where a single eight-inch wall will be sufficient ; and painted outside to insure dryness. If stone trimmings are used, they should project as little as possible from the surface, as any irregularity interrupts the free sweep of air, and gives opportunity for dust to collect. Especially in those buildings occupied by patients, relief to the eye should be attained by variation in *color*,

rather than by projections or depressions in the walls. There is obvious opportunity for architectural effect in the front buildings. The administration building will be likely to vary in height in different parts. The private ward is in a commanding position, and a tower or cupola on it would afford a magnificent view. The out-patient and operating buildings are of sufficient size and height to balance the front symmetrically.

The inside of the walls should either be plastered directly on the brick work, and so prepared as to be hard, smooth, and impermeable like stone, so that they can be freely scrubbed; or, if this is impracticable, very thin furring should be so attached as to be easily removed and replaced; and this renewal should be made in the buildings occupied by patients at least as soon as the plaster becomes cracked or marred. Where the plaster remains smooth and sound, a thin coat of paint applied every year probably renders it perfectly healthful. However constructed, the walls should have all corners and angles rounded to prevent accumulation of dust, and allow of ready cleansing. This is especially desirable at the junction of the base-board and the floor, where a broom is apt to leave more or less dust in spite of care. (See figure on next page.)

All floors should be made of strips of hard wood, not over two inches wide, tongued and grooved and blind nailed.

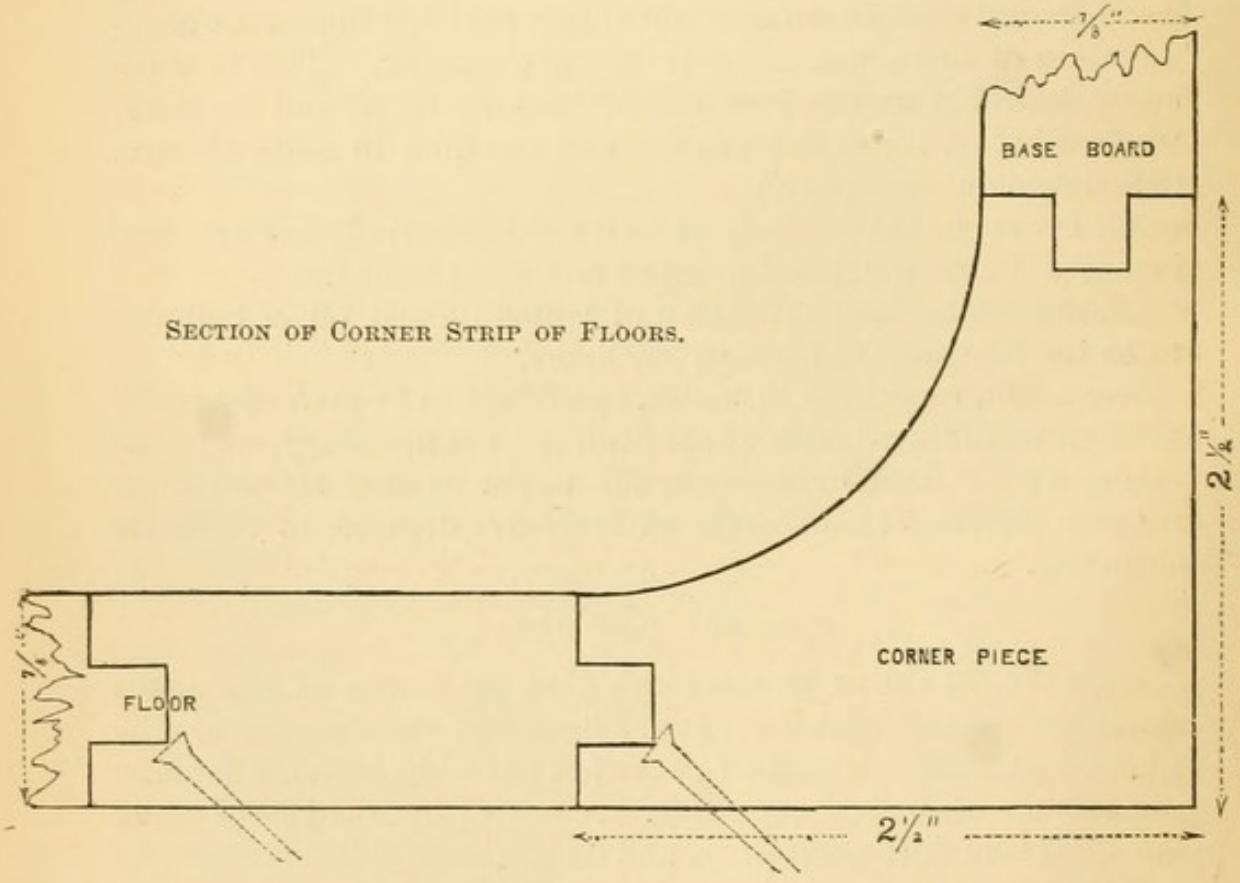
On the whole, the application of boiled linseed oil is believed to be the best way of treating the floors.

The finish, especially in wards, is advised to be perfectly plain, without mouldings; and where projection is necessary, as in the casing over a door or window, the upper surface should slope towards the floor at an angle of forty-five degrees, to facilitate cleansing.

GROUNDS AND PATHS.

Plate No. 27 shows on the block plan the course of the paths about the grounds. A driveway, fifteen feet wide, surrounds the whole, and from this lead off paths ten feet wide, which will allow the passage of carts if necessary. A row of trees is placed along the outer side of the driveway, and on the inner side wherever the buildings are not so near as to be shaded by them. In planting the double rows, the trees should be placed opposite, rather than alternate, to insure the formation of a vista of gothic arches.

The front or business entrance to the Hospital, to which all patients should be directed, is opposite the southerly front door of the administration building. Close to the gate is the lodge, where the gate-porter lives night and day. He sees every one who enters, inquires the errand of all newcomers, and directs them accordingly. Applicants for admission and visitors to the wards go to the door opposite the gate. Vehicles conveying persons injured by accident, or cases of severe sickness, unable to walk, are driven to the door at the southerly end of the administration building. Out-patients are directed by the next path to the south to the front door of the out-patient building. Students pass by the path still further south to the entrance to the operating theatre, which should be their regular place of assembly, except when, under special instructions, they are to meet the visiting staff at the wards, or the Pathologist at the autopsy theatre.



SECTION OF CORNER STRIP OF FLOORS.

A path leads around the southerly end of the administration building directly to the middle of the short corridor which passes

across to the main corridor. At this point a cut and arch-way, with a catch-basin at the bottom, might be made, so that a cart could pass beneath the corridor and reach the court-yard behind the administration building, which is the only space about the Hospital entirely enclosed by buildings.

At the northerly end of the administration building is the private entrance, which serves for visitors to the Resident Physician's family, and to the patients in private rooms. The grounds about the private ward are made as attractive as possible, and in the centre of the space to the east of it is a fountain.

The rear entrance to the Hospital is close to the boiler house, and is under the charge of the man on duty there, so far as necessary. Teams bringing stores and ice, drive up to the easterly side of the kitchen building. Those bringing other goods, and the scavenger-carts, pass south and west of the kitchen to the goods-receiving room door, and to the dust and garbage rooms. The driveways and the yard around the kitchen are macadamized.

The wood-shed is reached from the kitchen yard. Here waste boxes, barrels, etc., are broken up to be utilized for fuel. Here also broken furniture, and badly soiled bedding are placed while waiting for repairs and cleansing. The roof of the covered way between the coal-shed and autopsy building projects over the northerly gates, to protect persons passing across from the weather, so that, through the wood-shed and boiler-room, the stable can be reached from the main buildings without exposure.

Teams bringing coal for the boilers turn to the left on entrance at the gate, drive into the coal-shed by a southerly door upon a bridge of plank supported by brick piers, from which the coal is dumped on the floor below. They then leave the shed by a westerly door, coming out through the covered way between the shed and the dead-room. Undertakers pursue the same route, pass the coal-shed, and back into the covered way through the southerly gates, which are then closed. After the remains are placed in the wagon or hearse, the gates are reopened and the vehicle passes out; in this way being entirely out of view of the patients, on some of whom the associations connected with such matters would have a depressing effect.

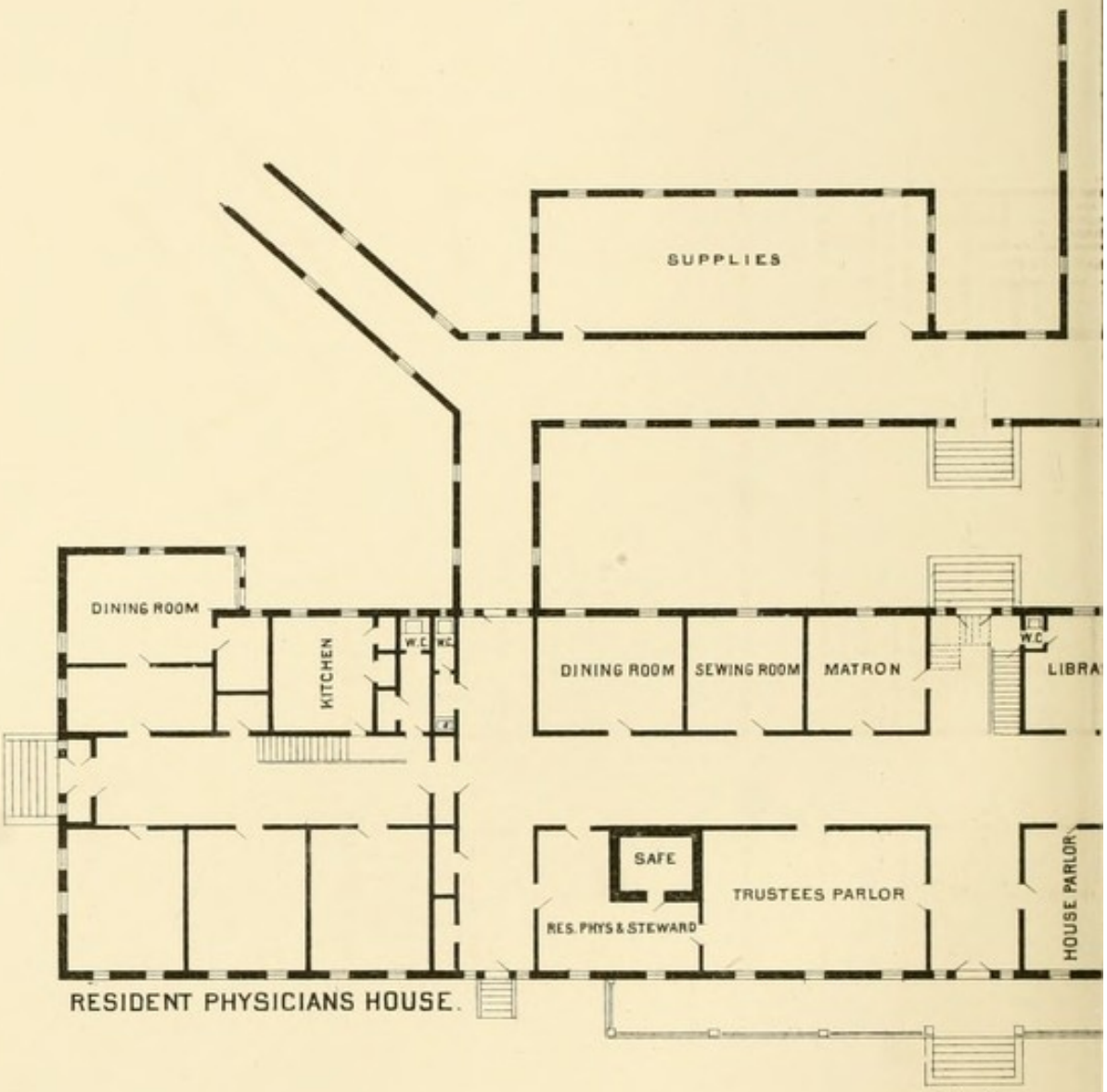
A driveway to the horse-sheds for the visiting staff, just to the east of the operating theatre, can be reached by either the front or rear entrance. Coal for use in the wards is carried to a

small coal-cellar in each building, by the cart-paths which run along their northerly aspects. The same paths conduct those patients who are able to go out of doors, or who are carried out in baskets and litters, to the garden. A summer-house, or rustic arbor, shaded by trees, is readily accessible from the end of one of the corridors, and an uncovered inclined plane might readily be constructed for trucks or wheeled chairs to pass to and fro upon. Most of the garden or airing ground had better be smooth turf; any irregularity of level and any trees now existing on that portion of the lot being preserved, if suitable, and flower-beds and shrubs disposed at angles and near the paths, so as to give as much expanse of green as the limited space allows. A fountain is suggested at a central point.

As has been stated, the most north-easterly building, an isolating ward, is to stand a little higher than any other building. It follows that the general downward slope of the lot should be made to be towards the south-west, as indicated by the grade of the surrounding streets; but this slope need not be regular. The elevation now existing near the centre of the lot might be lowered to about the level of the north-easterly building, and from this plateau the slope would be more rapid to the south and west.

To insure dryness, the various buildings, especially those occupied by patients, are immediately surrounded by gravelled paths a few feet in width, beyond which the turf slopes quietly away from the buildings. The surface water is thus directed to points intermediate between the cross-corridors and the row of wards to the north of each, and as the downward slope is to the west, there will be a lowest point between each two rows of wards, somewhere near the main or connecting corridor. At these lowest points, and at intermediate points, if slight irregularity or any other cause makes the surface water collect, catch-basins are placed, which overflow into brick drains. These drains, and the earthen pipe or other drains from the various buildings and from the fountains, empty into a main drain running south, probably diagonally, intersecting the cross-corridors, but avoiding passage beneath any large building, to reach a sewer beyond the boundaries of the estate.[1]

[1] If, as has been intimated, this sewer is located in Ann Street, the main drain would follow a diagonal line drawn from the north-easterly corner of the private ward to a point near the rear entrance of the Hospital.



No. 2.

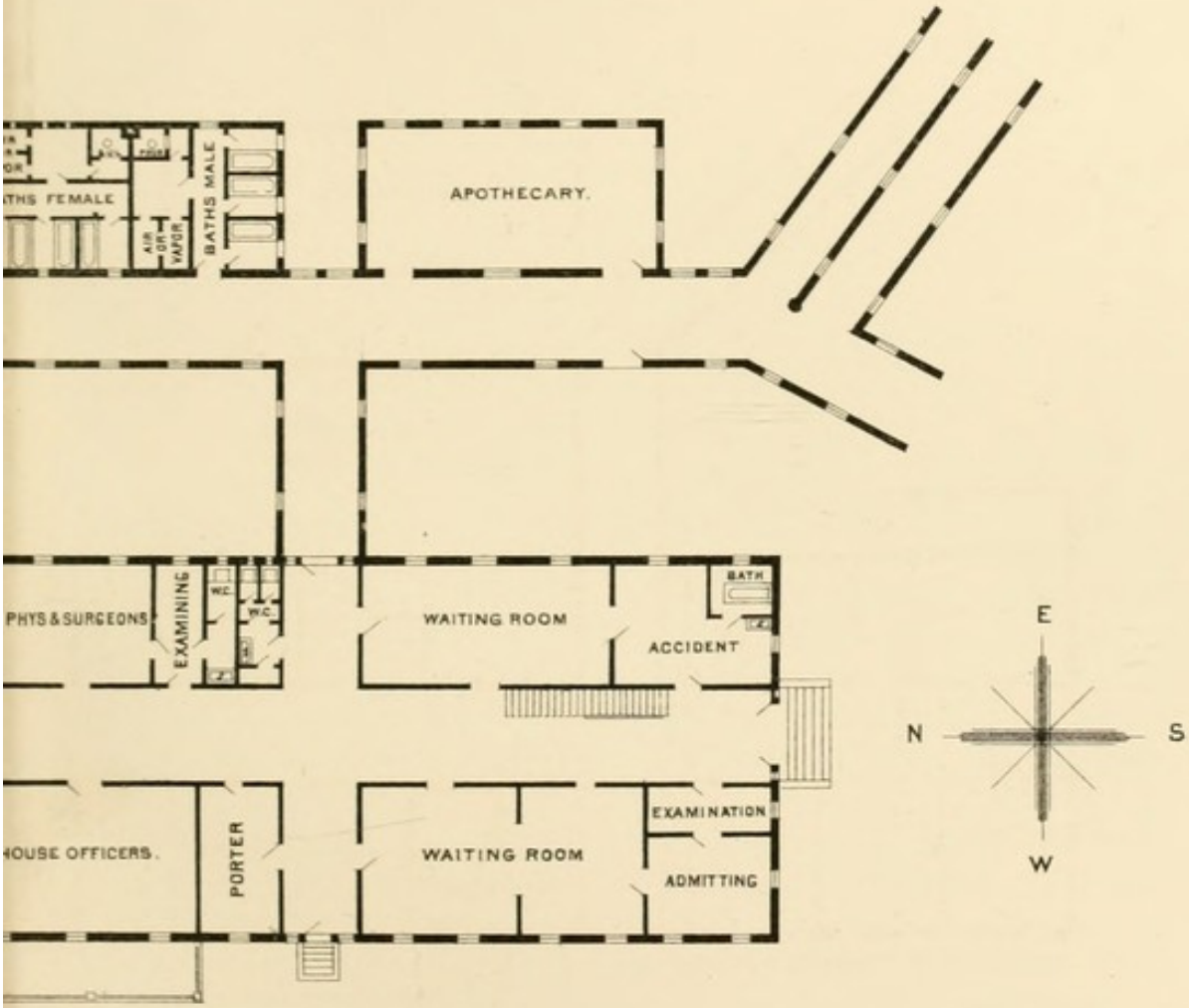
PLAN OF ADMINISTRATION

FIRST FLOOR.

Dr. Folsom's Suggestions

FOR

JOHNS HOPKINS HOSPITAL.



BUILDING.

SCALE, $\frac{1}{32}$ IN. = 1 FT.

Cesspools, if required in connection with the smaller drains, would be placed near the paths, to facilitate the necessary annual emptying process.

ADMINISTRATION BUILDING.

Plate No. 2 is a plan of the first story of the administration building and its appurtenances.

The main building is 250 feet long and 50 feet wide, divided longitudinally by a hall, 12 feet wide, intersected by three equidistant cross-entries. The central cross-entry, 12 feet wide, opens on the front veranda, 100 feet long and 8 feet wide, by the front door of the building; and at the opposite end of the entry, the central rear door leads by a few steps to the courtyard behind the building, and opposite to these, other steps lead to the centre of the main or connecting corridor.

The northerly cross-entry, 10 feet wide, passes from a door in front, seldom used, to a short cross-corridor of the same width, leading to the northerly end of the main corridor.

The southerly cross-entry, also 10 feet wide, passes from the principal business entrance, opposite the front gate, to a short cross-corridor of the same width, leading to the main corridor, which is also 10 feet wide. The corridors leading from this main corridor to the wards are 7 feet wide. All the corridors are to be very low studded; allowing about 7 feet below the steam and water-pipes, which are recommended to be wrapped in asbestos, covered with canvas and painted, and hung along the corridor ceiling, in plain view.

The northerly end of the building, beyond the cross-entry, is appropriated to the Resident Physician and his family. It opens on the cross-entry by two doors with a small lobby between. A projection or ell at the north-east corner gives opportunity for a south window. The situation of a kitchen (more for serving food than for cooking) and a dining-room are indicated, but further details are left unsettled. If it were found that all the room in the upper stories was not needed for the Resident Physician, the partition wall could be placed further to the north in those stories, without departing from the idea of a dwelling for him, separate from the Hospital, yet readily accessible. A speaking-tube at the door on the cross-entry should communicate with his bedroom.

Opening on the northerly cross-entry are two closets, and a lavatory and water-closet for the use of officers.

Between the northerly and central cross-entries is, in front, the business office or counting-room of the Resident Physician, about 22 by 19 feet, including a strong room for account-books, records, and valuables.

Next is a room for meetings of the Board of Trustees, about 29 by 19 feet. On the other side of the main hall are a dining-room for the officers of the Hospital, about 20 by 15 feet; a sewing-room and a matron's office, each about 15 feet square.

Between the central and southerly cross-entries is, in front, a small parlor or reception-room, for general use, about 19 by 12 feet. Next is the office of the house officers, about 29 by 19 feet, containing eight desks, and in the corner, not indicated on the plan, a ventilated cupboard and sink for the examination of urine. One window is arranged for the convenient use of the microscope. A small medical library of books of reference should be placed in this room, in the custody of some one house officer; and a glazed case should be provided for certain surgical instruments and apparatus liable to be needed suddenly. Next to this room is the porter's office, about 19 by 10 feet, where the head porter remains by day, and where he sleeps by night. On the other side of the main hall, next to the central cross-entry, is a library room, about 15 feet square, containing entertaining books for patients' use. A catalogue of the library should be kept in each ward, and there should be a stated time for the nurses to procure and change the books for the patients. In the corner of this room, and also accessible from the central cross-entry, is a water-closet for the use of the females employed in this part of the institution. Next the library is the room, about 19 by 15 feet, appropriated to the visiting staff. Here consultations would often be held. Adjoining is an examining-room, about 6 by 15 feet, and beyond it a lavatory and water-closet. Next to this, and opening on the southerly cross-entry, is a lavatory, with a housemaid's closet, and two water-closets,—one to be kept locked for the use of male employees, the other for the use of persons from the waiting-rooms near by.

The portion of the building south of the southerly cross-entry contains in front a double waiting-room, about 36 by 19 feet, for applicants for admission, and other persons calling on busi-

ness. Beyond is the admitting office of the Resident Physician, about 16 by 12 feet, and leading from it an examination-room, about 16 by 6 feet, which also gives access to the main hall, and thence to the accident-room on the opposite side, about 15 by 20 feet; where are several beds covered with rubber sheeting, for the temporary reception and examination of "accidents" and persons too sick to sit up. Here are kept tourniquets and dressings, for the prompt arrest of hemorrhage, and a tray containing ether and restoratives. A sink and a bath-room are placed in the corner, the latter being only for exceptional use in emergencies, or when patients are unable to go to the regular bath-house. Next the accident-room is a waiting-room for visitors to patients, about 15 by 32 feet. There should be a regular hour for the admission of these visitors, arranged so as not to interfere with the visits of the physicians and surgeons.

In the rear of the main building, on the easterly side of the main or connecting corridor, are three low, one-story buildings. The most northerly of these, about 52 by 18 feet, is appropriated to household supplies—bedding, crockery, utensils, etc.—which are given out as needed, under the direction of the Matron, a regular time being established for issuing, and the head nurses of wards being made to account for all deficiencies in their supplies of articles. It opens on the corridor by two doors, one of which is double.

Immediately to the south of the most central cross-corridor is the bath-house. The portion appropriated to females, about 19 feet square, opens on the cross-corridor. On the right of a central entry are three ordinary bath-rooms, about 6 feet square. On the left of the entry is a room 7 by 8 feet, for shampooing and douche bathing. From this open two hot-air or vapor closets, of different temperatures, and a specially ventilated closet for sulphur baths. The other half of this building, exactly similar, is appropriated to males, and opens on the main corridor. This building, as drawn, is of the smallest dimensions consistent with usefulness. More space might well be allowed for it. It should be under the charge of an assistant nurse, who should keep both portions clean and in order, and who should be instructed in rubbing and applying electricity to female patients, ward tenders doing the same for male patients.

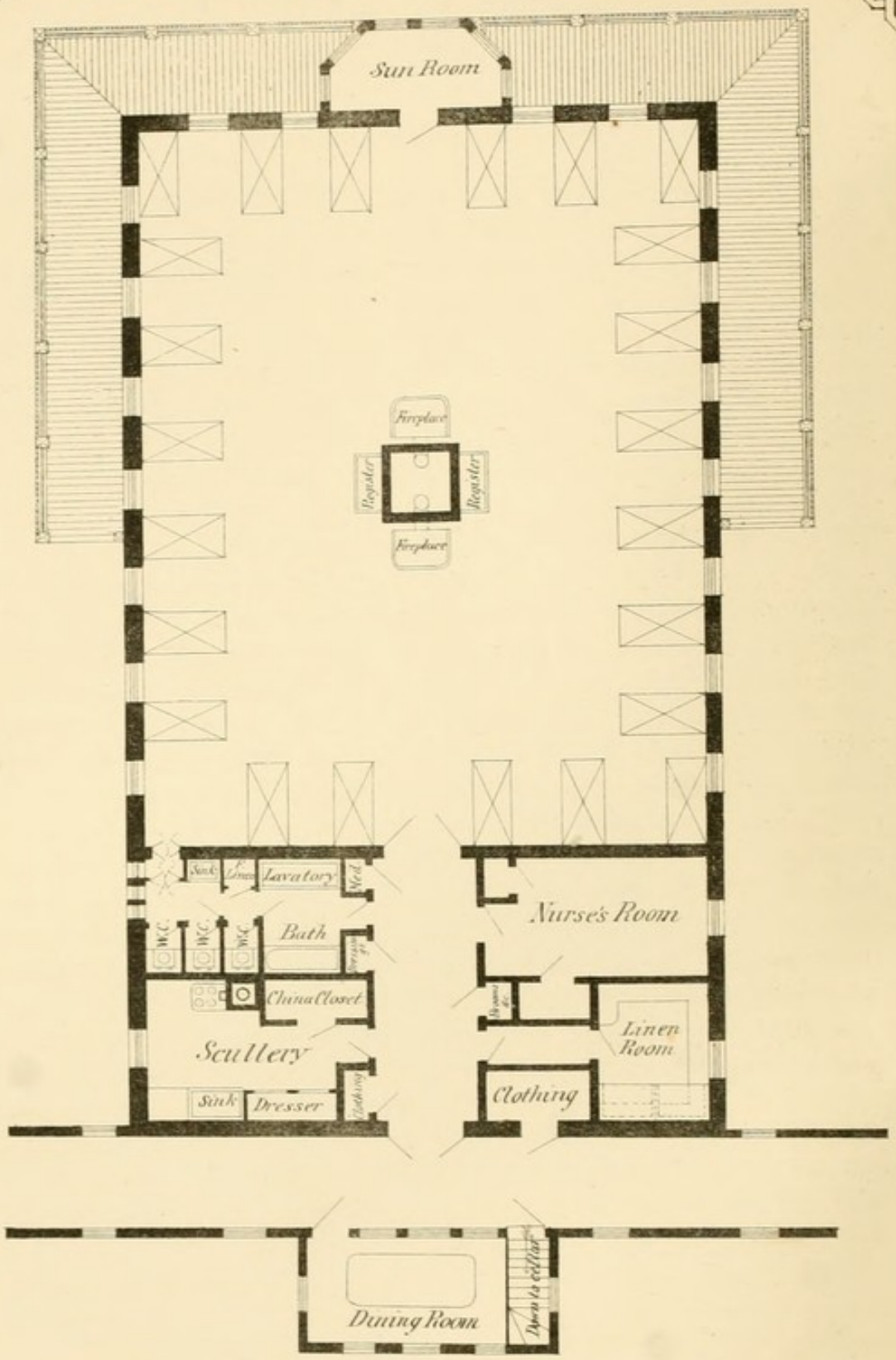
Ten feet south of the bath-house, the interval being left for

light and air, is the dispensary, about 38 by 18 feet—opening on the corridor by two doors, one of them double, and a central window—devoted to the preparation and dispensing of drugs. The orders of the attending staff in respect to medicines and stimulants are transmitted in writing to the apothecary by the house officers, and the head nurses receive the remedies prescribed at the window, every bottle being distinctly labelled with the patient's name, the number of the ward, and the nature of the preparation. Articles for external use should be dispensed in bottles of peculiar shape or color; and poisons, besides having a special label, should be put in phials having small projections from the surface, and hence distinguishable in the dark. These phials are obtainable as a regular article of trade, and their general introduction and use is very desirable.

Opposite the dispensary, on the corridor wall, would be a series of knobs, with a directory, governing electric bells placed in every ward and in the principal other buildings, summoning the nurses and other employees. This place is sufficiently central, and, as the apothecary uses the ward-bells more frequently than any one else, they are placed near him.

South of the dispensary are three branch corridors before alluded to, the most westerly one leading directly from the out-patient building. Out-patients will enter this corridor for two purposes only: to go to the dispensary for remedies prescribed, or to reach the admitting-room, when sent to the Resident Physician with a recommendation for admission from the physician or surgeon to out-patients. It is proposed that a *red stripe* on the right-hand wall should serve as a guide to the dispensary, while a *blue stripe* on the left-hand wall, leading around the corner into the main building to the front waiting-room, would enable the patients to find their way to this point, verbal instruction being given them to follow the *red* or the *blue* line, as required.

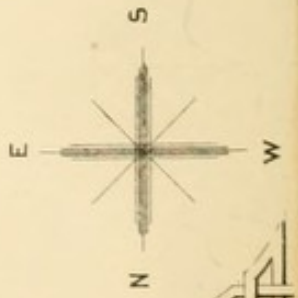
No chimneys have been drawn in the administration building, but open fireplaces would be desirable in many of the rooms, for ventilating purposes if nothing more. The basement, reached by stairs immediately beneath the main stair-cases, should contain steam-radiators sufficient to thoroughly heat the building; flues, with registers, conducting the warm air to every room, and especially to all water-closets, which should each have a special



No. 3.

PLAN OF COMMON WARD.

SCALE 1/16 IN. = 1. FT.



DR. FOLSOM'S SUGGESTIONS, FOR JOHNS HOPKINS HOSPITAL

outlet behind the seat, leading to a chimney or to a flue in the outer wall, opening beneath the eaves.

The second story, of which no drawing is presented, would be appropriated to officers and female employees. Two of the cross-entries, required in the first story, would serve no useful purpose on this story, as sufficient light could be supplied by sashes over the doors. The central one, to which the central stair-case leads, might be retained. Narrow cross-entries might be desirable at other points, to afford more private access to water-closets, etc. The two series of rooms, opening on the long entry, would be appropriated as follows:

For the assistant physician, a room with a bed-room and bath adjoining. For the matron and the apothecary, the same. For the eight house officers, four double bed-rooms, with a bath-room and lavatory between each two. A speaking-tube leading from the entry below to the bedside of each house officer, would enable the night nurses to communicate with the particular officer whose services might be required, without rousing all.

The southerly portion of this story, separated from the rest by a partition across the hall, would give ample room for dormitories for the assistant nurses, with bath-rooms and water-closets, and one or more sitting-rooms. The assistant matron should room among them, and maintain discipline without interfering with proper relaxation and cheerfulness.

A third story would probably be required only at the centre and at the ends of this building. Room should be reserved for a series of water-tanks, supplied from the street, connected with each other by pipes with valves so arranged that the supply of the institution could be taken from any one tank, or from all, at will. They should have capacity for at least three days' supply for the whole Hospital; or say 50,000 gallons.

The remaining portions of the third story would furnish rooms for all female employees not provided for in the second story; and there should be bath-rooms and water-closets for their use.

COMMON WARDS.

Plate No. 3 is the ground plan of a common ward.

The room for patients, about 56 by 43 feet, is calculated for 23 beds. A central chimney-stack, 6 feet square, gives opportunity for two large "Franklin stoves" or detached fireplaces, for soft

coal, wood, or coke, made of soapstone, placed on the northerly and southerly sides, the flues of which are cast-iron pipes 10 inches in diameter. On the easterly and westerly sides are two large drums or registers, with grated fronts and ends, which supply fresh, warm air to the ward. The distance between beds is 4½ feet. In wards occupied by patients with suppurating wounds or active fever, the three corner beds might be removed, or kept empty; but it is believed that the system of ventilation and air supply herein suggested would prove ample for the full capacity of the ward. In practice, convenience requires that there should be at least one vacant bed in a ward, at all times, for facility of change.

The shape of this room for patients differs from that usually adopted in pavilion wards. The advantages of a nearly square room with a central stack are the *privacy* of each bed, as compared with its situation in a long hall without obstruction to the view; the absence of *draughts*, the fireplaces and warm air supply being nearly equally distant from all parts of the ward, and the chimney-stack by its volume and position interrupting and mixing accidental air-currents; and the ease of administration; the beds being nearly equidistant from the supplementary rooms of the ward.

This form of room was suggested by the late Mr. George M. Dexter, and adopted by the trustees in enlarging the Massachusetts General Hospital in 1844; and, in constructing a pavilion ward in 1872, described and figured in the report of the trustees for the year 1873. I do not think that the attractive, home-like character of such rooms, in comparison with long, narrow wards, can be appreciated without seeing both in occupation.

A veranda, 7 feet wide, extends around the southerly half of the ward, so that shade or sunshine, as required, in the open air, can be obtained at all times of the day. A *sun-room* or glazed porch, 13 by 6 feet, for use in cold weather, occupies the centre of the south veranda.

The ward is entered by a double door-way 6 feet wide, over which is a large window, shown in Plate No. 6, which, with the window in the gable shown in Plate No. 5, gives light and free circulation of air in mild weather, to the entry and northerly part of the ward. The entry is about 7½ feet wide, and, as shown in Plate No. 6, is 17 feet high; and the rooms which lead

from it are 11 feet high. These rooms are as follows: The nurses' room, where the head nurse sleeps at night, and where any private examination of patients is made; 17 by 9 feet, with two closets, one large enough for trunks; heated by a stack of steam-radiators beneath, with the arrangement shown in Plate No. 15; with a ventilating flue in the wall, with an opening near the floor, and an outlet beneath the eaves.

Next this room is a small closet for brooms, dust-pans, etc.

Next is an entry, 3 feet wide, with shelves on one side, leading to a linen room, about 11 by 8 feet, lined with shelves made of narrow slats, for linen, pillows, etc., and with a set of tight drawers to hold blankets. This room has a cold fresh air duct, and an outlet beneath the eaves.

Next this is a closet about 8 by 4 feet, opening on the corridor, for patients' clothing, provided with shelves and hooks, with a cold fresh air duct, and an outlet beneath the eaves.

On the easterly side of the entry are three closets, respectively for medicines and stimulants, dressings, and for patients' hats and outer clothing, the latter closet having a ventilator beneath the eaves. The medicine closet is kept locked, under control of the head nurse. The dressing closet is the receptacle of articles of daily use, placed here to avoid having any cupboard, case, or closet, in the main ward-room. A shelf at the top of the head of each bedstead, and a drawer in the small wooden table beside each patient, should be the only places where anything can be "put away" in the ward-room, and these should be frequently inspected by the nurses. A list of the contents of the medicine and dressing closets, and of the furniture required for a general ward, is appended to this paper.

On the easterly side of the entry, next the corridor, is a scullery, about 14 by 11 feet, containing on one side a dresser, where food is prepared and carved, and a sink and drain-board; on the other, a china-closet, and a small portable range, for preparing gruel and light diet, and keeping food warm.

The flue of this range is a cast-iron pipe, which occupies the centre of a chimney two feet square, the outer space of which ventilates the water-closets and bath-room adjoining, and, by an opening at the top of the room, the scullery itself.

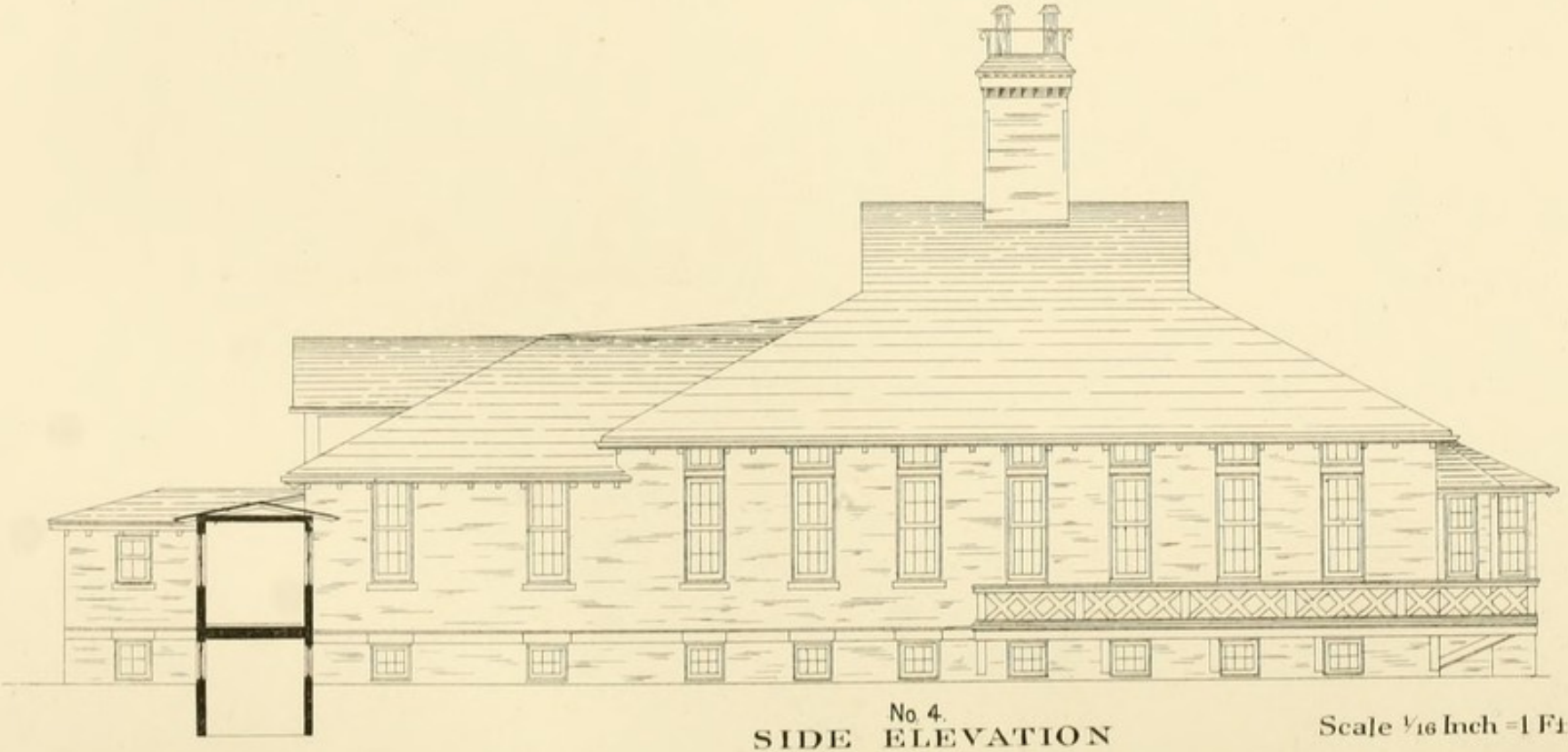
The three water-closets occupy a space or room, entirely surrounded by a wall of brick from the foundation, so as to make

it practically a separate building, about 9 feet square. The floor should be tiled. Access is gained from the ward by two sets of double doors, swinging both ways, and closed by springs. The space between the doors is ventilated by a window. The construction of the water-closets is shown in Plates No. 24, 25, and 26. The most easterly one is for patients' use. The middle one would be commonly used for emptying and cleaning bed-pans, and should have a short hose at the side for this purpose. Opposite it is a sink for washing spit-cups and dressing basins. The third water-closet is especially for the nurses' use, and can be reached through the bath-room; and a blind-door separates it from the others. Opposite it is a receptacle for the ordinary soiled linen and clothing of the ward, which should be carried to the laundry frequently; the badly soiled linen, dressing cloths, etc., being conveyed to the rinsing-room in pails, as soon as removed from the patients. The water-closets are heated by a steam radiator beneath, arranged as in Plate No. 15.

Next the water-closets is the bath-room, about 9 by 6 feet. On one side is a soapstone sink, supplied with tin basins, for patients' use. On the other side is a movable bath-tub, on wheels, with a drain-pipe in the floor under the outlet, and hot and cold water faucets in the wall, for filling it. It can be used *in situ*, or rolled to the side of a patient's bed if required. It would be used comparatively infrequently, as all patients able to go to the regular bath-house should do so. This room would be heated and ventilated like the water-closets.

On the north side of the corridor, opposite the entry, is a dining-room for the use of patients when able to leave the ward, 20 by 10 feet, and about 7 feet high, with windows all around, to be kept open in summer; heated, like the corridors, by direct radiation. At one end, a staircase affords access to a small coal-cellar beneath; the cellar of the main building being devoted entirely to the heating and ventilating apparatus. The cellars should be paved with asphaltum throughout, and the windows, being supplied with wire nettings to keep out cats and vermin, should stand open in all moderate weather; the steam pipes being wrapped with asbestos to save waste condensation.

Plate No. 4 is a west side elevation, and No. 5 a north elevation of a common ward. No. 6 is a longitudinal section, and No.

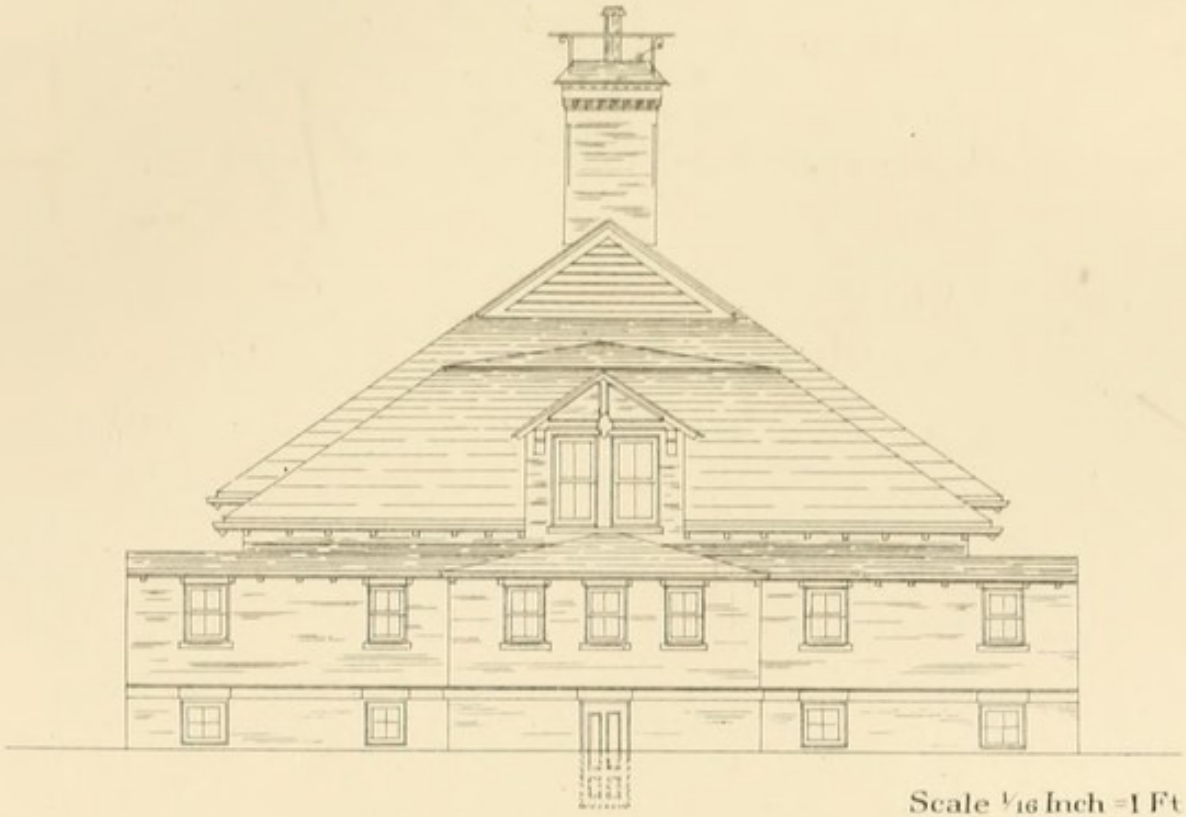


No. 4.

SIDE ELEVATION

COMMON WARD.

Scale 1/16 Inch = 1 Ft.



Scale 1/16 Inch = 1 Ft.

No. 5.
NORTH ELEVATION
COMMON WARD.

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7 a cross-section of the same. The relative height of the different parts of the building are shown in the elevations. At the apex of the main part, the roof is continued out, north and south, about 8 feet, to form louvered gables. The roof of the northerly lower portion is truncated, and the flat part is tinned. From this level runs out the narrow gable for the north entry window. The roof of the dining-room is nearly flat, and but little higher than the corridor roof. All the roofs have projecting eaves. The corridor is drawn 7 feet high inside, but would need to be a little higher, to accommodate the steam pipes, etc. All corridors should be *kept low* so as to obstruct air-currents as little as possible.

The room for patients is 14 feet high at the wall, and is finished into the roof so as to be about 20 feet high at the centre. The superficial area provided for each bed is over 100 feet. The cubic space for each bed is over 1,600 feet. The purity of the air of a ward depends rather upon the rapidity with which it is changed than on the capacity of the room, but in a large room, to say nothing of the cheerfulness of its aspect, a free supply of air does not create perceptible draughts, and temporary emanations from patients give rise to little annoyance.

Between the beds, on three sides of the ward, are windows 3 feet wide, 3 feet from the floor, and 10 feet high; with ordinary sashes below, and the upper two feet, above a transom, having a sash hung on hinges at the bottom, opening inward to a limited extent, and provided with wings or sides of sheet copper, which convert it into a sort of hood when open; so that the entering air is directed upward to the sloping ceiling instead of sinking downward directly on the patient below. These windows are protected by the projecting eaves. (See figure on next page.)

It is worthy of consideration whether all sashes should not be doubly glazed, with an air-space between the panes to make them better non-conductors of heat; which would be desirable in both hot and cold weather. The only objections would seem to be the slight additional *expense* and *weight*. As a substitute for the outside sashes sometimes applied to exposed windows in winter, their merit seems obvious.

Corresponding to the ridge ventilators in an army pavilion are two large openings in the ceiling of the ward, controlled by valves and cords, and leading into the ridge-space around the chimney shown in Plate No. 6.

The ends of this space are the louvers, shown also in Plate No. 5, behind which are valves worked from below. In cold or

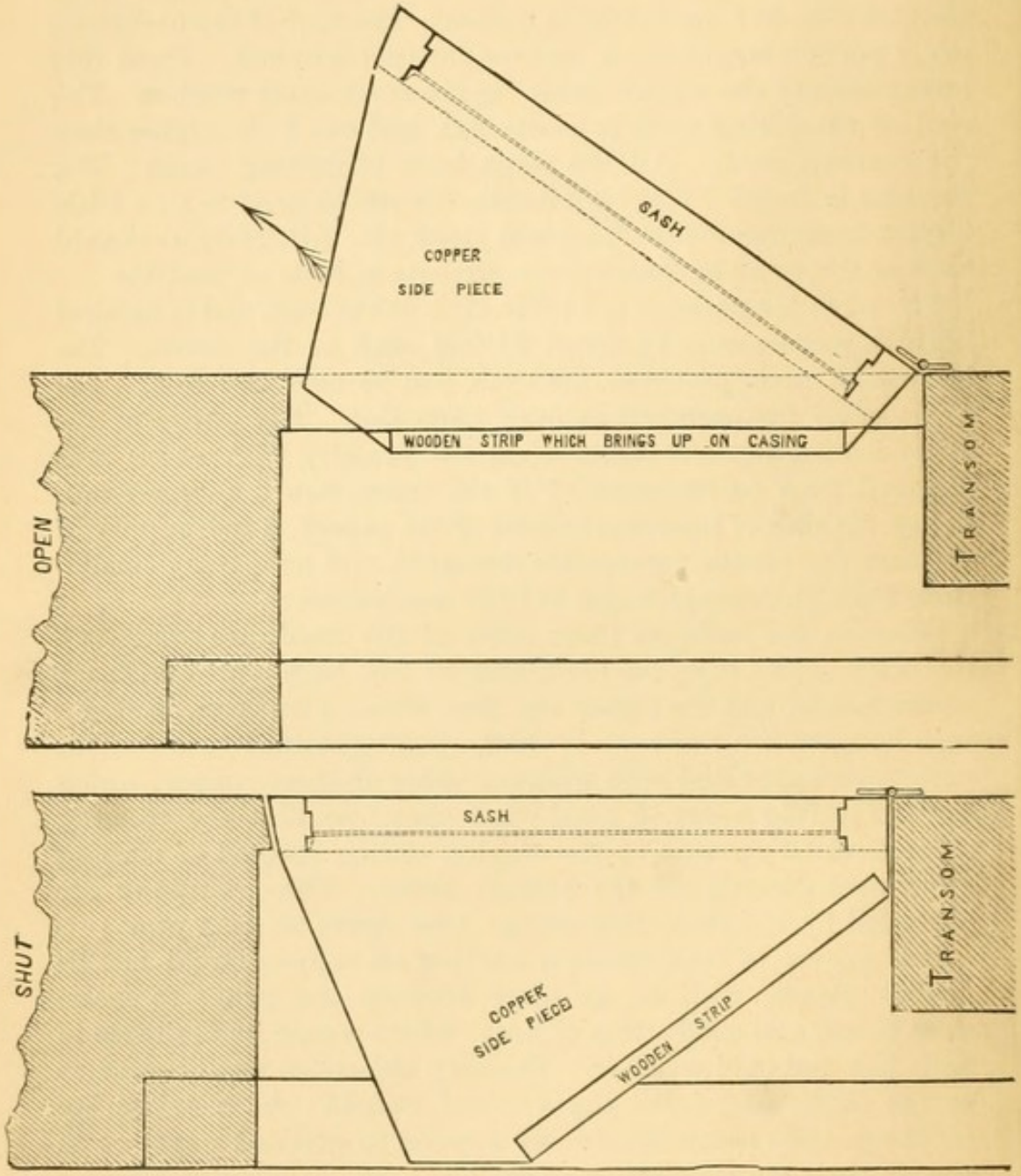
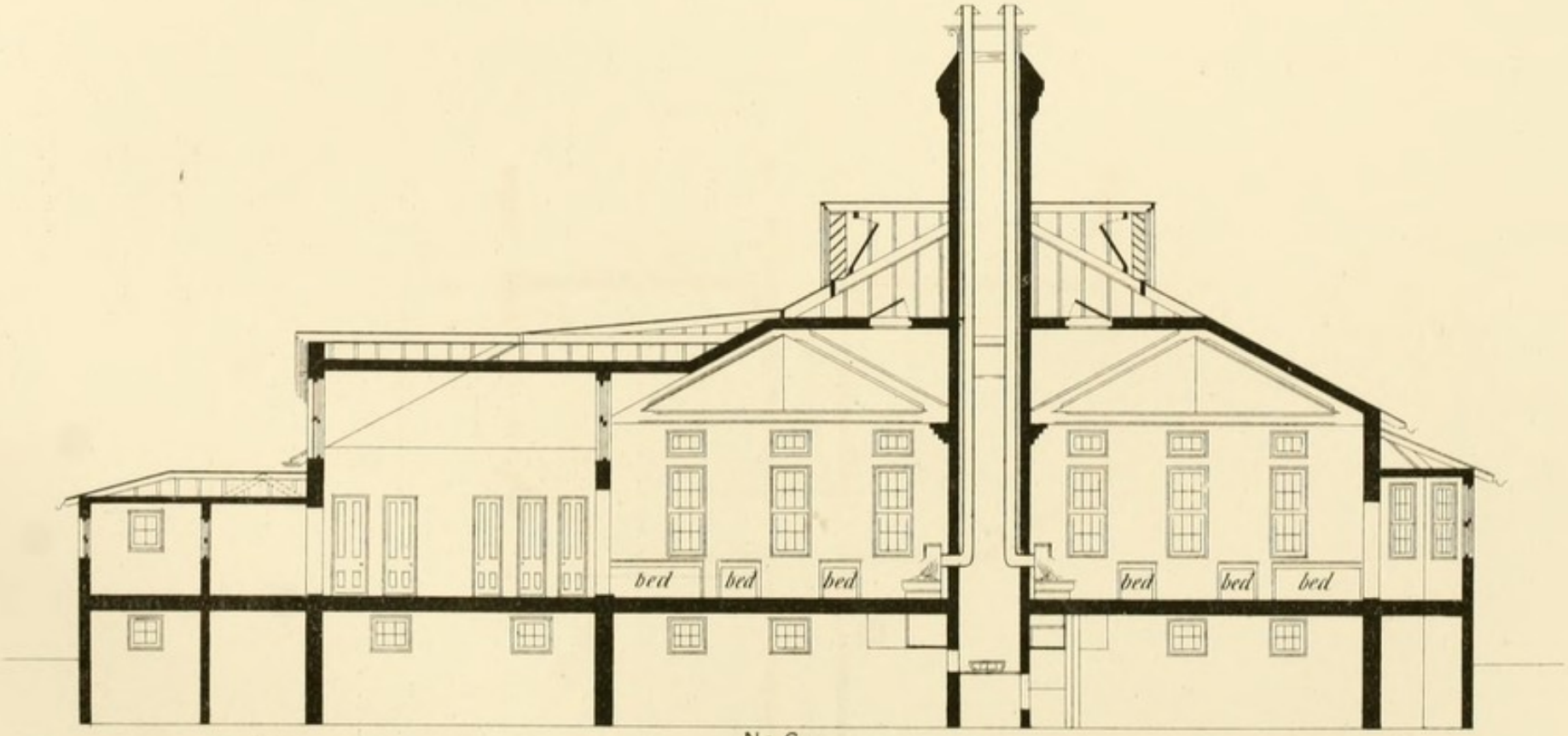


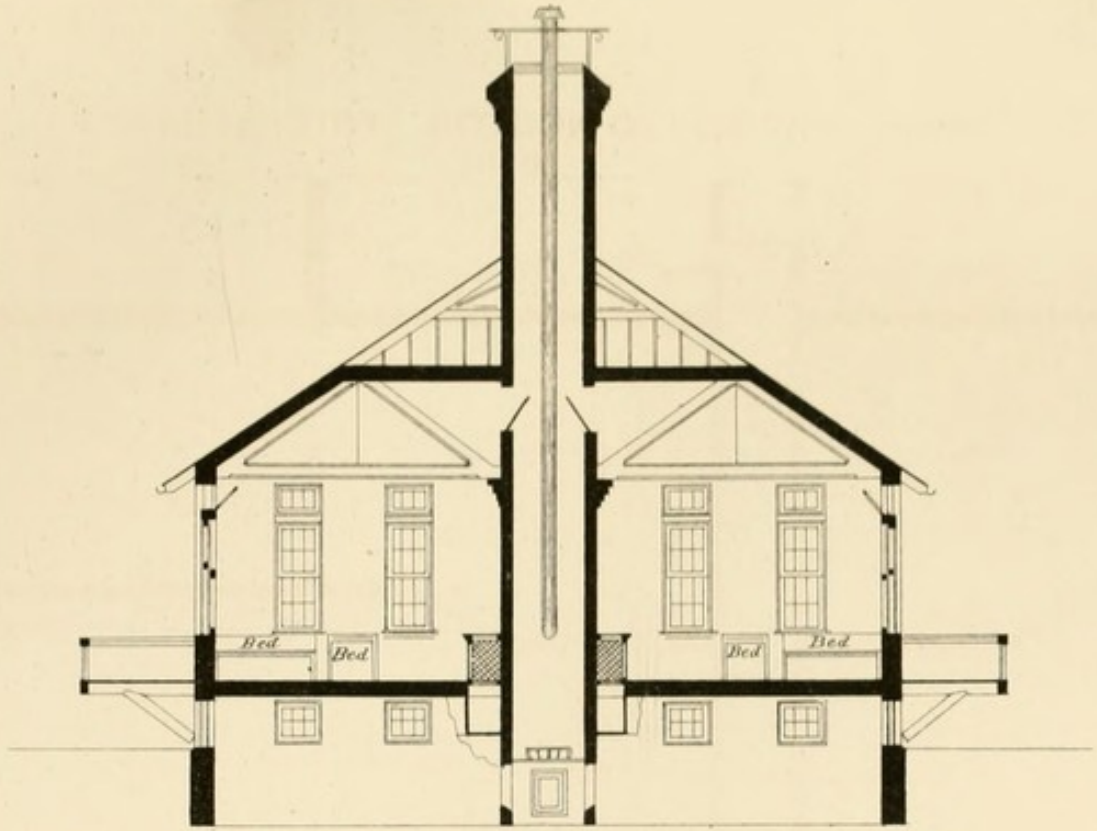
DIAGRAM OF TRANSOM WINDOW WITH SIDE PIECES.

stormy weather the louver to windward would be *closed*, to prevent a downward draught unimportant in mild and pleasant weather, when all the orifices would be freely open. In very cold



No.6.

LONGITUDINAL SECTION OF COMMON WARD.



No. 7.

CROSS SECTION

COMMON WARD.

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weather, this ceiling ventilation would be used only when, as at the dressing hour in surgical wards, rapid change of air would be desired; the usual and principal means of ventilation being the central chimney.

The upward draught of the chimney is secured in weather cool enough to call for any artificial heat, by the passage through it of the two cast-iron flues of the Franklin stoves, shown in Plate No. 6. These are intended to be used in preference to the steam-heat, when both are not needed, as, for instance, on many spring and autumn days. These fireplaces and iron flues are, of course, themselves active ventilators by their own draughts. At the bottom of the chimney is seen a basket-grate of iron, hung in the middle of the main shaft. In weather so warm that artificial heat is objectionable, but when the air seems heavy and stagnant, as in the "dog-days," a coal-fire is to be made in this grate through a door in the cellar, and, smouldering all day, it will keep the air moving steadily up the shaft, while no heat reaches the ward. The ashes which fall through the grate are removed by another door below.

For this suggestion I have to thank my friend, Mr. A. C. Martin, architect, of Boston, whose authority in the matters of ventilation and heating is well recognized, and to whom I am indebted for many hints and criticisms during the preparation of this paper.

The ventilating ducts leading to the shaft are shown in Plates Nos. 10 and 11. Arising by twelve vertical grated openings in the side walls, these ducts descend to below the level of the cellar floor, and directly seek the chimney, which they enter above the floor by two openings on the east and west sides, 4 by 2½ feet each. These openings are proportioned to the size of the ducts, which are each 1 by 2 feet. Near the ceiling are two openings from the ward into the main shaft, controlled by valves worked from below, for exceptional use—like those leading to the ridge space—when it is desired to rapidly evacuate the air at the top of the ward.

The steam heating apparatus and ducts supplying fresh air to the ward are shown in Plates Nos. 8 and 9. To insure a rapid supply of cold air, whichever way the wind blows, we have two ducts to each stack, the one to windward being opened, and the one to leeward closed by valves worked from above. The ducts,

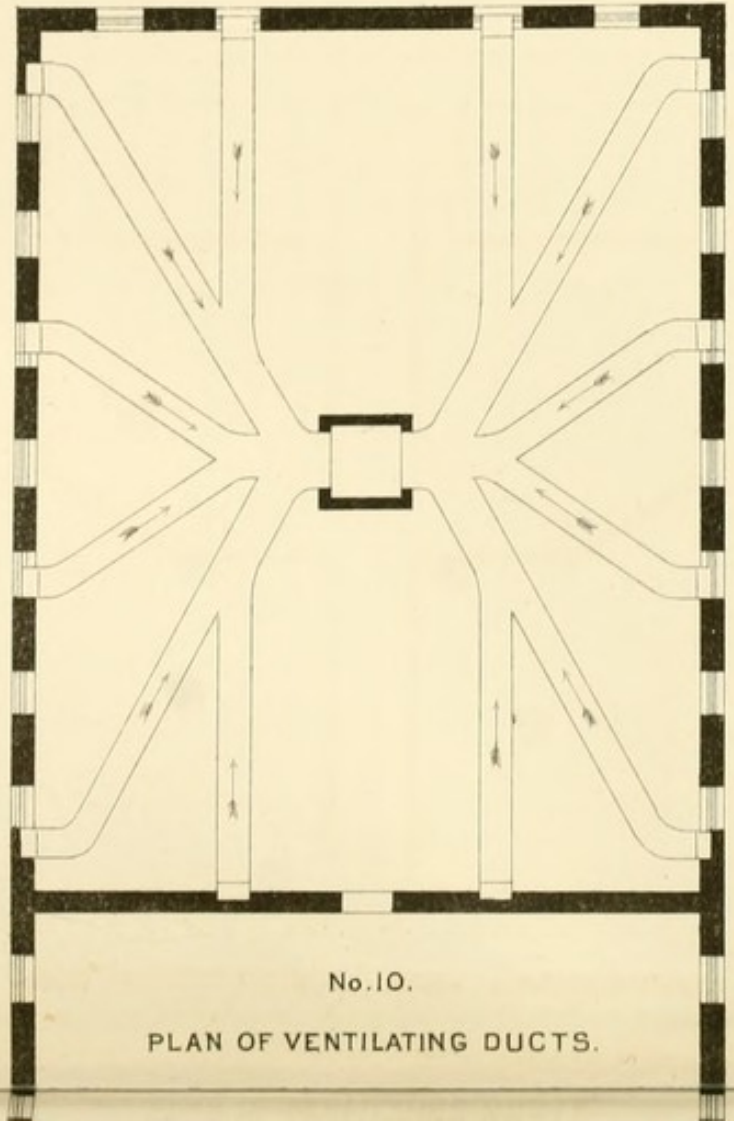
each 3 by 2 feet, run from grated openings just beneath the veranda, along the ceiling of the cellar to reach the stacks of steam-heated radiators, which, enclosed by a non-conducting wall of brick, are placed at the corners of the chimney. At the junction of the air-duct with the enclosure of the radiators is a mixing valve, similar in action to that shown in Plate No. 15, controlled from the ward above. This valve directs the air either *downward*, so as to pass up again through the radiators and be strongly heated and then reach the ward through the drum above; or, the valve being lowered, the air passes *laterally* over the top of the radiators and reaches the ward through the drum very slightly tempered; or again, the valve being placed at the proper intermediate position, part of the air goes one way and part the other, and can be made to enter the ward at any temperature desired.

The air-ducts pass immediately beneath the Franklin stoves, and a register might be placed under each, connecting with the duct, to be opened when the *stoves alone* should be in use; so as to bring the entering current of air, which is supposed to be *constant in all weathers*, directly in contact with the stoves, which are made double, to allow the air to pass up between the layers of soapstone and be heated.

In warm weather all windows and orifices in the ward would be freely open, so that the patients would come as near to living in the open air as is desirable, and much nearer to it than would be possible in a two-story building. It is my belief that *tents*, so extravagantly lauded by some writers for hospital purposes, would be inferior to this pavilion in comfort and healthfulness, in *any* weather.

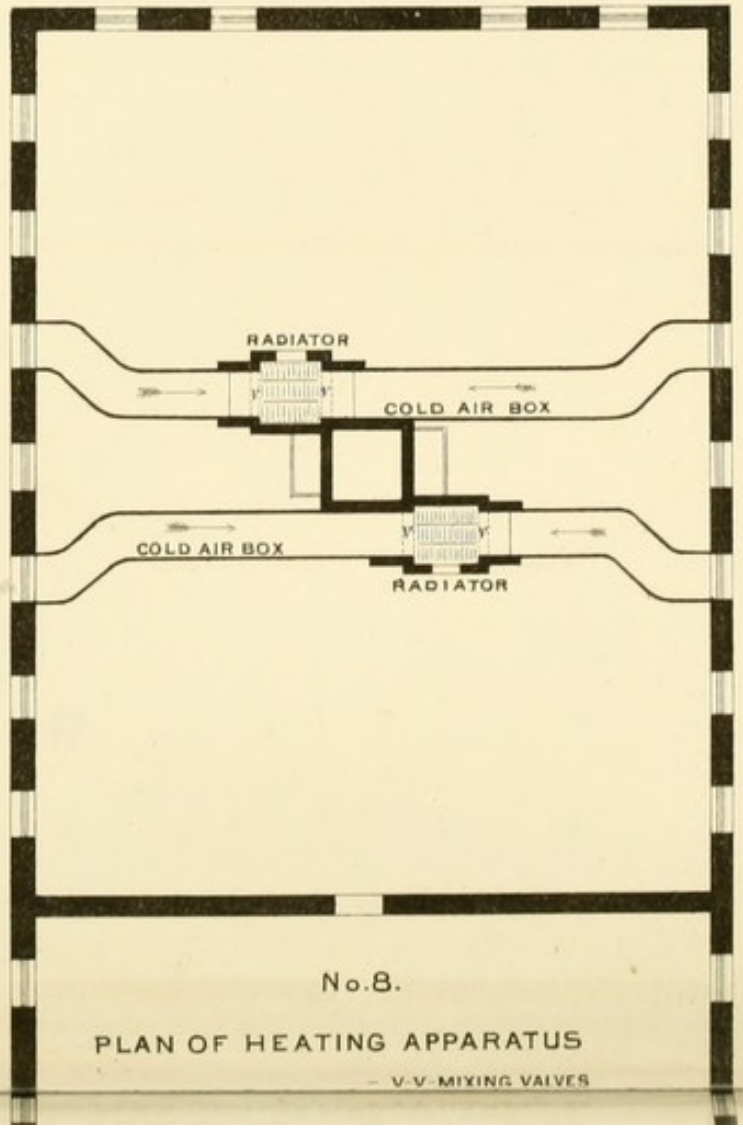
In weather requiring the great body of the air supply to be artificially warmed, the windows and top ventilators would be closed most of the time, and the general course of the air would be as follows: A large volume of very slightly heated air would enter the middle of the room, and, rising by virtue of its less specific gravity to the upper part of the room, would be diffused equally and, cooling somewhat, descend at the walls. The central fireplaces would draw a certain amount of the lower strata of air in their direction, but the greater portion would leave the ward by the peripheral vertical openings which are beneath the patients' beds. Thus the emanations from patients

COMMON WARD.



No. 10.

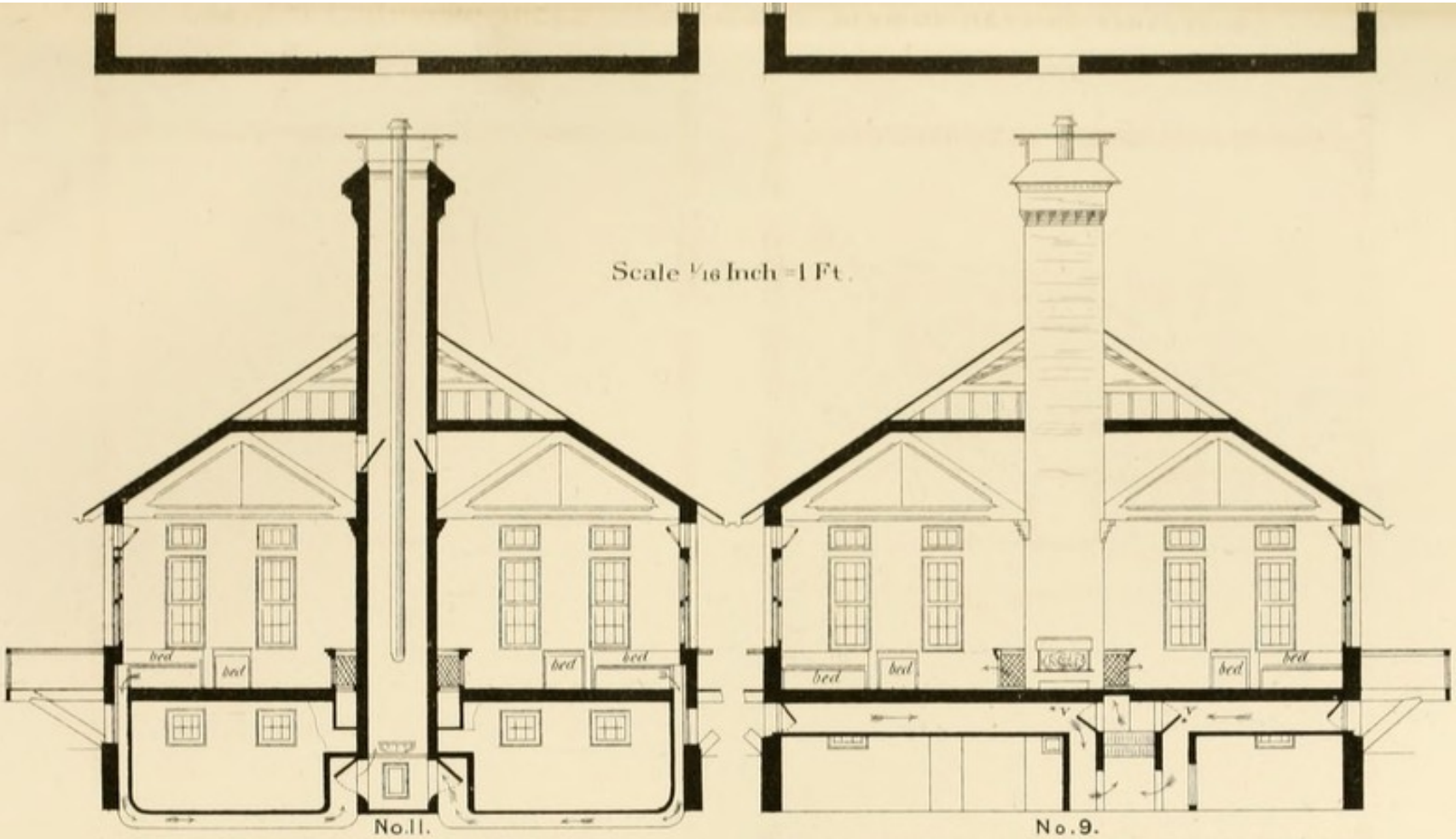
PLAN OF VENTILATING DUCTS.



No. 8.

PLAN OF HEATING APPARATUS

– V-V- MIXING VALVES



No. 11.
CROSS SECTION SHOWING VENTILATING DUCTS.
COMMON WARD.

No. 9.
CROSS SECTION SHOWING HEATING APPARATUS.
* - V.V. - MIXING VALVES.

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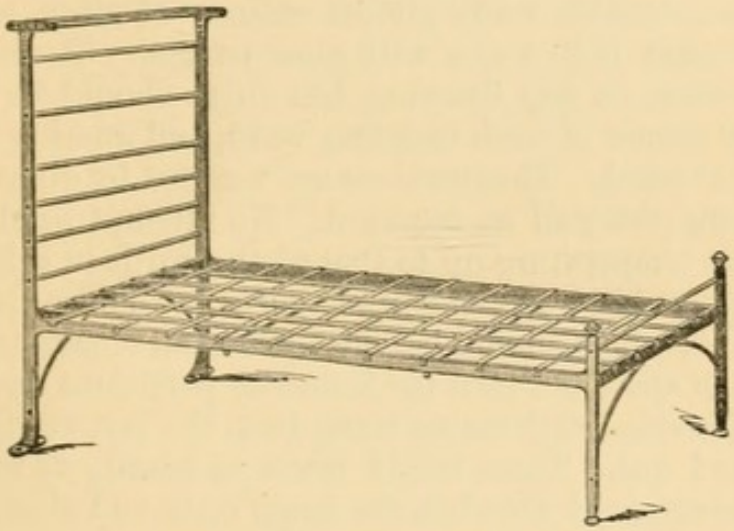
will be, to a great extent, drawn from the ward at once, by a short path, instead of becoming diffused.

The beds are high enough, as seen in the sections, to allow the air to pass freely below them. This height is recommended for all hospital bedsteads, on account of the great facility for the physical examination of patients, and for the application of dressings, etc., which it affords. The patients enjoy a better view of the world, within and without, than from low bedsteads.

The pattern in use for many years in the Massachusetts General Hospital is so satisfactory that I give a figure of it, as sup-



plied by the Tucker Manufacturing Company. It is made of wrought iron. Its length is 6½ feet, its width 3 feet, its height nearly 2 feet; and on the iron straps, which by a simple contrivance are allowed to spring a little, goes a palm-leaf under-mattress, 6 inches thick, and on this a firm hair mattress, rounded up at the middle to allow for flattening, 6 inches thick; so that the patient lies 3 feet above the floor. The head of the bedstead rises to the height of 5½ feet, and has a shelf of hard wood, 6 inches wide. An iron semi-circle, for a tester or head-curtain, attaches here, and when attached can be raised to a perpendicular position, out of the way, when desired. The horizontal rods running across the head of the bed are ¾ inch in diameter, so as not to bend when patients pull themselves up and lift themselves by their aid, as they do constantly. The whole is welded together, and made so strong and heavy as to be very firm. It does

not vibrate when touched, like an ordinary iron bedstead, and never needs repair.

ISOLATING WARD.

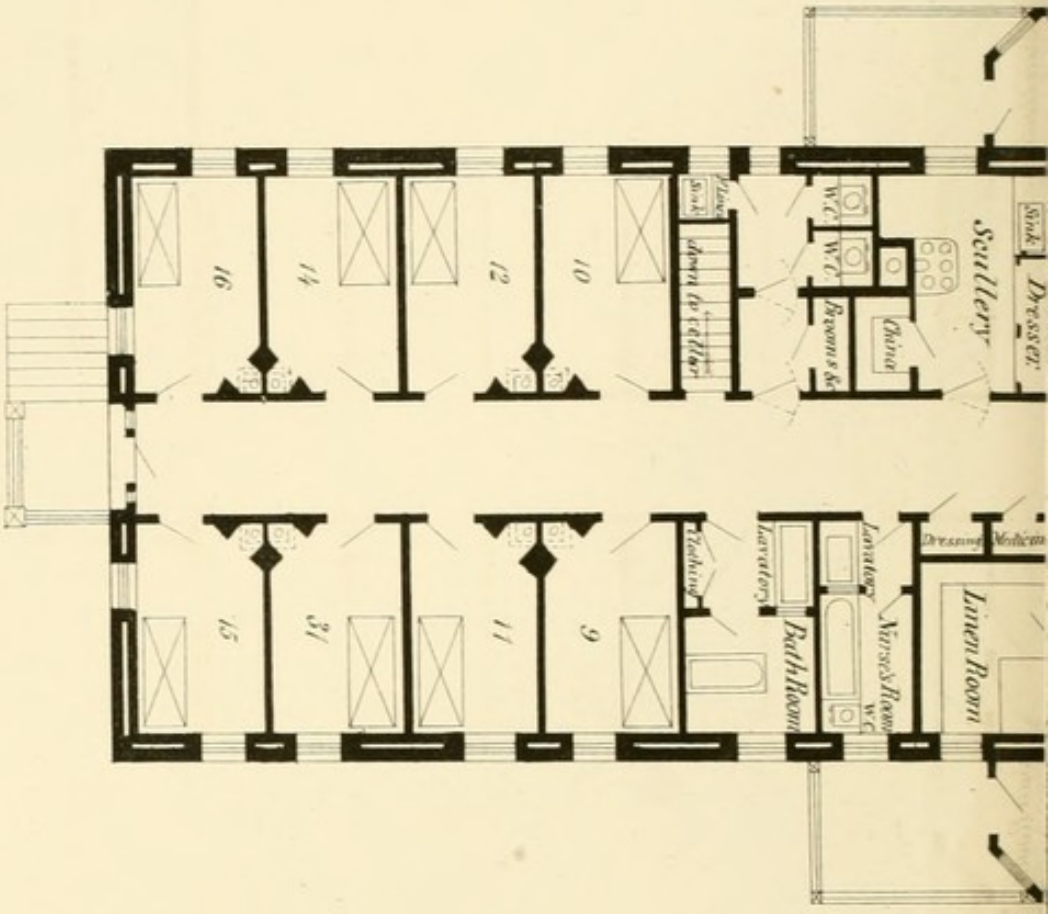
Plate No. 12 is the plan of an isolating ward. It corresponds in most respects with a pavilion lately erected at the Massachusetts General Hospital, described and figured in the Report of the Trustees for the year 1874.

The access to this building is by the cross-corridor, common to several wards. The possibility of communication by aerial currents between different wards should be precluded by partitions across the corridors made almost entirely of glass, with spring doors swinging both ways, with glass panels. These partitions are not shown on any drawing, but there should be one at the north-west corner of each isolating ward, and another between it and the next ward. The corridors are warmed by direct radiators placed along the wall as required. No attempt would be made to keep the temperature up to that of the wards in cold weather, but the air would be constantly tempered. The ventilation is by the windows, which should be wide open in all moderate weather; and in each space between the isolating partitions two windows would be provided with sashes hung from the top, swinging freely both in and out. These would move so readily as to allow the ingress and egress of air when the doors open and close, thus preventing the forcing of the air onward through the second pair of doors when the first pair are swinging.

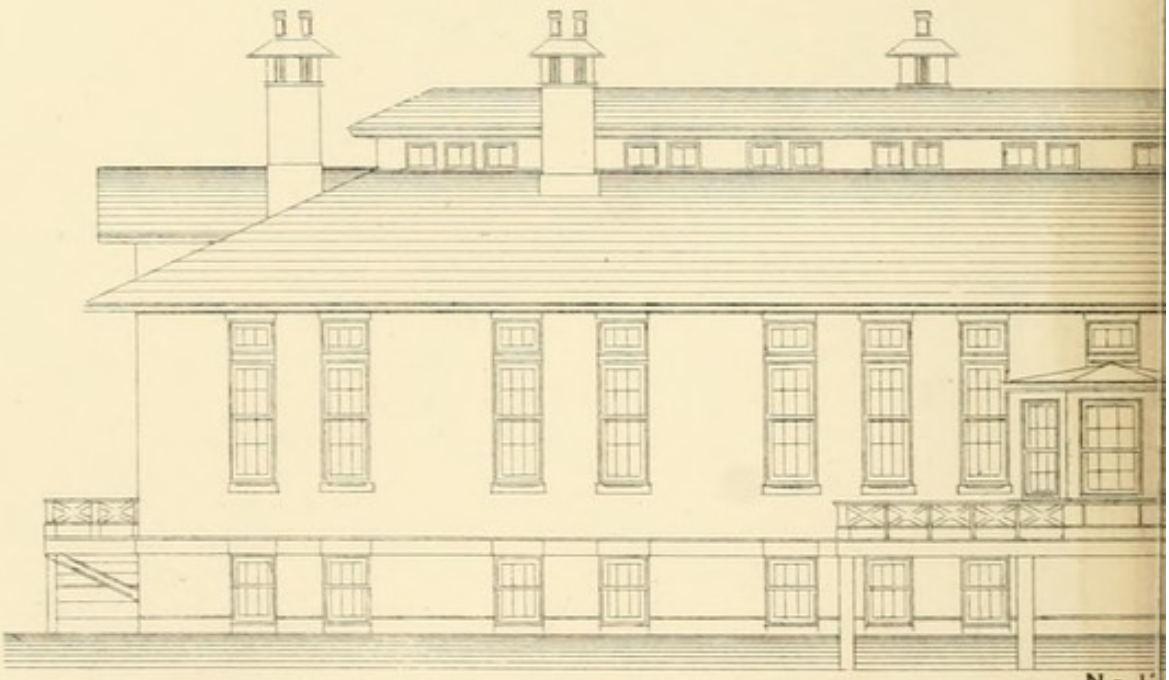
In cold weather, the lower sash of the corridor windows should be raised two inches; and a board, with a spring in the end to hold it in place, fitting the window-casing in front of the sash, occludes the opening. The air then enters *between* the sashes, without creating a draught. This contrivance, very simple and inexpensive, is recommended wherever it is desired to apply a regulator to the draught of a window, and will be useful in other parts of the Hospital.

The isolating partitions would hardly be needed, considering the distances between the pavilions, except for the isolating wards, and for such surgical wards as it might be desirable to separate from all others. A number of the partitions might be made, and stored, to be put up when required.

The isolating ward is about 113 by 37½ feet, and has 16 rooms



PLAN OF IS



No.1

EAST ELEVATION O

SCALE $\frac{1}{16}$ I

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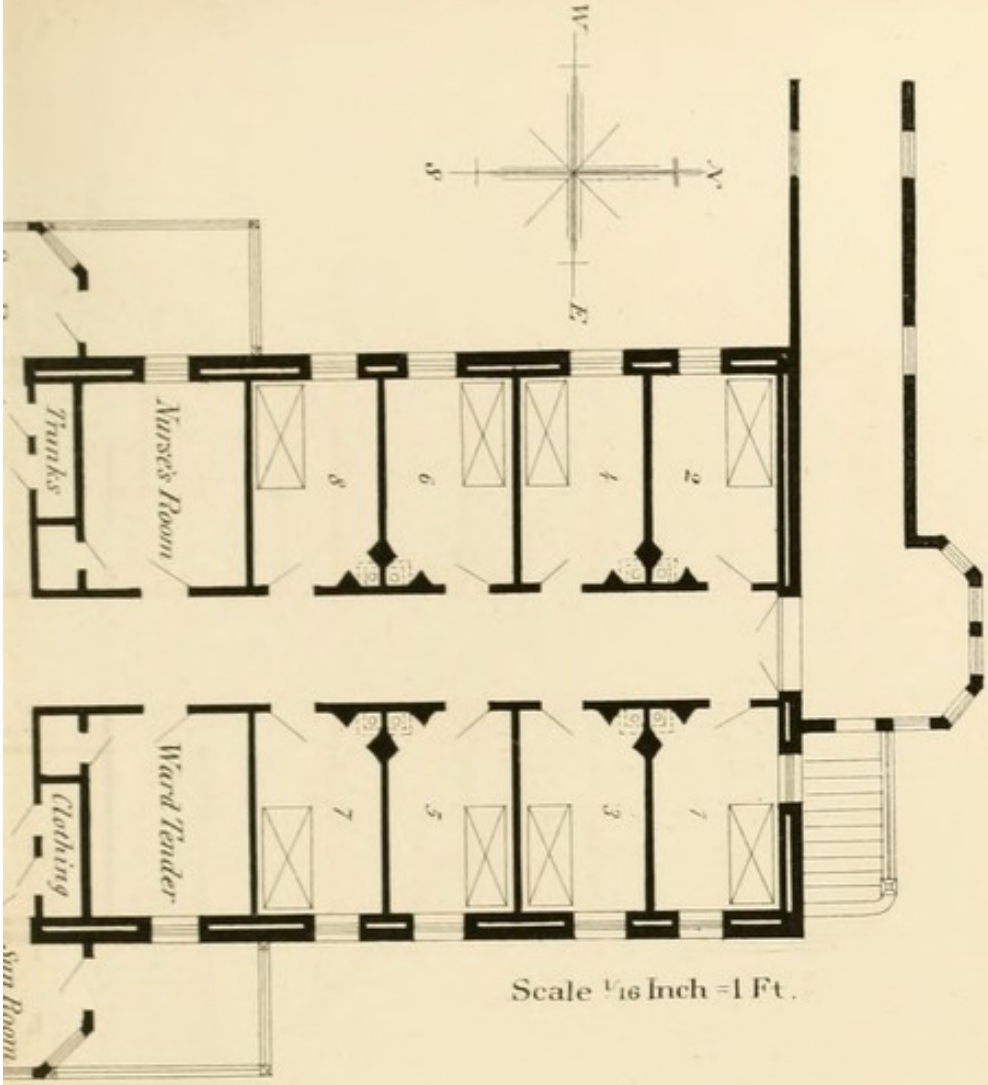
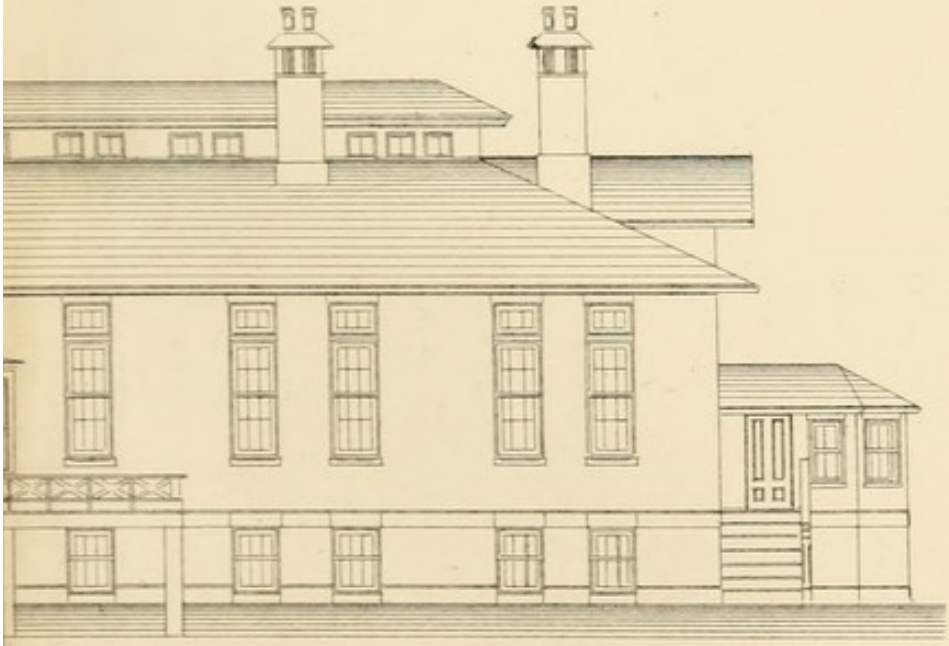


Scale 1/16 Inch = 1 Ft.

12.

ATING WARD.



ISOLATING WARD

FT.

for one patient each. An entry, 7 feet wide, divides the building longitudinally, and opens at the southerly end on a porch, from which access may be had to the garden. At the northerly end are double doors closed by springs. Opposite them is a bay-window in the corridor; and access to the garden is provided at this point also, for general use. A cross-entry, 4 feet wide, at the middle of the ward, opens on two verandas, about 34 by 8 feet, with sun-rooms or glazed porches at the centre of each.

The administration of the ward is provided for at the centre. Two rooms, about 13 by 10 feet, with a closet in each, serve for the nurse and male attendant, the latter of whom officiates also in the adjacent common wards. Opening on the cross-entry by two wide doors each are two closets, with cold air ducts and ventilators beneath the eaves, for the trunks and clothing of patients. Opening on the main entry are a medicine-closet and a dressing-closet like those already described, and behind them a ventilated linen room about 10 by 8 feet. Next this is a room, about 8 by 5 feet, for the use of the nurses, with a bath-tub and water-closet, and in a small lobby a soapstone sink. Next is the patients' bath-room, about 8 by 7 feet, with a tub on wheels, as described in the common ward. Access to this room is through a lavatory about 8 by 5 feet, with a soapstone sink and tin basins, and opposite it an unlocked closet for patients' hats and outer clothing.

Opposite this room is the stairway leading to the cellar; and next this are the two water-closets—one usually devoted to bed-pans—which are enclosed by a thick wall from the foundation, as in the common ward building. The floors are tiled. Opposite the water-closets is a sink for washing spit-cups and dressing-basins, and beneath this a receptacle for moderately soiled linen. The water-closets have a lobby, with a closet for brooms, etc., at one side. Thus there are two doors between the water-closets and the entry. The next room is the scullery, about 13 by 10 feet, arranged as in the common ward, the chimney to ventilate the water-closets.

The patients' rooms are each 13 by 8 feet, with an open fire-place, 2 feet wide, in the corner of each, next the door, and a window opposite, 3 feet wide, like those in the common ward.

Plates Nos. 13 and 14 are the east elevation, and the cross-section of the isolating ward. The longitudinal entry is 24 feet

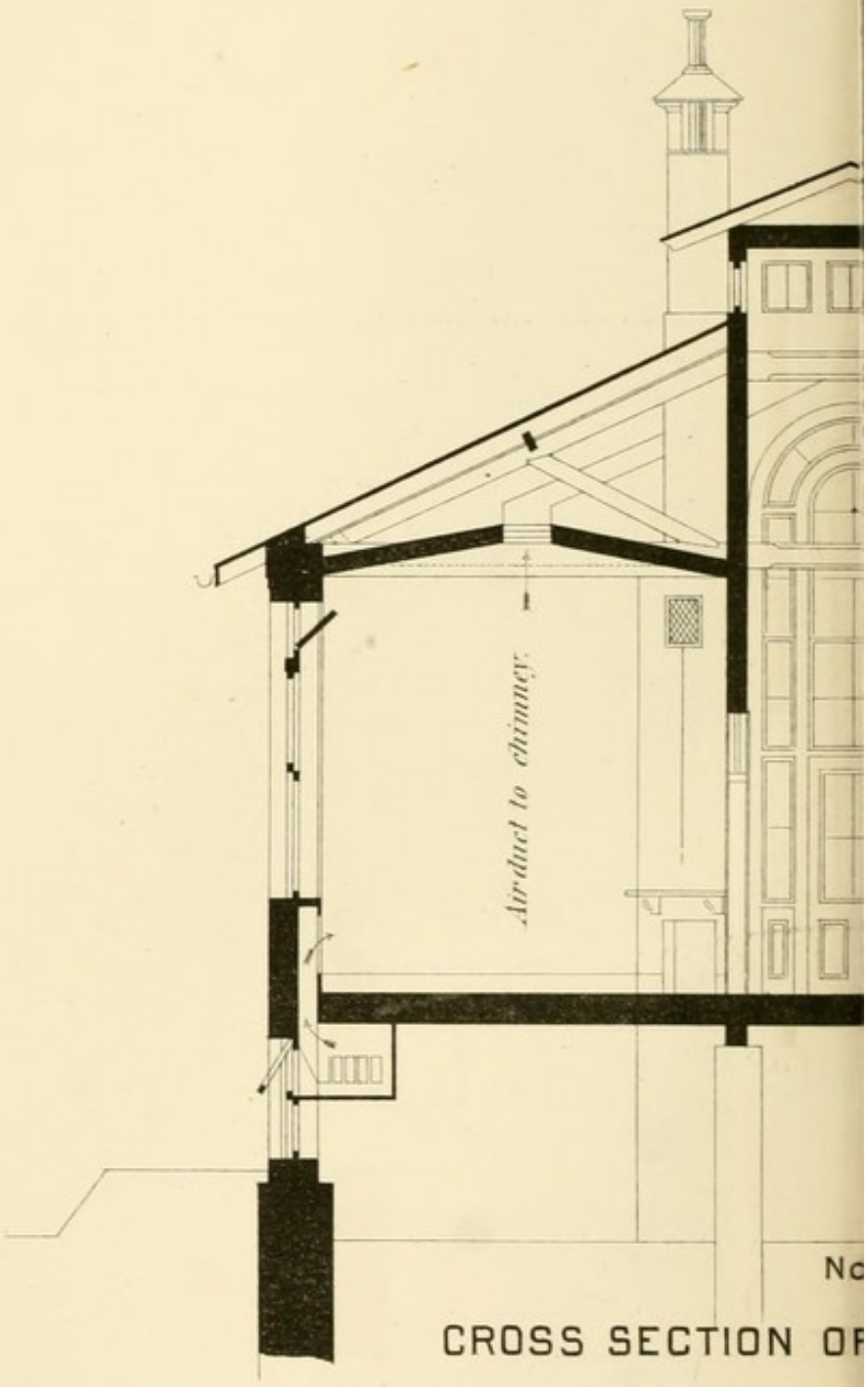
high, and has a separate monitor roof, with windows beneath the projecting eaves, which gives ridge ventilation for the whole building, when the rooms are suffered to communicate with the entry. A narrow gable at each end gives opportunity for a large arched window over each door. The rooms are 13½ feet high at the walls, and 14½ at the centre. Over the doors are windows opening to the height of the ceiling. When these windows and the doors are opened, the circulation of air is free throughout the building, and the rooms ventilate into the entry; but each room is arranged to be heated and ventilated as a unit when occupied by a case requiring more complete isolation, in which event the door and window would remain closed. The fireplace in each patient's room, arranged to burn soft coal, has a cast-iron pipe for a flue. The space in the chimney, around the iron pipe, closes in at the level of the ceiling, and fresh air being supplied to it by a duct in the cellar, a register, shown in the cross-section, gives passage to the air, moderately heated by contact with the iron pipe, into the room. An air-supply is thus provided for in such weather as does not necessitate the use of steam; and even in summer a very small fire can be made, for ventilating purposes, radiation being prevented by an iron screen. A duct leading from an opening in the middle of each ceiling, controlled by a valve, opens into the space in the chimney around the iron pipe, above the level of the ceiling, which is thus utilized for ventilating.

The linen-room is not warmed, but has a cold air supply duct, and a ventilator beneath the eaves. Every other room in the ward is supplied with fresh, warm air, in weather requiring the use of steam-heat, by a register opening beneath the window, the supply being regulated by the contrivance now to be described.

Plate No. 15 shows a contrivance for regulating the temperature of the air admitted to the rooms of the isolating ward, or for any room having an independent stack of radiators beneath.

The radiators are hung from the floor-timbers by iron rods, and are enclosed in a wooden box lined with tinned sheet-iron, with a door at the side for the removal of dust.

The air is admitted through the top half of the cellar window, which is hung on hinges at the top, and opens outward, and the amount of air admitted is regulated by a crank in the room above, which connects by a rod, with a quarter circle attached to



No

CROSS SECTION OF

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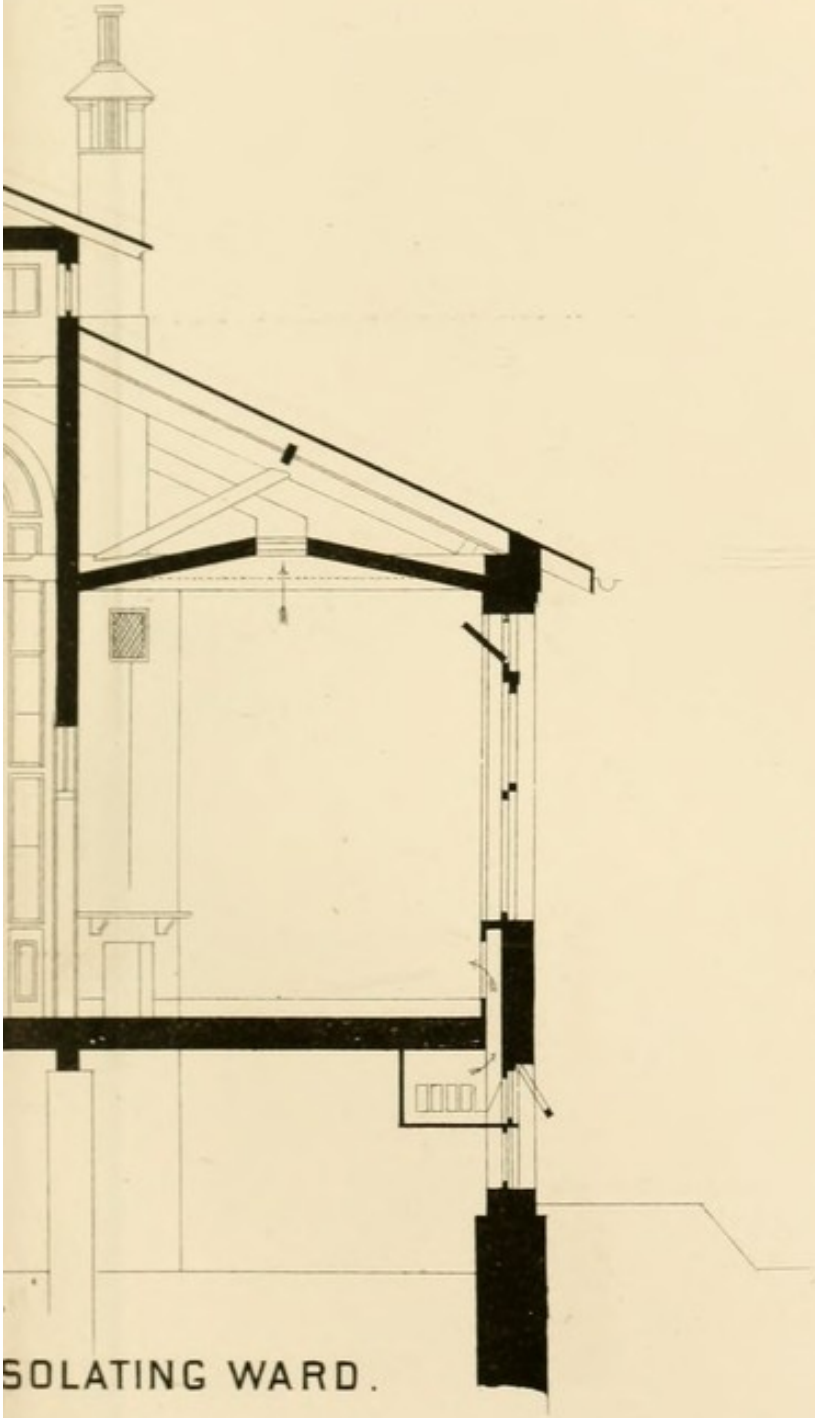
Scale $\frac{1}{8}$



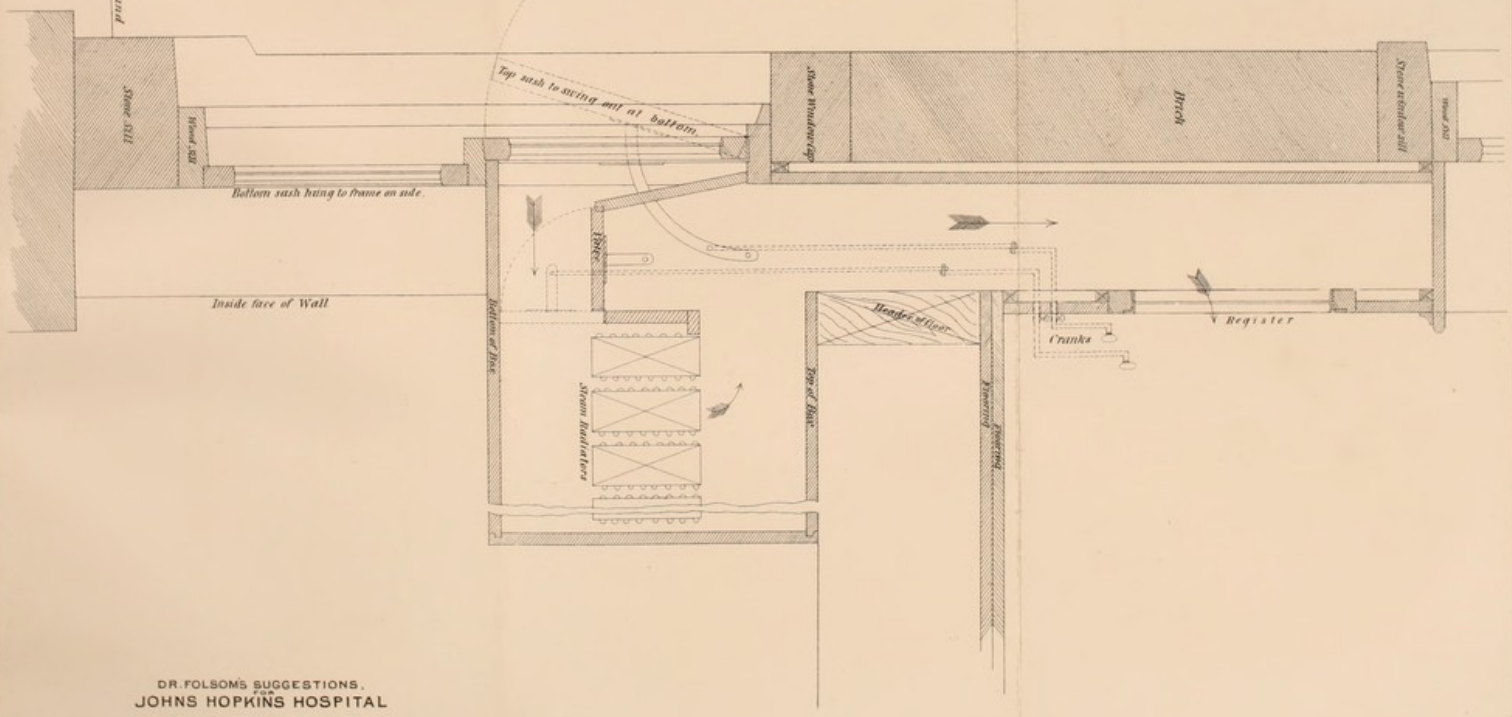
SOLATING WARD.

=1 Ft.

No. 15

DETAIL OF MIXING VALVE FOR ISOLATING WARD

SCALE ½ IN. 1 INCH.



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the window-sash. The movement of the crank opens and closes the window; but, opening to the full extent represented by dotted lines in the plate, would be desirable at all times unless during a very high wind.

The direction of the air thus admitted is determined by a valve made of a strip of board, suspended by hinges from below the front of the radiators, the position of which is regulated by a rod connected with a second crank in the room above. The stability of the crank in the position given it by the hand of the attendant, is insured by a set-screw, with a bit of rubber or leather beneath the tip.

When the valve is in the horizontal position, all the air is directed to the radiators, and is fully heated by rising through the stack, after which it passes up through the space in the wall, beneath the window, shown also in Plate No. 14, to the vertical register just under the window-seat. When the valve is placed in the vertical position, indicated by dotted lines in the plate, all the air is directed upward away from the radiators; but is tempered by mingling somewhat with the air circulating in the space over the radiators, and then reaches the room by the register above. When the valve is placed in an intermediate position, the air-current is divided, part of it only is heated by passing through the radiators, and this then mingles with the ascending cold portion before it reaches the register and enters the room.

It is apparent that the temperature of the room can thus be regulated to suit varying conditions, without interfering with the fresh air supply, and without modifying the access of steam to the radiators. If the room gets too warm, the nurse, instead of *closing the register*, and so shutting off the oxygen, simply turns the crank a little upward. If the thermometer, which hangs near the door, falls below the standard directed by the attending officer, the crank is turned downward. If a sudden general atmospheric change has taken place, and the temperature still falls, the *supply* of air may need to be temporarily diminished, till the engineer, who watches the thermometer out of doors as well as his gauges, has time to restore the suddenly fallen steam pressure.

The proper use of the contrivances described requires intelligence and faithfulness on the part of the attendant, but *no more*

than would be required to properly regulate temperature in any other way.

Besides the cases which can properly be treated in the rooms of the isolating ward, by closing the doors and the windows over them, cases will arise of exceptional character, needing, temporarily, more complete isolation than the ward affords. Although contagious diseases are excluded by the admitting physician, cases of variola and scarlatina are liable to develop after admission, and their immediate removal may be impossible. Odors are sometimes developed in disease, of such peculiar intensity that they permeate everything near. Surgical complications may be such as to demand that the case should be absolutely in a building by itself.

To supply this exceptional want, it is proposed that there should be kept, in the cellar of each isolating ward, one or more *sectional buildings*, made of pine wood, the different parts of which fasten together by hooks and bolts, so that one can be erected in an hour without the aid of a carpenter. Such a building might be 8 by 7 feet, and 7 feet high at the eaves, with a door in one end and a window opposite. The floor should be raised a foot above the ground. A frame with slats, resting on cleats, would supply the place of a bedstead, and a bed-tick filled with hay would be used instead of a hair mattress. In one corner would be a hole through the roof, protected by a piece of soapstone, for the funnel of a small stove, which would have a cold air register opening beneath it. After use, the building could be taken apart, exposed to the sun and air for a sufficient time, painted or varnished a thin coat, and put away in the cellar again. All the bedding should be boiled or baked before being used again. In hot weather, a canvas tent-fly could be used in the usual way to protect the building from the heat of the sun.

PRIVATE WARD.

Plate No. 16 is the plan of the private ward. It is so arranged that none of the rooms for patients front to the north; and this, together with its position in the lot, have given the building its shape, which is that of the letter L. The entrance to the ward from the main corridor is at the north-easterly end. Near it is the corridor leading to the most northerly series of wards, but this opens in such a way that passers will not look

down or invade the private entry. The northerly portion of the ward is about 132 by 42 feet. An entry 8 feet wide runs east and west the whole length of it. The southerly portion of the ward, about 80 by 48 feet, is placed at right angles with the other portion, near its westerly end. It is bisected by an entry 8 feet wide, running north and south, which crosses the other entry to reach the northern wall, where a window gives it air and light. A cross-entry, 4 feet wide, runs east and west between the two portions of the ward.

The rooms for administration are all on the north side of the northerly entry. There are two sets of water-closets; each set of two enclosed in a room, with brick walls from the foundation, about 12 by 9 feet, including a lobby with a sink in it, for washing spit-cups, basins, etc. These are situated at opposite ends of the entry, one set for ladies, and the other for gentlemen. The easterly pair are ventilated into the chimney of the scullery, which is 24 by 12 feet, placed convenient to the corridor, with a range, sink, and dresser, into which open a cool pantry with a window, and a china-closet, each about 8 by 6 feet. Next is a bath-room, about 12 by 6 feet, with a movable tub, as described in the common ward, and a wash-bowl in the corner. Next is a room 12 feet square, with a closet, for the male attendant. Next this is the linen-closet, 12 by 10 feet, and next this again, a room 12 feet square, for patients' soiled linen, with a closet for brooms, pails, etc., in the corner. Next comes the northerly end of the south entry, and beyond it is a second bath-room like the first, one being for ladies and the other for gentlemen. Sitz-baths, on wheels, with rubber tires, could be filled in the bath-rooms, and readily moved to the patients' rooms. The westerly pair of water-closets are ventilated into the chimney of the nurses' room, which is about 18 by 12 feet, placed at the north-west corner of the ward, a sufficiently central position, having a closet and an open fireplace or stove.

All these rooms, except the linen-closet and soiled clothing room, which have cold air supply ducts, are warmed by radiators beneath, arranged as shown in Plate No. 15. All the rooms, except the water-closets, have ventilators beneath the eaves.

On the southerly side of the north entry are six rooms for patients, each about 18 by 12 feet, and about 14 feet high, rising

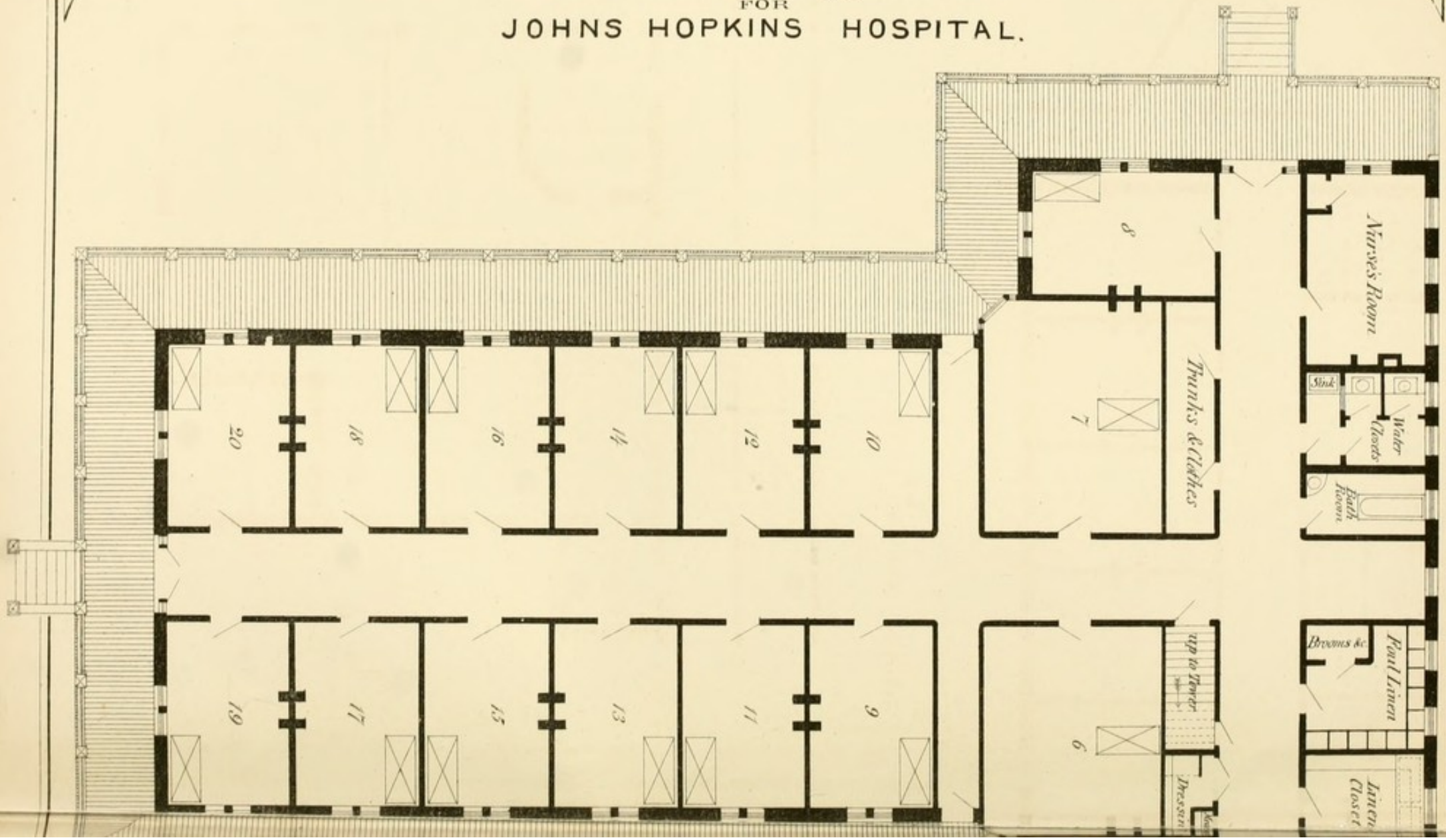
to 17 at the centre, with a mullioned window 4½ feet wide, and a hooded top sash over a transom. Over the doors are windows, extending nearly to the ceiling. Each room has an open Franklin soapstone stove, for soft coal, and likewise a radiator beneath, arranged as shown in Plate No. 15. A cold air duct leads to the double back and sides of the Franklin stove, and a large ventilator opens into the chimney near the ceiling, for exceptional use.

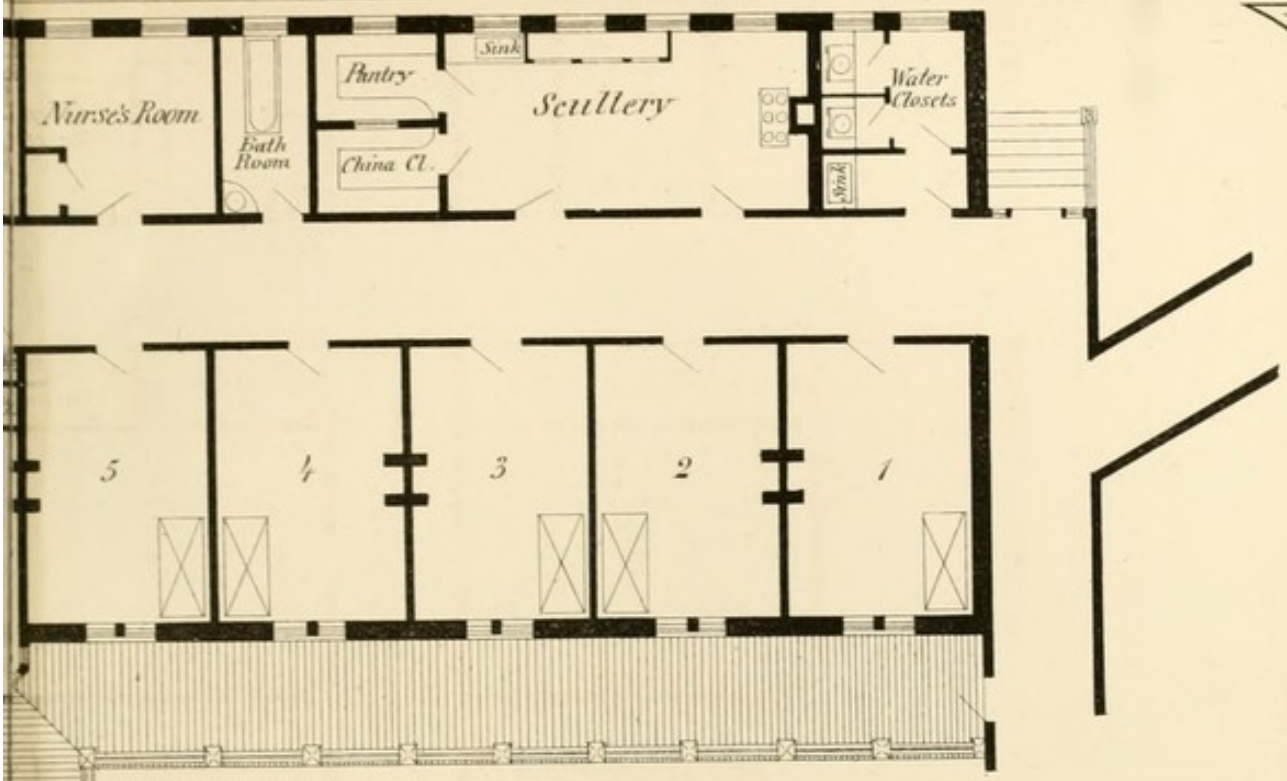
An electric indicator placed at the intersection of the entries is operated from the various patients' rooms, and from the bathrooms and water-closets. In the patients' rooms a handle is attached to a wire cord, so that it can be put by the side of the patient's pillow wherever the bed is placed. A light touch on a knob in the handle rings the bell, and indicates the number of the room to the nurse. A similar system, with knobs in the wall, would be desirable in the isolating wards; and by arranging couplings for the attachment of wire, a few minutes would serve to connect one of the sectional isolating buildings with the indicator in the ward, where a signal would be reserved for it.

The southerly portion of the building contains twelve rooms for patients similar to those just described.

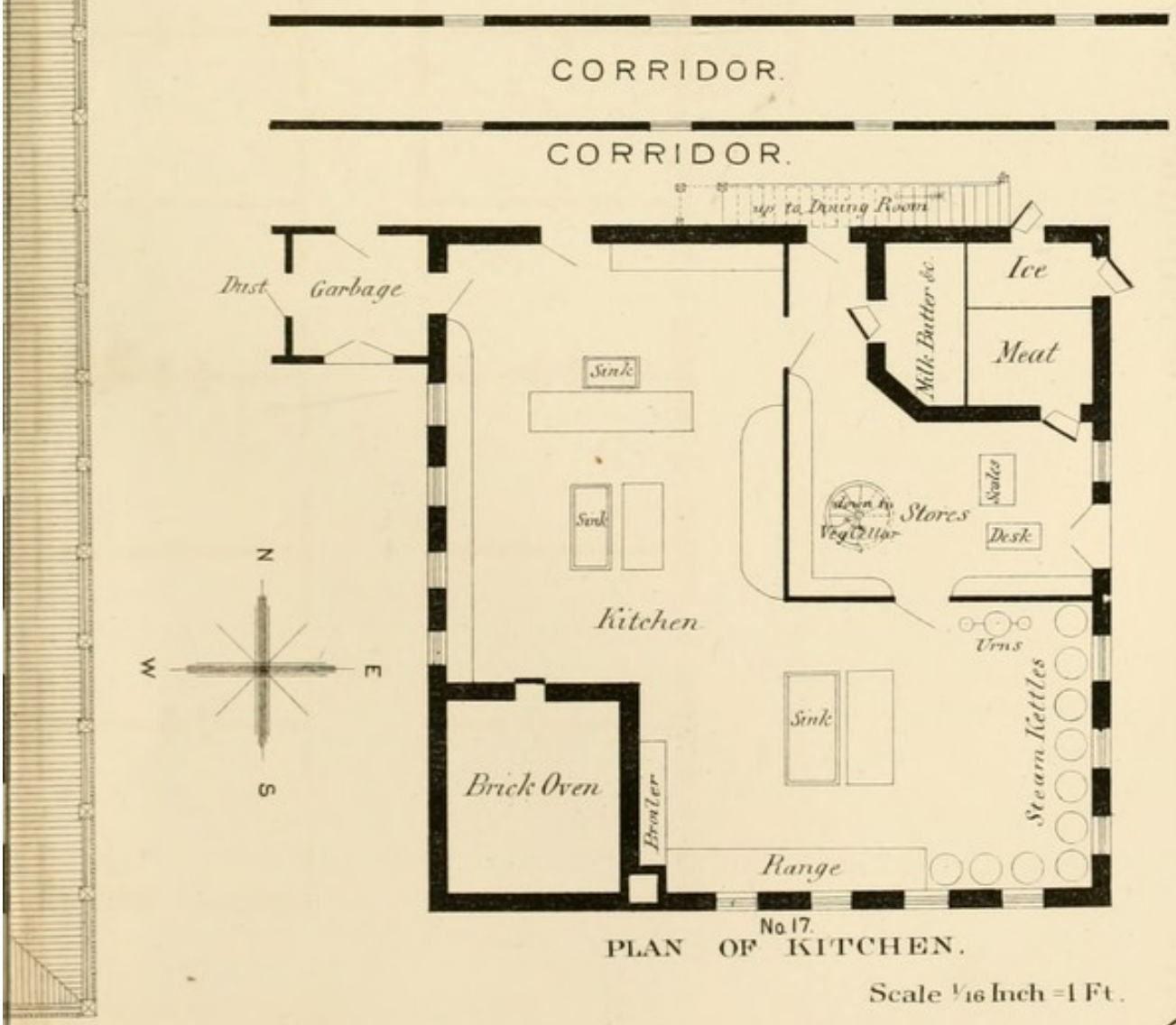
The two rooms at the centre of the building are larger than the others, which will prove a convenience when relatives are permitted to remain with patients at the Hospital. This should generally be discouraged in the interests of the patients themselves, but circumstances sometimes render it necessary. These rooms are about 22½ by 17½ feet, arranged like the smaller rooms, except that the windows, placed in the south-east and south-west corners respectively, are bays, 4½ feet wide, the side panes looking south, east, and west, the whole being carried up nearly to the ceiling. Opening on the north entry, north of one of these rooms, is a closet for trunks and clothing, about 22½ by 4½ feet; and north of the other room, the closet for dressings, splints, etc., about 9½ by 4½ feet, including the medicine-closet, which opens separately on the entry. At the intersection of the entries are the cellar stairs, where coal is brought up; and above them is a staircase leading to a second story of limited dimensions, devoted to sleeping-rooms for a second head nurse and one or two assistant nurses. A small billiard and reading room for patients'

Dr. Folsom's Suggestions
FOR
JOHNS HOPKINS HOSPITAL.





No. 16.
PLAN OF PRIVATE WARD.



No. 17.
PLAN OF KITCHEN.

Scale 1/16 Inch = 1 Ft.

use could be placed here to advantage. Above this is a tower or cupola, carried to as great height as taste will allow, and commanding not only a view of the whole Hospital, but a magnificent prospect all around.

The advisability of having a water-closet and bath-room attached to each private room has been considered; and it would add much to the convenience and elegance of the ward. But comfort does not require it, as movable bath-tubs and commodes can be supplied for such as need them. It would seem desirable to avoid, in rooms which are intended to offer absolutely *no* drawback to recovery, the possible source of impure air which the opening of a soil-pipe or drain-pipe affords. For this reason no set basins have been placed in the rooms. The furniture is to be of hard wood, finished with as few irregularities of surface as possible. Instead of carpets, rugs are to be used. The only piece of stuffed furniture to be allowed is a lounge, with a linen cover which can be readily removed and washed. On the departure of a patient, the room is to be closed from the entry, and swept, aired and dusted; the rugs to be shaken and sunned; and the windows left open for some days, unless the weather is stormy.

Double doors at the south and west ends of the building give access to a veranda, 8 feet wide, which surrounds the building, excepting on the north side. The narrow cross-entry also opens on it. Steps lead to the grounds at the south and west ends, and from the corridor at the north-west corner. The south door is the entrance for visitors. Sun-rooms or glazed porches might be constructed at both the double doors if desired.

The cellar is devoted to the heating apparatus, etc., with coal-bins at the north-easterly corner.

KITCHEN.

Plate No. 17 represents the kitchen, about 50 feet square, including the store-room, about 26 by 22 feet. A wide door leads from the corridor to the kitchen proper. Against the walls are shelves and dressers as needed. There are three sinks with tables adjoining—the largest of which is for the preparation of vegetables, and is therefore near the kettles. The brick oven, about 14 by 12 feet, is in the corner. It is heated by a small hard coal fire in the front corner, the fuel being put in at the front door, and

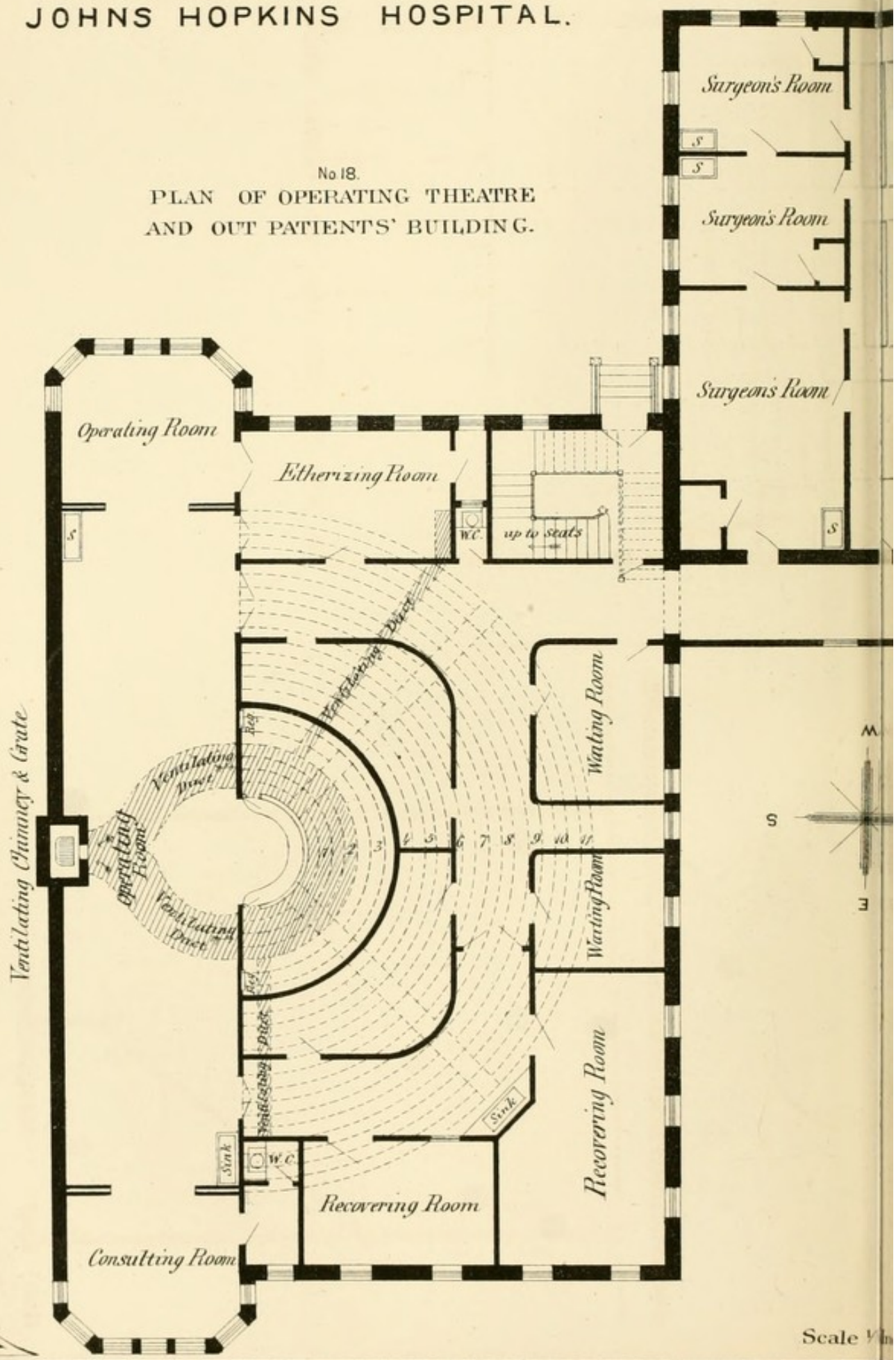
the ashes removed by a door beneath. The oven has two flues; one over the fire, the other diagonally opposite; both controlled by slides. When the oven is heating, the flue over the fire is closed and all the gases pass across to the further corner. When it is hot, the flue over the fire is opened and the other closed, so that the oven is free from gases while baking. A slide over the door can be opened to take the heat and gases when the door is open. An iron shelf or hearth is hinged to the front, just under the door, with a catch to keep it horizontal, for basting meats, etc. If the Hospital were to employ a baker and bake its own bread, a small room for kneading and raising the dough would probably be built at one side of the oven. This piece of apparatus is the cheapest and most efficient means of cooking *meats*, as well as other articles. Adjoining the oven is the broiling range, about 9 by 2 feet, where a shallow fire is continually kept for broiling and toasting. It is arranged to draw the smoke downward and backward away from the meat. Next comes a French range of ordinary construction, about 19 feet long. The chimney, 2 feet square, is common to the three pieces of apparatus last described. Next the range come ten steam-jacket-kettles, each cast in one piece; and beyond them automatic tea, coffee, and water urns.

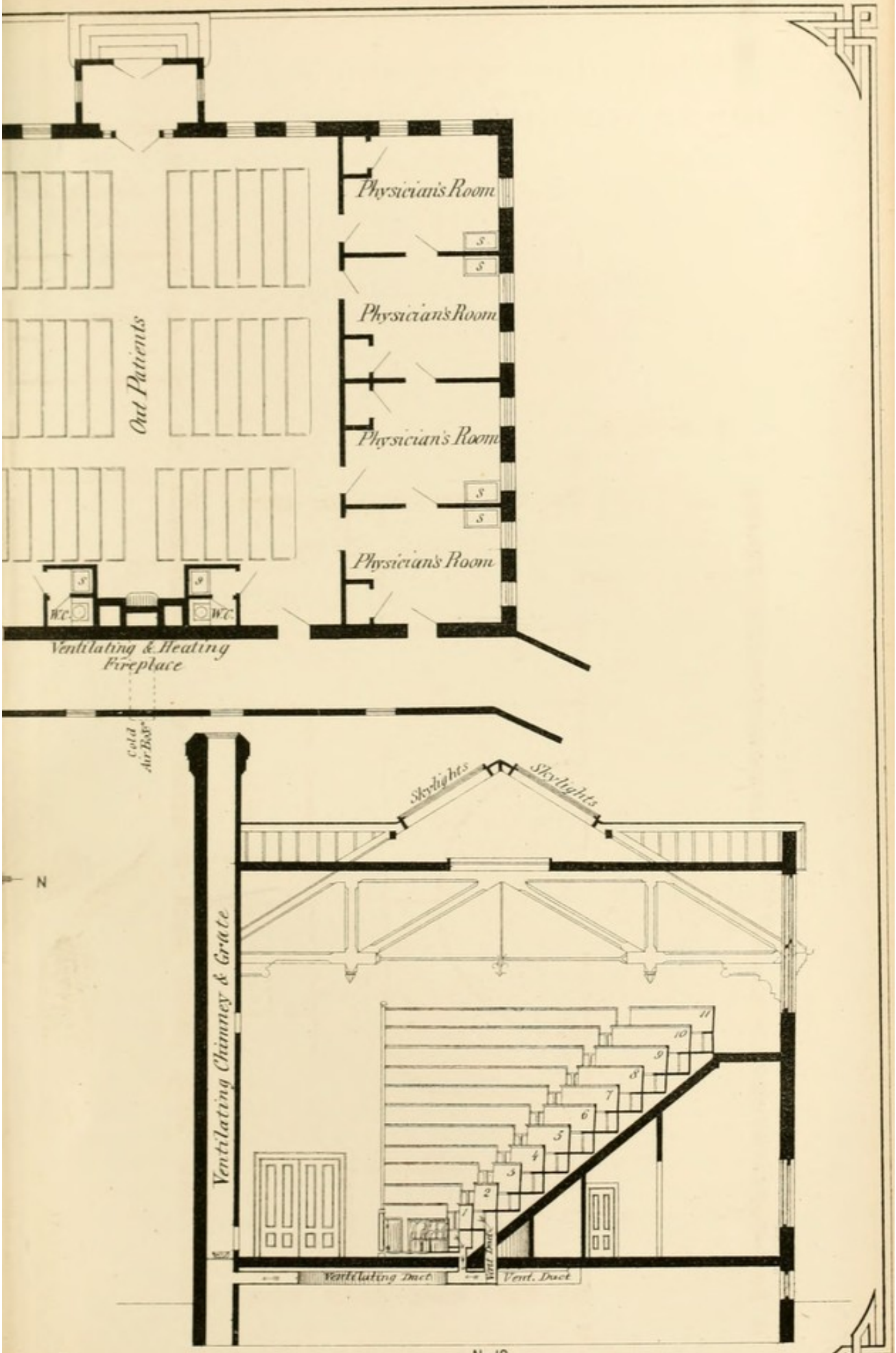
The store-room opens into the corridor, and also by two doors into the kitchen proper. It is lined with shelves, bins, and places for barrels. A spiral staircase leads to the vegetable cellar below. Double doors at the side admit the supplies, and the storekeeper's desk and the scales are near them. All goods are ordered in writing, on cards inscribed: "Please deliver the following articles, and *return this card with the goods.*" The weight or quantity, etc., is verified on the spot by the storekeeper, the card marked "correct" and transmitted to the office, and the tradesman is then credited with the goods on the supply book. When the monthly bill is presented, it is readily verified by reference to this book. In the corner of the store-room is the ice-room, which is filled from the outside. A small door in the corridor furnishes the supply for the wards, etc. On one side of the ice-room is the room lined with shelves, for milk, butter, etc., and on the other, the meat-room, supplied with hooks all around.

A staircase in the corridor leads up to two dining-rooms in the

Dr. Folsom's Suggestions
FOR
JOHNS HOPKINS HOSPITAL.

No 18.
PLAN OF OPERATING THEATRE
AND OUT PATIENTS' BUILDING.





ch = 1 Ft.

No. 19

CROSS SECTION OF OPERATING THEATRE.

second story, one for the nurses and one for the other employees. The food is raised by dumb-waiters, not shown in the drawing.

The ventilation of the kitchen would be partly into the chimney, by means of a hood over the range and boiler, and over the kettles and elsewhere by means of large ducts passing up through the rooms above, terminating in Emerson's ventilators above the roof.

OPERATING THEATRE AND OUT-PATIENT BUILDING.

Plate No. 18 is a plan of the operating theatre and the out-patient building. It is desirable that one should be accessible from the other, and yet that patients brought from the wards for operation should not be under the observation of the out-patients. The doorways opening from the out-patients' room on the corridor should therefore have two sets of spring doors, and there should be a general understanding that out-patients should not be sent through the corridor during operations.

The out-patient building is about 75 by 50 feet. The main room, about 50 by 40 feet, is provided with seats for about 200, so as to avoid the crowding which produces unsavory results in most such places. The front door, at the west side of the building, is provided with a porch, where wet umbrellas may be left, and where an attendant meets the patients and directs them to the part of the room appropriated to the particular ailment of each. Here they sit, facing the doors of the rooms of the physicians and surgeons, until summoned to go in, by the passing out of the preceding patient, and by a signal at the side of the door, on a level with the eye, which displays the words, "Come in," when the medical officer presses a handle on his desk. This device is suggested to avoid the confusion of bells sounding from the different rooms. At the east side of the room are two water-closets, for males and females, with a sink in the lobby of each. These are ventilated into the flues shown next to them, the draughts of which are reinforced by their relation to the fireplace. This fireplace, made of iron castings, is the principal means of heating the main room, and has a large cold air duct leading to the space around it, from which registers eight feet from the floor open into the room. Above the level of the registers, the water-closet flues come into relation with the cast-iron pipe which forms the smoke-flue above. This fireplace does not

differ in principle from those suggested for other parts of the Hospital, but it is intended to be more on the scale of a furnace. Two stacks of steam radiators are placed under the westerly part of the room, for use in extremely cold weather. Four ventilating ducts, controlled by valves, open at the ceiling and terminate in Emerson's ventilators above the roof.

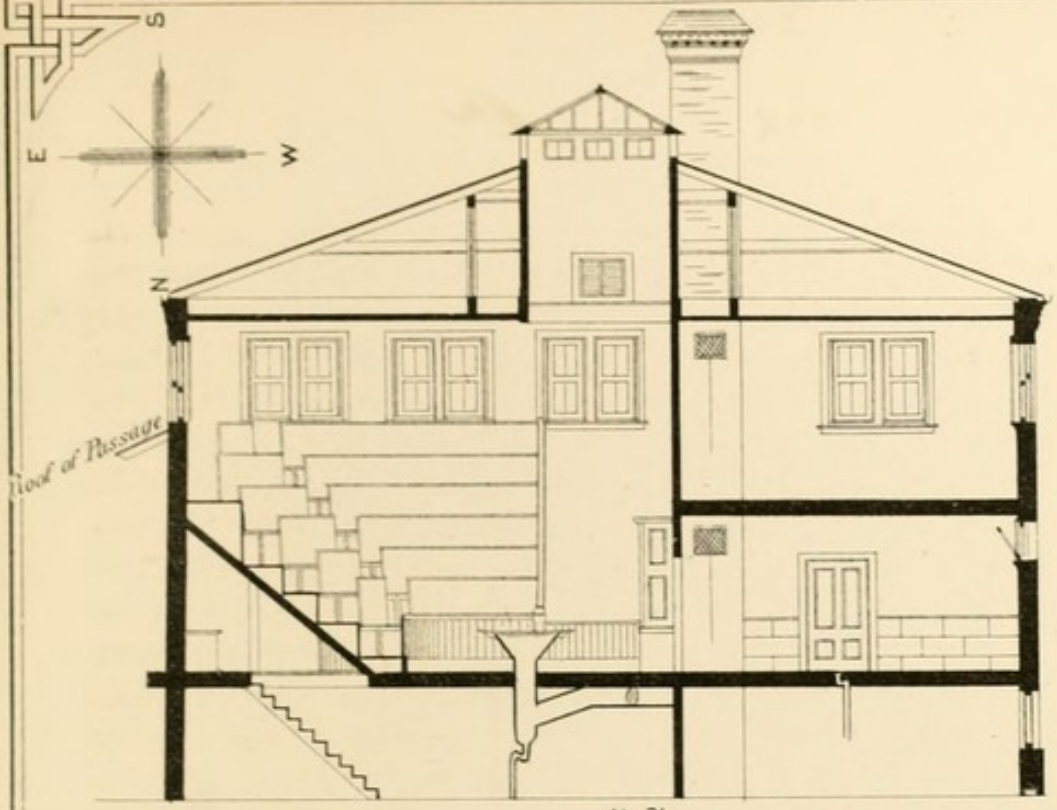
On the northerly side of the building are four rooms for the treatment of medical cases, and on the southerly side are three for surgical cases. The rooms are connected with each other, and with the corridor, so far as possible, and the details of their use would vary with the development of the out-patient department. Each room is provided with a closet and sink, and each is heated by steam radiators beneath, and has a ventilator beneath the eaves.

The main room is fifteen feet high, and the side rooms thirteen feet. Over the central part of the building is a second story, reached by the staircase of the operating theatre, and appropriated to rooms for the male employees, numbering 8 or 9, not provided for elsewhere. One water-closet and one bath-room, near the chimney, would be required on this story.

The operating theatre is about 82 by 60 feet. The operating room is about 64 by 16 feet, with smaller rooms mostly walled with glass, at the ends. One of these is for operations requiring privacy, or side light. The other, having a closet and water-closet adjoining, is for the surgeons' use. Near the folding doors leading to these rooms are two sinks. The seats rise from a semicircle of 10½ feet diameter, to within 7 feet of the rear wall. They are 2 feet and 4 inches from centre to centre, and the capacity of the theatre is about 500. Although this number of persons would seldom be present, it would seem that there ought to be some one place in the hospital grounds where members of the medical profession and all connected with the institution and the university could be gathered, when occasion should arise.

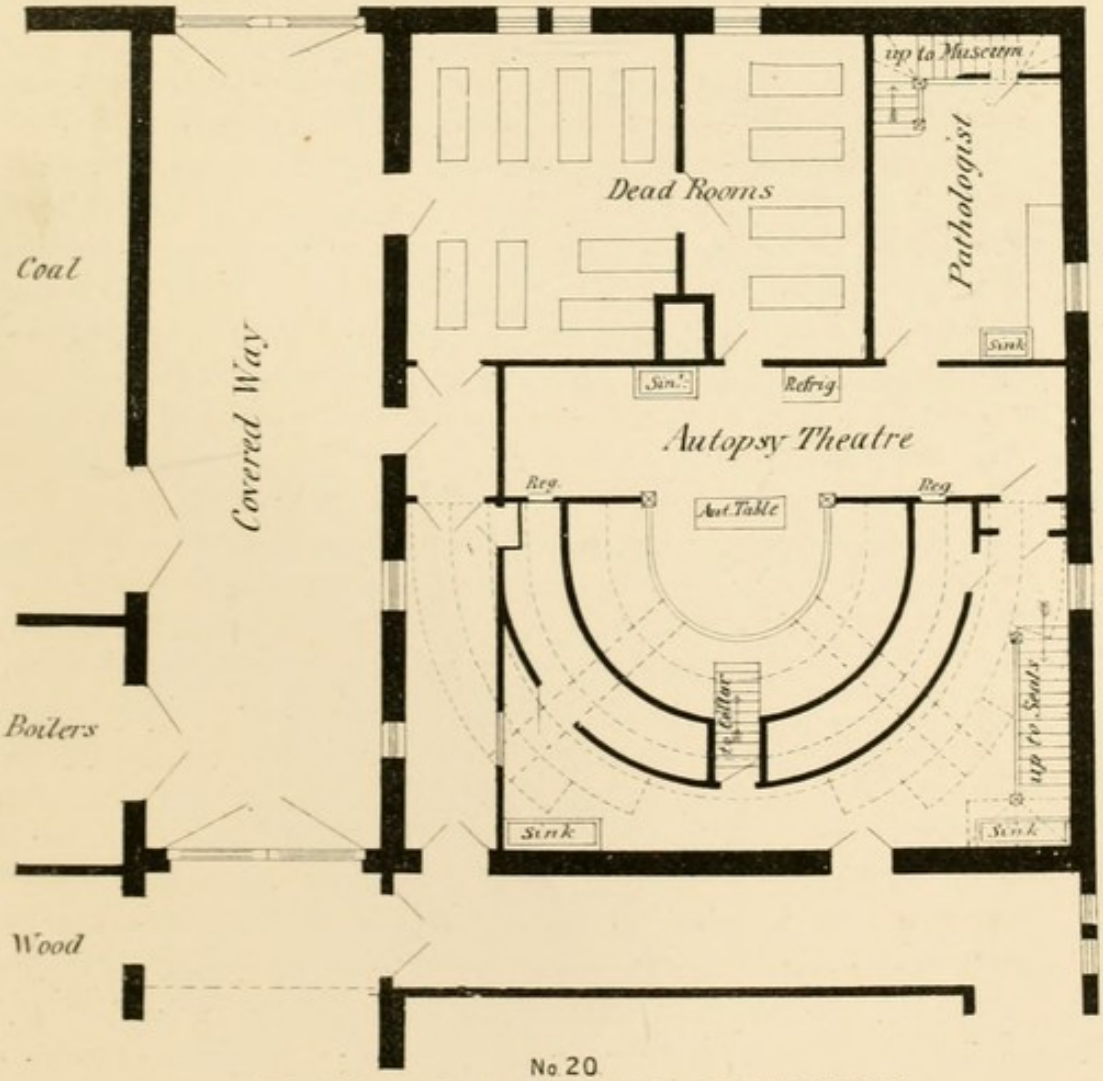
Beneath the seats is found abundance of room for, on the west side, an etherizing room, about 19 by 12 feet, with a closet, and a water-closet near it; a square entry containing the stairs by which the seats are reached; two waiting-rooms, 15 and 10 by 12 feet, where patients are brought from the wards or from the out-patient department, before being etherized; and a male and

DR. FOLSOM'S SUGGESTIONS FOR JOHNS HOPKINS HOSPITAL



No. 21.

Longitudinal Section of AUTOPSY BUILDING.



No. 20

PLAN OF AUTOPSY BUILDING

AND DEAD-HOUSE.

Scale 1/16 Inch = 1 Ft.

female recovering-room, about 28 and 18 by 12 feet, where patients are put to bed temporarily, after operations, while recovering from ether. The entry behind is divided by glass doors, and the doors of the rooms have glass panels, so that light may be supplied, while sound is obstructed. A sink in the corner of the entry serves for both recovering-rooms. South of the entry behind are large closets with sloping ceilings for storing surgical apparatus, etc.

Plate No. 19 is an elevation of the operating theatre. It shows the method of lighting, by central sky-lights above; and a large north window above the seats. There will be no glare of direct sunlight from this window, and, as it is the nearest source of light, operators will not be likely to intercept the view of the audience by standing before the patient. More distant ground glass windows on the east and west sides will add to the general lightness of the room.

The theatre is heated by steam radiators beneath, the vertical registers being in the wall of the operating-room, under the seats, one on each side, about 7 feet from the semi-circle. It is ventilated by a chimney, 5 by 2 feet, in the middle of the south wall, containing a basket grate, in which a fire is made at the moment the room is to be used. The duct leading to this chimney has a narrow opening at the floor around the semi-circle, where the chairs of the surgeons are placed, and also beneath the first and second rows of fixed seats, and from the two water-closets at the sides of the building.

AUTOPSY BUILDING.

Plates Nos. 20 and 21 are the plan and longitudinal section of the autopsy building and dead-house. The whole building is about 52 by 42 feet, and the auditorium is about 42 by 31 feet. The access to the autopsy-room is by an entry, opening from the corridor, leading beneath the seats to the stairs by which the seats are gained. At the foot of the stairs is the door for the pathologist, leading through a lobby which serves for a clothes closet, to the space where the autopsy is performed. Beyond this is a room for more detailed pathological investigation, with a sink and table; and from this stairs lead to a room above, about 42 by 21 feet, for the preservation of specimens. The two dead-rooms, measuring together about 29 by 21 feet, are reached

by a separate passage from the corridor. They contain tables of stone for the reception of the dead; and the remains of those dying in the hospital should be conveyed here *at once*.

The dead-rooms are kept as cool as possible. The autopsy-room is warmed by steam, the registers opening vertically in the wall of the room below the seats.

The ventilation of the dead-rooms is into a chimney about 3 by 2 feet, the draught of which is reinforced by making a fire in a basket-grate when an autopsy is to be made. An autopsy table, contrived for the Massachusetts General Hospital by Dr. Henry J. Bigelow, is shown in Plates Nos. 22 and 23, and has proved extremely successful at that institution. I quote his description of it:

"The autopsy table is supported upon a single hollow iron leg, "intended to insure ventilation and drainage. For this purpose, "the downward draught is concentrated upon the *trunk* of the "subject, from which alone objectional odors emanate. Air, to-"gether with water and other fluids, are drawn through a nearly "central opening in the table, which is fitted with a grating into "the iron leg. Here they are separated. The water falls verti-"cally to a trap in the cellar, while beneath the floor the air is "drawn laterally to a special chimney. The air-tube, where it "leaves the table-leg, inclines upward for a short distance, to ex-"clude water. The table-top is dished, and made of tinned copper. "The hollow leg is cylindrical at the floor, but expands above "into an oblong square, which closely fits the table around the "grated opening; the flaring part being a single casting lined with "porcelain, like a sink. To the top of this casting an iron flange "is bolted, which supports the whole edge of the copper table.

"Near the floor the leg is halved, to allow rotation. The "upper half is received into the lower half, and rests upon a "square shoulder, lubricated by a cup on the outside, which de-"livers oil slowly through the joint into the interior of the leg. A "small rubber hose is attached to a water-cock in the floor near "the leg."

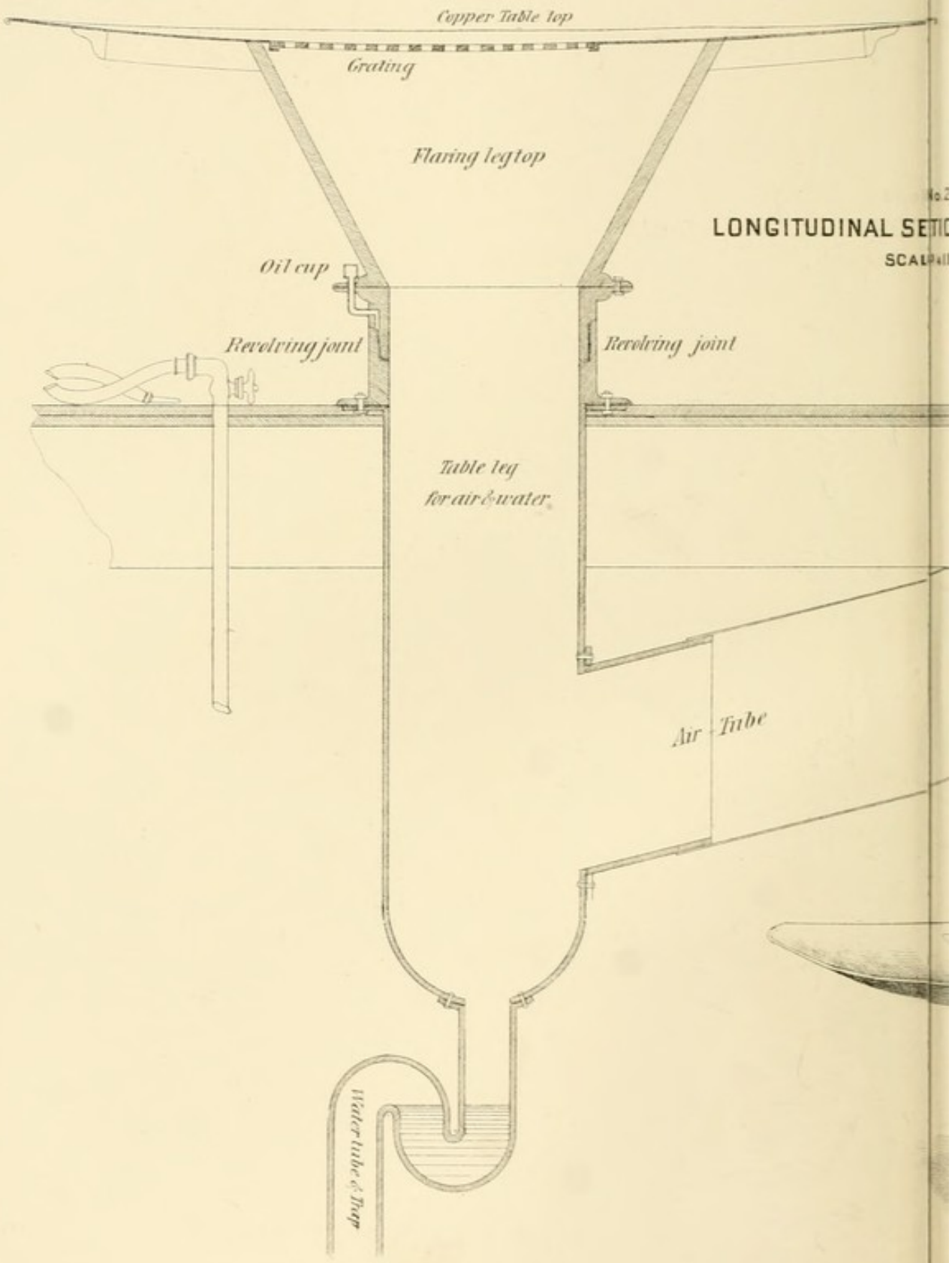
DIMENSIONS.

"Length of table-top,	6 feet 10 inches.
"Width " " "	2 " 6 "
"Length of grating,	2 " 5 "
"Width " "	1 foot 9 "

Dr. Folsom's Sug

FOR

JOHNS HOPKINS H



No. 2

LONGITUDINAL SECTI

SCALE

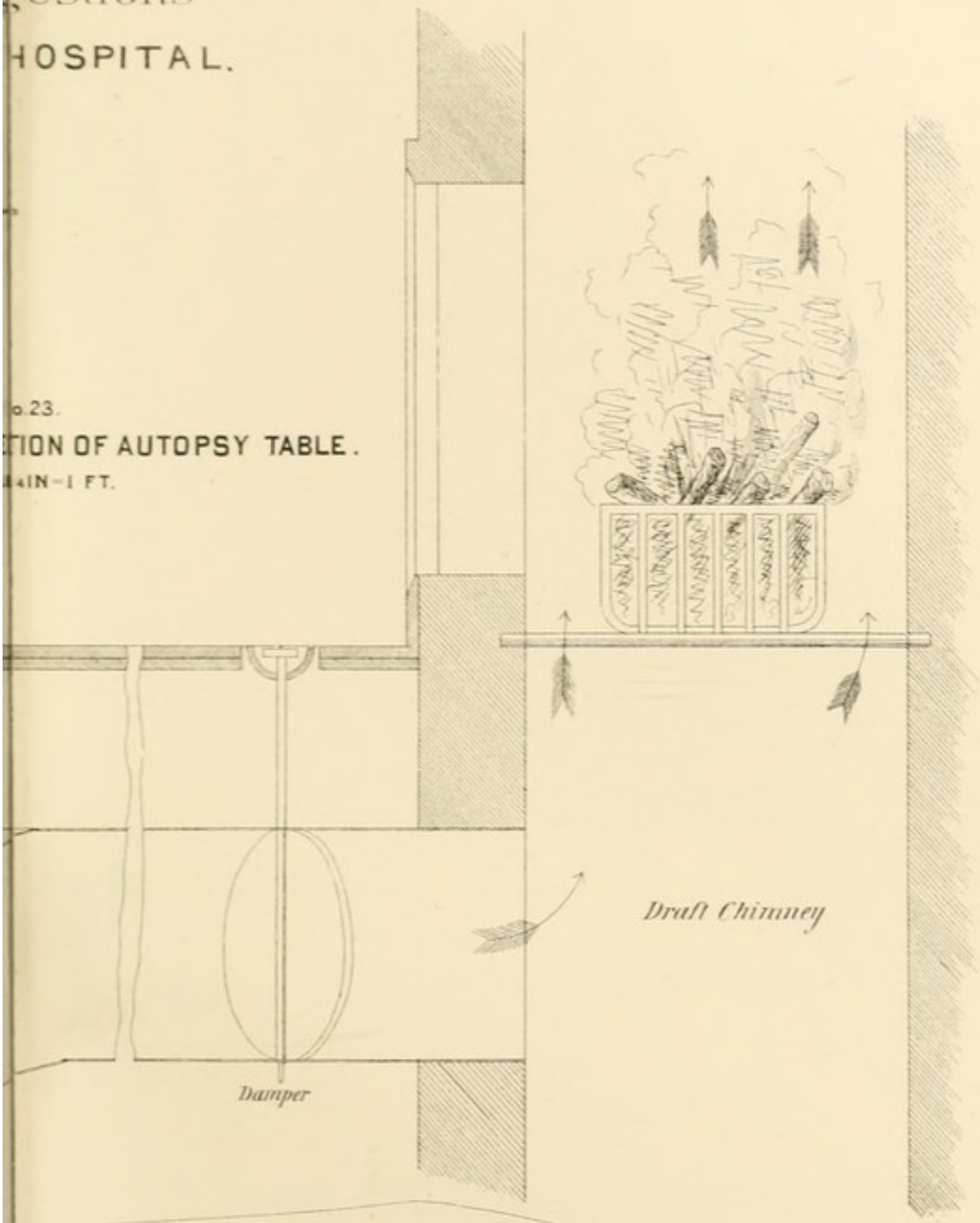
gestions

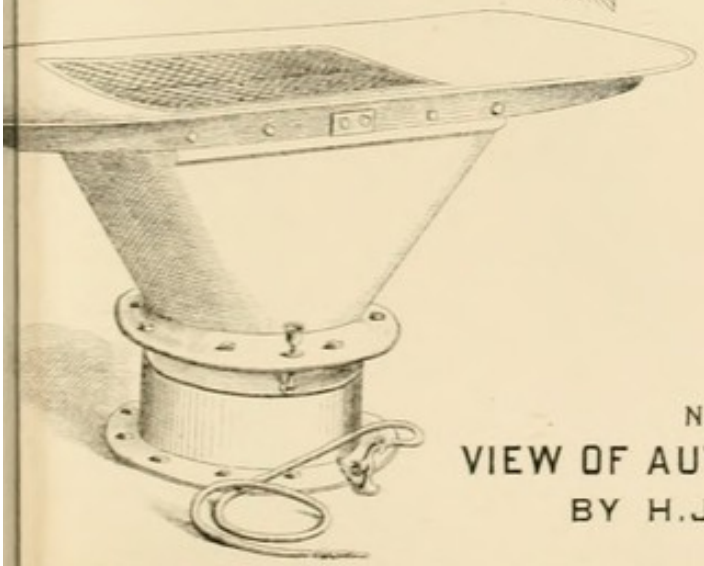
HOSPITAL.

o.23.

TION OF AUTOPSY TABLE.

4IN-1 FT.





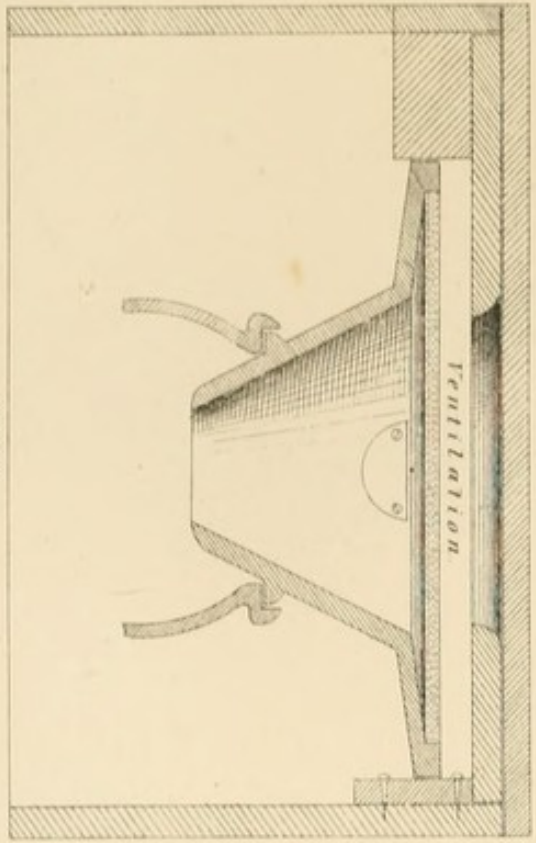
No.22.

VIEW OF AUTOPSY TABLE.

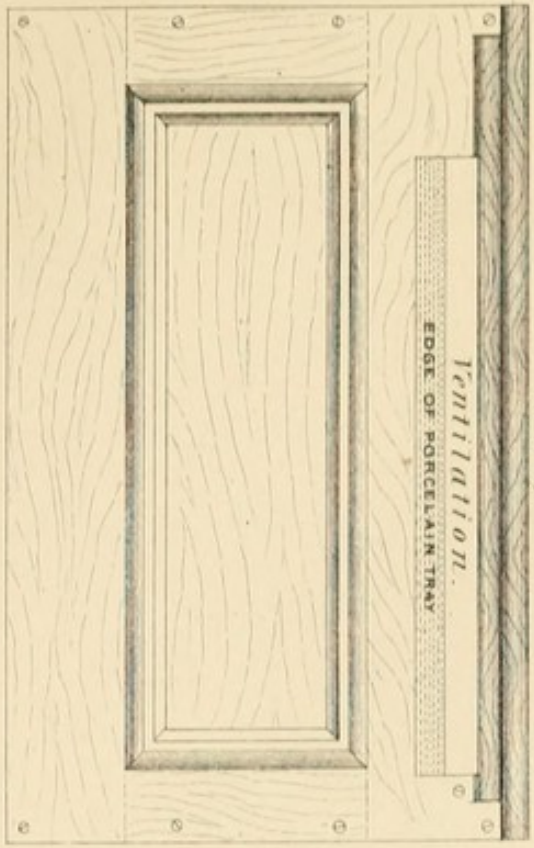
BY H.J. BIGELOW.

DETAIL OF WATER CLOSET.

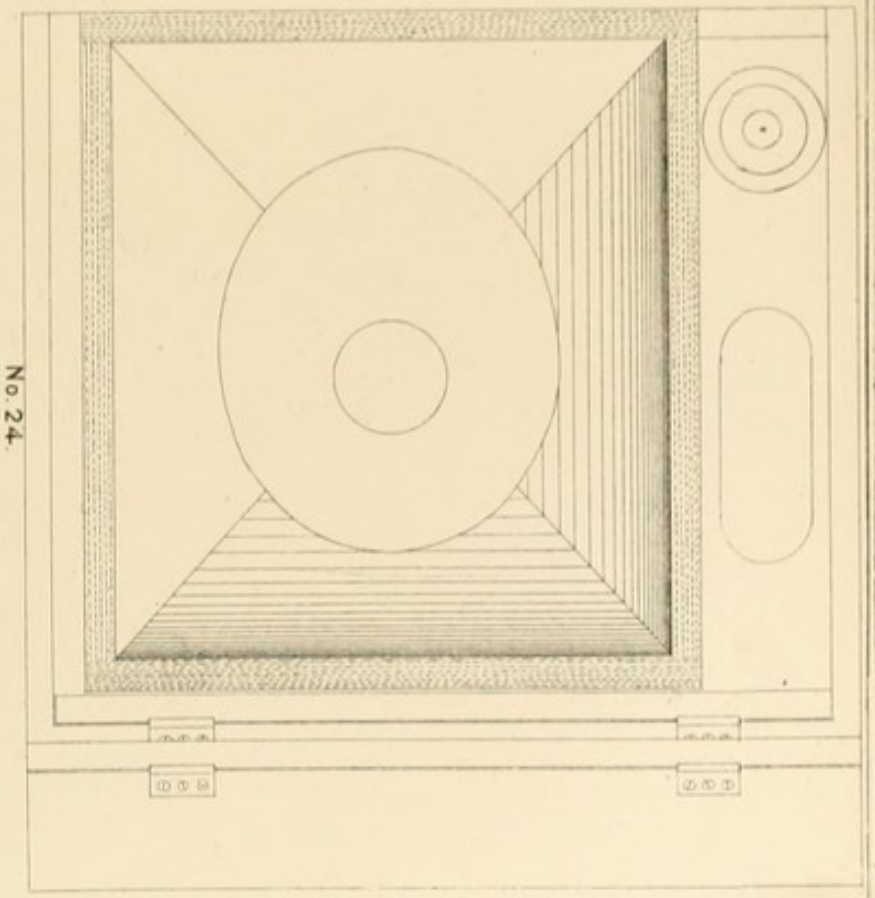
Scale 1½ Inch 1 Ft.



No. 26.
SECTION.

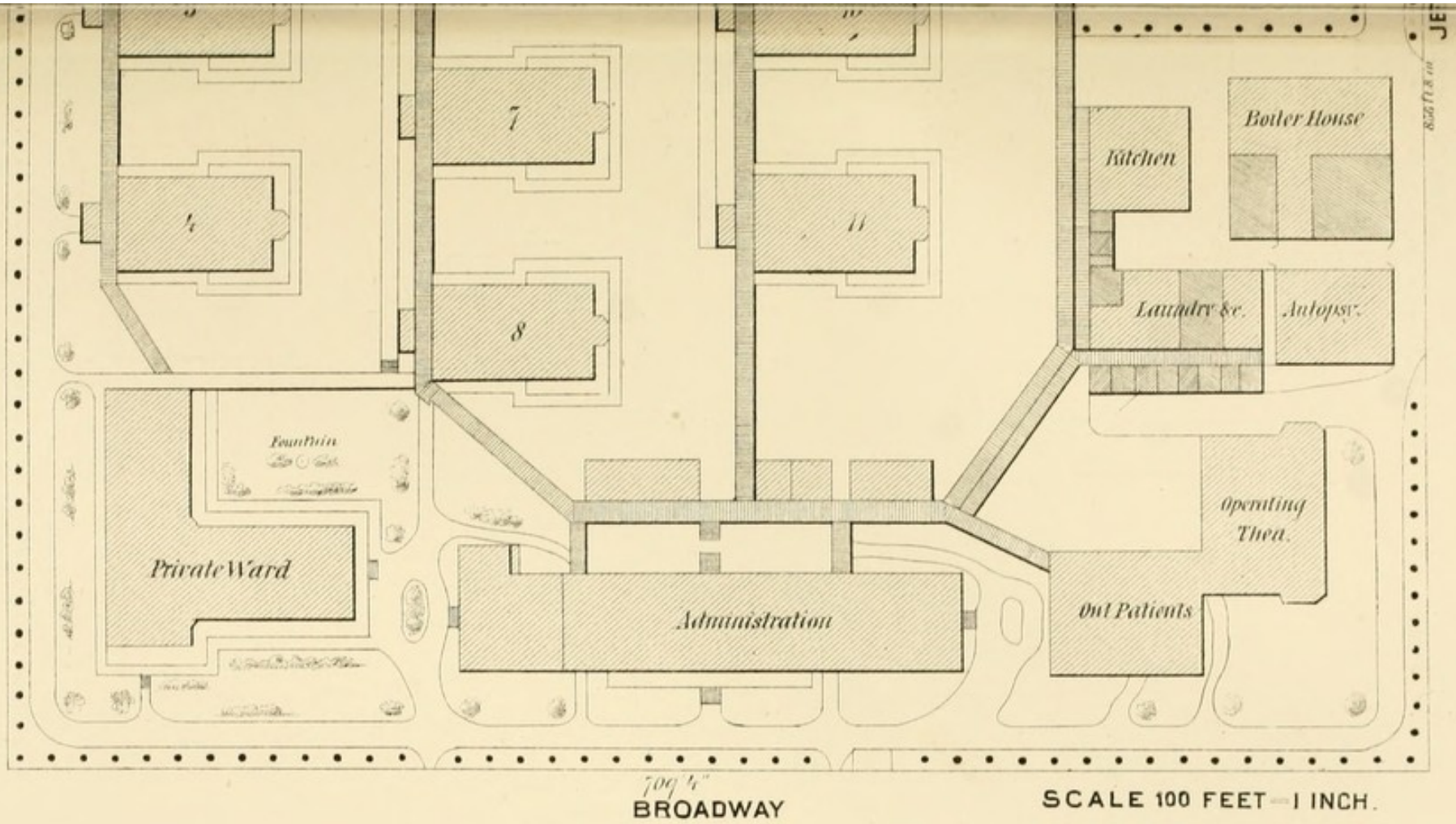


No. 25.
ELEVATION.



No. 24.
PLAN.

DR. FOLSOM'S SUGGESTIONS,
FOR
JOHNS HOPKINS HOSPITAL



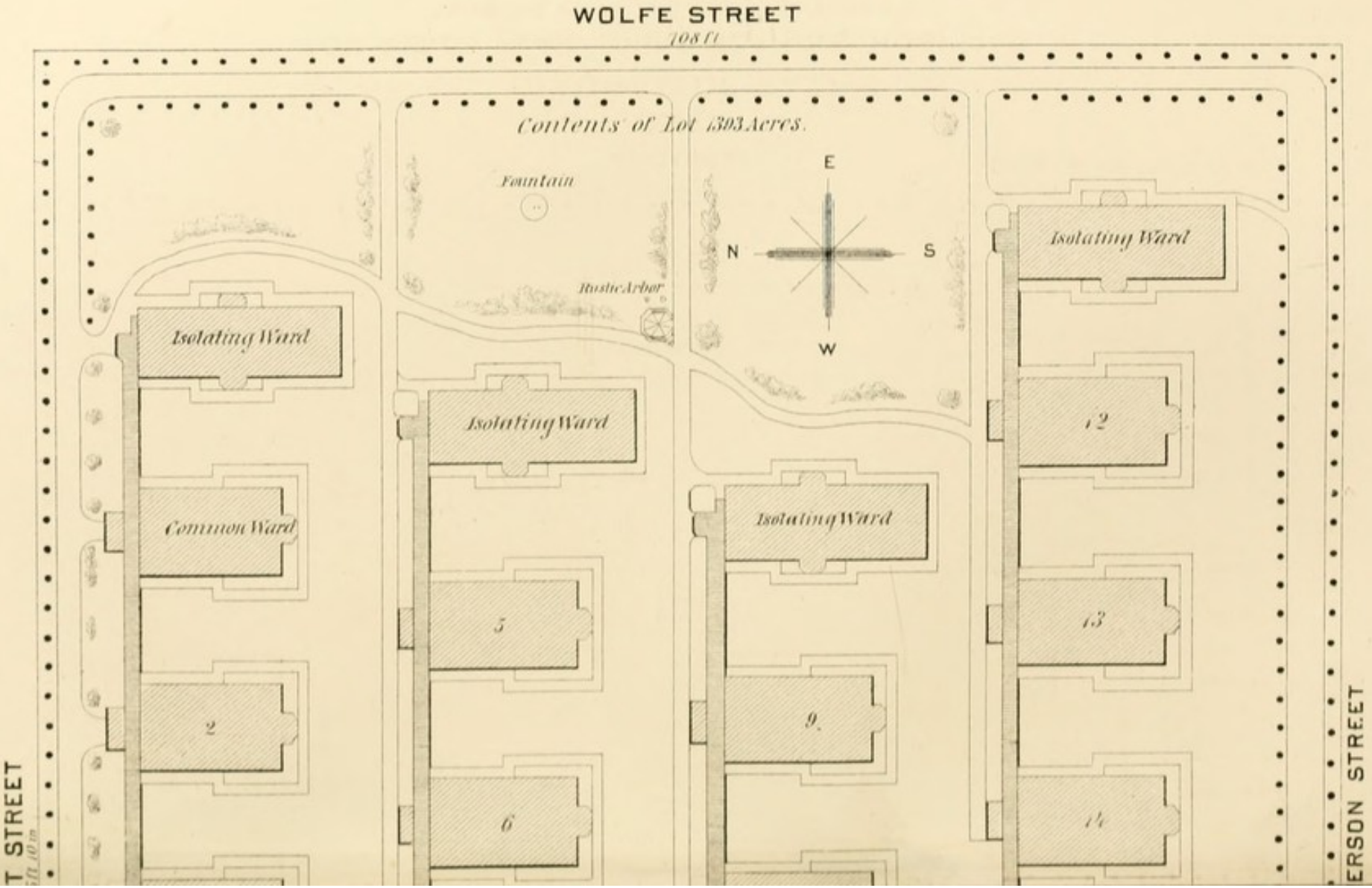
No. 27.

DIAGRAM OF PATHS

ON BLOCK PLAN JOHNS HOPKINS HOSPITAL

SHOWING POSSIBLE TREES SHRUBS &c.

PROPOSED BY DR. NORTON FOLSOM


WOLFE STREET
108 ft
Contents of Lot 1303 Acres.
Fountain
Rustic Arbor
E
N
S
W
Isolating Ward
Isolating Ward
Isolating Ward
Isolating Ward
Common Ward
2
3
6
9
12
13
14
ERSON STREET
T STREET

"Distance from head of table to grating,	2 feet.	
" " " foot " "	2 "	5 inches.
"Height of table,	2 "	9½ "
"Depth of dish from ends,		2¼ "
" " " " " sides,		1¼ "
"Inside diameter of cylindrical leg,	1 foot	4½ "
"Diameter of air-tube,	1 "	6 "

"At the rear of the theatre a soapstone sink with a steep incline "and draining slab at the end, provided with hot and cold water, "is enveloped by a glass hood, or chamber of glazed sashes, like "that in a chemical laboratory. Ventilation is secured by a large "exhausting duct, with an enforced draught.

"With these appliances, an autopsy is almost, if not quite, "odorless."

A refrigerator for the temporary preservation of specimens is also seen at the rear of the theatre.

The floors of the autopsy and dead-rooms are water-tight, and arranged to be washed with hose.

Plates Nos. 24, 25, and 26 give respectively a view of the open top; of the front when closed; and a vertical section, of the top arrangements proposed for all water-closets, as a substitute for "leading" them in the ordinary way. Urinals, as heretofore constructed, cannot be kept free from odor, and are not as well adapted for hospital use as a water-closet with the seat raised. Every water-closet requires daily washing with soap, and sometimes with sand, to keep it clean.

In the pattern proposed, the top of the porcelain bowl, instead of being round or oval, is a square shallow tray or sink, the edges thickened for strength, but rising only half an inch all around. The usual oval opening of the bowl is in the middle of this slightly shelving sink, and the verge of the opening is perfectly smooth. The fan-jet of water is in its usual place in the bowl, which is of the usual shape and construction below, to secure the playing of the fan-jet around the circumference.

The front edge of the square sink comes forward flush with the face of the wood-work.

The seat, hinged at the back, is raised when the water-closet is used as a urinal or slop-sink, or while washing bed-pans; and, though there is no play of water over the square part of the sink,

except from the hand-hose, there is every opportunity to wash it thoroughly.

When the seat is down, it rests, not on the sink, but on separate wooden cleats at the sides, one inch higher than the top of the sink, so that there is always an interval of an inch between seat and sink, even when the cover is shut down; and through this interval the air constantly passes horizontally from the front, backward over the sink to the ventilating duct behind.

As the bowls are not made in this country, it may be necessary to use one of the usual kind, and fit a tray of glass or lead to the top of it.

The wood-work in front slopes in at the bottom three inches, to give standing room.

LIST OF FURNITURE FOR A WARD OF TWENTY-THREE BEDS.

Articles.	No.	Cost of each.
Wooden Trays	3	$2.00
Coal Hods	2	3.00
Coal Hods (small)	1	1.00
Shovels	1	1.50
Shovels (small)	2	16
Match Safes	1	20
Oil Lamps (Britannia)	6	75
Oil Cans	1	1.00
Lamp Fillers	1	33
Lamp Shades (tin)	2	75
Spit-Cup Covers (tin)	36	06
Wooden Pails	4	25
Keelers, or Dish-Tubs	1	42
Brooms	2	33
Floor Brushes	2	92
Dust Brushes	2	37
Window Brushes	1	1.00
Mop Handles	2	21
Mops	2	29

Articles.	No.	Cost of each.
Dish Mops	1	$0.12
Scrubbing Brushes	2	25
Soup Tureens (tin)	1	5.00
Vegetable Dishes (tin)	3	75
Coffee-Pots	2	75
Tea-Pots	2	61
Wash-Bowls	12	30
Poultice Dippers	2	43
Tin Dippers	2	18
Tin Cups	2	29
Dust Pans	2	16
Graters	1	03
Tunnels	1	12
Strainers	1	12
Sugar Boxes	1	1.19
Bread Boxes	2	1.28
Tea Trays	12	60
Chamber Pails	1	95
Casters	1	2.00
Corkscrews	1	85
Poker	1	50
Tongs	1	1.00
Steps for Linen Closet	1	4.00
Card-Frames (tin)	23	30
Cambric-covered Screens	6	4.26
Clocks	2	3.50
Thermometers	2	1.00
Clothes-Brushes	1	21
Baskets, for carrying Bottles	1	50
Bandage Winders	1	4.00
Nail Brushes	2	30
Combs	6	10
Trucks, for Litters	1	10.00
Litters	1	6.00
Basket Litters	1	6.00
Rubber Sheeting, yds	20	2.25

Articles.	No.	Cost of each.
Rubber Pillow-cases	12	$1.35
Lamp Scissors	1	50
Scissors	1	1.00
Shears	1	2.50
Copper Heaters (to fill with water)	4	5.00
Knives	23	56
Forks	23	75
Carving Knives and Forks	6	33
Large Spoons	6	13
Table Spoons	23	31
Tea Spoons	12	14
Blankets	60	1.24
Quilts	46	1.40
Sheets	200	93
Pillow Cases	200	28
Half Sheets	100	34
Mosquito Nets	30	16
Shirts	50	50
Table Cloths	6	1.55
Table Covers (Turkey Red)	3	3.81
Dressing Towels (diaper)	200	13
Toilet Towels (crash)	150	18
Rollers (crash)	12	44
Towels (coarse crash)	12	15
Toilet Towels (huckabuck)	50	23
Table Covers (one for Nurse)	2	2.35
Spit-Cups	36	13
Bed Pans	3	1.42
Soap Dishes	3	15
China Wash-Bowls and Pitchers	2	1.50
Plates	30	12
Small Plates	30	11
Bowls	30	15
Mugs	30	13
Medicine Mugs	30	05
Drinking Ducks	6	20
Cups and Saucers	30	11
Dishes	6	67

Articles.	No.	Cost. of each.
Platters	2	$0.95
Water Pitchers	2	83
Small Pitchers	6	39
Very Small Pitchers	6	31
Sugar-Bowls	2	57
Ice-Jars	1	1.99
Tumblers	12	7
Salts	24	1
Hair Mattresses	28	13.51
Husk Mattresses	25	3.31
Husk Bolsters	25	61
Hair Pillows	25	1.66
Feather Pillows	60	1.96
Small Wooden Stands	23	90
Reclining Chairs	1	27.00
Arm Chairs (with cushions)	23	4.80
Small Wooden Chairs	16	92
Long Tables	3	18
Towel Stands	2	1.00
Looking-Glasses	3	4.50
Boxes for Soiled Clothing	1	3.00
Bureau and Glass (for Nurse)	1	20.00
Square Table " "	1	2.00
Rocking Chair " "	1	3.75
Small Chairs " "	4	1.40
Iron Bedstead " "	1	15.00
Wash-Stands " "	1	3.00
Lounge " "	1	20.00
Wheeled Chairs	1	40.00
Iron Bedsteads	23	30.00
Total cost		$2,486.15

CONTENTS OF MEDICINE-CLOSET.

8 oz. Solution of Iodide of Potassium, 40 grains to 1 oz.
12 " " Bromide of " " " 1 "

4 oz. Solution of Sulphate of Morphia, 1 grain to 1 oz.
12 " " " Magnesia, 2 drachms to 1 oz.
8 " " Chloral Hydrate, 4 grains to 1 oz.
4 " Tincture of Opium.
4 " Deodorized Tincture of Opium.
4 " Spirit of Nitrous Ether.
4 " Solution of Acetate of Ammonia.
12 " Cod-Liver Oil.
8 " Castor Oil.
4 " Fluid Extract of Senna.
8 " Mustard.
1 pint of Lemon Syrup.
4 oz. Compound Tincture of Gentian.
4 " " " Cinchona.
2 " Tincture of Chloride of Iron.
8 " Solution of Sulphate of Quinine, 8 grains to 1 oz.
4 " Oil of Turpentine.
1 pint of Lime Water.
2 oz. Aromatic Spirit of Ammonia.
2 " " Sulphuric Acid.
2 " Essence of Peppermint.
2 " Tincture of Ginger.
1 doz. Compound Rhubarb Pills, 5 grain.
1 " " Cathartic " 5 "
1 " Dover's Powders, 10 grain.
1 " " " 5 "
1 " Powders of Sub-Nitrate of Bismuth, 10 grain.
1 " " " " 5 "
4 oz. of Seidlitz Mixture.
2 " Tartaric Acid.
4 " Bitartrate of Potassa.
4 " Compound Licorice Powder.
1 doz. Pills of Sulphate of Quinine, 2 grain.
1 " " " " 1 "
1 " " Opium, 1 "
1 One-ounce Graduated Glass Measure.
1 Minim Glass.
1 pint of Brandy.
1 " Whiskey.
1 " Gin.

1 pint of Sicily Madeira.
1 " Tarragona or Port Wine.
1 quart of Dilute Alcohol or Rum, for bathing.

CONTENTS OF DRESSING-CLOSET.

5 yards of Cotton for Compresses.
5 " Poultice Muslin.
2 doz. Assorted Roller Bandages.
1 yard of Sheet Lint.
½ lb. of Scraped Lint.
2 oz. Tincture of Iodine.
1 Camel's Hair Pencil.
2 oz. of Olive Oil.
2 doz. Sponges.
½ lb. Simple Cerate.
1 yard Adhesive Plaster.
1 Eight-inch Spatula.
1 Four " "
1 yard Oiled Linen.
1 Pincushion.
12 Sheets Cotton Batting.
½ lb. of Charpie.
Assorted Splints.

LIST OF PLATES.

No. 1. Block Plan.
" 2. Plan of Administration Building.
" 3. Plan of Common Ward.
" 4. (West) Side Elevation of Common Ward.
" 5. North Elevation of Common Ward.
" 6. Longitudinal Section of Common Ward.
" 7. Cross-Section of Common Ward.
" 8. Plan of Heating Apparatus of Common Ward.
" 9. Cross-Section of Heating Apparatus of Common Ward.
" 10. Plan of Ventilating Ducts of Common Ward.
" 11. Cross-Section of Ventilating Ducts of Common Ward.
" 12. Plan of Isolating Ward.
" 13. East Elevation of Isolating Ward.
" 14. Cross-Section of Isolating Ward.
" 15. Detail of Heating Apparatus, with Mixing Valve, of Isolating Ward.
" 16. Plan of Private Ward.
" 17. Plan of Kitchen.
" 18. Plan of Operating Theatre and Out-Patient Building.
" 19. Cross-Section of Operating Theatre.
" 20. Plan of Autopsy Building and Dead-House.
" 21. Longitudinal Section of Autopsy Building and Dead-House.
" 22. View of Autopsy Table.
" 23. Longitudinal Section of Autopsy Table.
" 24. Plan of Water-Closet.
" 25. Elevation of Water-Closet.
" 26. Section of Water-Closet.
" 27. Diagram of Paths, showing possible Trees, Shrubs, etc., on Block Plan.

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HOSPITAL CONSTRUCTION

AND ORGANIZATION.

JOSEPH JONES, M.D.,

Professor of Chemistry and Clinical Medicine, Medical Department University of Louisiana; Visiting Physician of Charity Hospital, New Orleans; Formerly Surgeon in the Provisional Army of the Confederate States.

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495 St. Charles Street, New Orleans, La.,
April 8, 1875.

Francis T. King, Esq.,
President, "The Johns Hopkins' Hospital," Baltimore, Md.

Dear Sir:—Your kind favor of the 3d inst. has been received and carefully considered; and whilst feeling great hesitation in accepting the important trust of rendering counsel in the execution of the noble bequest of the late Johns Hopkins, of Baltimore, and whilst distrusting the extent of my qualifications and experience, to which you have been pleased to allude in such generous terms, allow me to say that I will endeavor to present a practical view of the more important subjects which will be involved in the erection and operation of a great Hospital.

I gather from your letter, that the objects and uses of "The Johns Hopkins' Hospital" will be—

1st. The relief of human suffering; the recovery of health; recovery from sickness in the shortest time; with the smallest possible mortality.

2d. The establishment of a Medical School, where pupils shall be taught the ways of nature in the recovery from diseases and casualties, and in which the daily experience of the medical staff shall be enlarged, perfected, and preserved for the use of future generations.

I will endeavor to present concise and practical observations on the following points:—

1st. Hospital Construction. Form and size of Hospital Buildings. Building Material. Size and arrangement of Wards. Ventilation. Light. Heat. Disinfection.
2d. Distribution of Patients.
Classification of Diseases and Accidents.
3d. Administration.
Medical and Surgical Staff.
Duties of Physicians, Surgeons, and Resident Students.
4th. Nurses and Attendants.
5th. Arrangements for Cooking.
Diet.

6th. General Police.
7th. Clinical Instruction.
Proper Location and Structure of Amphitheatre and Lecture Room.
Disposal of Dead.
Structure and Conduct of Dead House.
Post-Mortem Examinations.
8th. Laboratory for Chemical, Microscopical, and Pathological Investigations.
9th. Library.
Duties of Librarian.
Preservation of Hospital Records and Works of Reference.
Museum.
Duties of Curator of Museum.
Preservation of Anatomical and Pathological Specimens.
10th. Hospital Dispensatory.
Duties of Druggists.
Preparation and Dispensation of Drugs and Medicines.
11th. General Dispensatory for Out-door Patients.
12th. Regulations relating to Students attending Clinical Lectures and General Dispensatory ; and Visiting, Obstetrical, Surgical and Medical Wards.
13th. Observation and Registration of Cases.

I shall endeavor to make the observations under each head as explicit and practical as my experience may permit.

In conclusion, allow me to request, that if I have not fully comprehended the nature of the subjects to be discussed, I may receive further instruction at your earliest convenience.

With great respect and high esteem,

I have the honor to be

Your obedient servant,

JOSEPH JONES.

HOSPITAL CONSTRUCTION

AND ORGANIZATION.

JOSEPH JONES, M.D.,

Professor of Chemistry and Clinical Medicine, Medical Department University of Louisiana; Visiting Physician of Charity Hospital, New Orleans; Formerly Surgeon in the Provisional Army of the Confederate States.

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495 St. Charles Street, New Orleans, La.,
May 10*th*, 1875.

To Francis T. King, *President, and* John W. Garret, Hon. George W. Dobbin, Galloway Cheston, Thomas M. Smith, William Hopkins, Richard M. Janney, Joseph Merrifield, Francis White, Lewis N. Hopkins, Alan P. Smith, M.D. *and* Charles J. M. Gwinn, *Trustees, of "The Johns Hopkins' Hospital," Baltimore, Maryland.*

Gentlemen:—In accordance with the request contained in the letter of your honorable President, bearing date April 3d, 1875, I have the honor to submit the following observations, which I shall endeavor to conform to the order of subjects indicated in my letter of the 8th of April.

In presenting the results of my experience, I desire to avoid as far as possible controversy and criticism; and it will be my effort to express my views and apply well established principles in such a simple, practical, and concise manner, that suggestions may be furnished worthy of the consideration of your honorable and learned body.

If such charity as that which actuated the late Johns Hopkins of Baltimore, and which has been regarded as the most benign of all the virtues, "*the very bond of peace, and of all virtue,*" was

universally diffused, there is not a disease that can afflict human nature, nor a want which the varying condition of man can require, nor any of the manifold visitations of adversity in poverty or distress, but would find an open asylum, prepared with every useful accommodation. The founder of this noble charity evidently held, that one of the first duties is to *feel for man.* The most distinguished ability and the greatest success in life are valueless when that duty is neglected.

Allow me to say, that I regard the letter of your honorable President as calling, not for an elaborate treatise on the history and construction of hospitals in this and other countries, nor for a detailed account of my personal experience in Civil and Military Hospitals; but rather for the expression of a definite opinion, and the unfolding of a definite plan of hospital construction and organization, which may be compared with those furnished by distinguished members of the Medical Profession, and which may be subjected to direct discussion. with a view to *adoption*, *modification*, or *rejection.*

LOCATION.

It is not necessary to discuss the location of a great hospital, as this subject has been decided beyond controversy, and in the most enlightened manner, by the terms of the bequests of the late Johns Hopkins.

Thus President King says in his letter of the 3d of April, 1875:

"The site of the proposed building" "consists of an eligible piece of ground situated in the eastern part of the city." "It is fourteen acres in extent, in the form of a parallelogram, 709 by 856 feet"; "it is very elevated above the general level of the city, and commands an extensive view in all directions;" "it is healthy, with complete surface drainage, whilst underground drainage may be accomplished to tide-water"; and "it is easily accessible by street railway, and by paved streets which bound the four sides of it."

DRAINAGE AND SEWERAGE.

The first attention should be paid to the *surface* and *underground* drainage, which should be of the most ample and effective character, so as to render the Hospital grounds dry and

porous, and prevent the accumulation of any water, either on the surface or in the soil.

The sewers should be ample in size, simple in structure, and capable of easy examination and repair; and they should be constructed upon the most approved and efficient plan.

The question of the drainage and sewerage appertains to Engineering Science.

Two main sewers should run across the Hospital grounds, one in the front, and the other in the rear of the buildings; and all minor sewers should discharge into them. The large sewers should be not less than four feet in diameter, and the smaller sewers not less than two feet in diameter.

The sewers should be properly ventilated.

No sewer should run under any ward or Hospital building.

The water used in the Hospital bath-rooms, kitchen, steam-laundry, dispensatory, laboratory, etc., should be used to cleanse out the privy vaults, flowing into and through them, and emptying into the main sewers.

As water is the best disinfectant, and the best means of removing filth and noxious gases from the sewers, the supply should be large and practically unlimited.

The free flow of the fecal matters in the sewers may also be promoted by a *system of fountains*, located at stated intervals in the Hospital grounds, the waste water from which should flow continuously and at stated intervals into the sewers. The fountains, whilst thus adding to the beauty and attractions of the grounds, and to the comfort of the patients, may be made of the greatest practical benefit in flushing out and cleansing the sewers.

WATER.

The supply of water is of the greatest moment. The Hospital grounds, buildings, and wards should be furnished with ample supplies of pure potable water, and the pipes should be constructed of such materials as to preclude the contamination of the water by *lead*, or any other deleterious agent.

Each ward and building should have its own system of water pipes.

The main *administrative* building may be so constructed as

to be surmounted by large iron tanks, to which the water may be elevated by engines, located in the Hospital grounds or buildings, if the water-works of the city of Baltimore have not sufficient force to accomplish this result.

ARTIFICIAL LIGHT.

The Hospital grounds and buildings should be supplied with the ordinary gas, which is the safest, cleanest, and most efficient means of illumination. The gas-pipes and gas-meters should be so arranged as to admit of frequent and efficient inspection.

SUNLIGHT AND HEAT.

The axis of the wards of the Hospital should be so located as to secure the largest possible amounts of the sun's light and heat. The location of the Hospital should also to a certain extent be regulated by the direction of the prevailing winds.

BUILDING MATERIALS.

Permanent hospitals should be constructed upon the most substantial principles.

The materials for the foundation, walls, and floors should be either brick, stone, or iron, or a combination of each.

Of all building materials, *granite* is the most durable.

The materials and plan of construction should be such as to render the Hospital buildings *fire-proof*.

The walls should be of impermeable material, such as *Parian cement*, or of *colored tiles*, or large *porcelain* or *glazed earthenware slabs*, joined perfectly by a good cement. It is impossible that any absorption of poisonous animal matters should occur, with walls formed of glazed tiles or slabs.

The floors should be constructed of *fire proof* materials, and covered with glazed tiles or slabs, which may be covered with good *oil-cloth*, or material of the like kind, which will not absorb organic matters and gases, and which will lessen the necessity of washing the floors, and which might be frequently removed and washed.

Without doubt, *wooden* buildings serve an excellent purpose, in time of war, and in great emergencies; but the objections to the construction of permanent hospitals of wood are :—

1st. Danger of destruction by fire.

2d. Perishable nature of wooden buildings, necessitating constant repair and renewal.

The chief objections which have heretofore been urged against permanent hospitals, are more correctly applicable to the evils of faulty construction, overcrowding, and the neglect of periodical evacuation and disinfection.

METHOD OF COMBINING THE ADVANTAGES OF TEMPORARY AND PERMANENT HOSPITALS.

An important principle in the construction and conduct of permanent hospitals, which has not yet been recognized and adopted, is that each permanent hospital should never be filled to its utmost capacity, *but that at least one-twelfth of the entire ward space should at all times be vacant.*

Thus: If a permanent hospital consists of 12 wards, only 11 wards should at any time be occupied; the twelfth or vacant ward should be fully ventilated, cleansed, disinfected and aired; and to accomplish its complete renewal or regeneration, so that it shall in fact constitute a *new* ward, one month should be devoted. Each ward should thus be treated once in twelve months. Each ward may be annually evacuated, cleansed, ventilated and disinfected with chlorine, carbolic acid and burning charcoal and sulphur, systematically and regularly, in rotation, so that all inconvenience and confusion would be avoided.

If the Hospital consists of twenty-four wards, then two wards should always be vacant; if of thirty-six wards, three wards; if of forty-eight wards, four wards, and so on.

At such times, as when contagious or infectious diseases are prevailing, the cleansing, evacuation and rotation may be performed at shorter intervals.

By ventilation, evacuation, cleansing, disinfection and renewal of bedding, the permanent hospital is perpetually undergoing the process of renewal and reconstruction, and thus attains the advantages of the destructible wooden pavilion hospital, without its defects.

By complete renovation of the vacated wards, we mean not merely disinfection of the floors, walls and space, by the fumes of burning charcoal and sulphur, chlorine and carbolic acid, but

the thorough cleansing and varnishing of all furniture, and the thorough renewal of the bedding.

It is probable that the chief source of the propagation of contagious and infectious diseases is to be found in the stuffing (moss, hair, straw, cotton, wool, etc.) of the beds. Absolutely new material, or material which has been subjected to thorough disinfection, by means of steam and other agents, should be used at stated intervals in the construction of beds. It is unfortunately too true, that the materials employed in the construction of beds are used, over and over again, in large hospitals, without proper cleansing and disinfection.

The hygiene of a hospital should commence with the *bed*, upon which the patient passes the greater portion of his time.

As beds are constructed of porous materials, they without doubt act as sponges for the absorption and retention of deleterious organic matters and gases.

No attention to ventilation, temperature, food and cleanliness of the wards and patients will avail, if the beds are used for indefinite periods.

By this principle of rotation in the ward service, we secure for the permanent hospital the advantages claimed for temporary wooden hospitals, which may be destroyed or removed at will.

With proper drainage and sewerage, it is impossible that the grounds of the permanent hospital should ever become saturated with organic matters.

FORM, SIZE AND ARRANGEMENT OF HOSPITAL BUILDINGS.

In permanent European hospitals constructed on the Pavilion system—the Lariboisière at Paris, the Herbert Hospital at Woolwich, the Blackburn Hospital near Manchester, England, the Hospital of Saint Louis at Turin, and the Military Hospital at Malta; and in American permanent hospitals—the Boston Free Hospital, the Pennsylvania Hospital, the Blockley Alms House and Hospital, the Pennsylvania University Hospital and the Episcopal Hospital of Philadelphia, and the Charity Hospital of New Orleans, furnish plans worthy of careful consideration.

In temporary Military Hospitals—the Confederate Hospitals of Camp Winder, Camp Jackson, Richmond, Virginia, of Gordonsville, Charlottesville, Staunton, Lynchburg, Petersburg, and

the large temporary hospitals attached to the Army of Tennessee, located at various times at Chattanooga, Tennessee, Rome, Atlanta, Marietta, Macon, Georgia, and other points, which were erected during the recent civil war, under the enlightened direction of Surgeon-General S. P. Moore, C.S.A.; and the great Federal Hospitals—of West Philadelphia, the Mower General Hospital, Chestnut Hill, the McClellan Hospital, Philadelphia, the Hammond General Hospital, Point Lookout, the Lincoln Hospital, Washington City, the Hospital at Fort Schuyler, New York, furnished plans worthy of the consideration of Army Medical Officers.

The Hospital should consist of a Central or Administrative Department, the buildings devoted to the reception and treatment of Diseases and Accidents, and the necessary rooms for Clinical Instruction and Pathological Investigation.

Hospitals, however necessary and excellent in themselves, and however they may to a certain extent reflect the civilization and charity of a community, as they relate only to the cure of disease and the necessities of mankind, must be regarded as holding only a subordinate station in the body politic of medicine, the science of which in its noblest extent aims not only at the cure of disease, but the eradication of the causes of disease, and the preservation and prolongation of the life of man, in every country and climate, and in every condition and occupation. If, therefore, the crowding of healthy men has its danger, the collection of many sick persons within the confined area of the hospital is far more perilous; and from the imperfection of the arrangements, as well as the contamination of the ill-ventilated and crowded wards with morbid substances, hospitals have frequently become pest-houses, and effected more harm than good.

The risks of aggregation are encountered in the hospital, in order that medical attendance and nursing may be more easily and perfectly performed; otherwise it would be more humane and more productive of good results to treat the sick at their own houses and homes, or in separate apartments, scattered over a great area, permiting of complete isolation.

Whilst it may be admitted that the many advantages of hospitals more than counterbalance the continual sacrifice of life from diseases arising from actual contact, and the rapidly

changing and putrefying substances emitted by the sick, or aggravated by impure air; at the same time it is well established, that the risks of contagion and aggravation of disease is the least in the *best constructed and ventilated* hospitals.

The following rules, governing the construction of hospitals, have met with strong support by many who have had the greatest experience in the erection and management of Civil and Military Hospitals:

1st. An unlimited supply of air is the cardinal consideration in the erection of hospitals, and should govern the construction of the buildings.

2d. The sick should be placed in detached and perfectly ventilated buildings, so disposed as to get the freest air and the greatest light.

3d. The sick should be distributed over as large an area as possible, and each sick man should be as far removed from his neighbor as possible.

4th. Not more than from 80 to 100 sick should be in the same building, under one roof, and there should be no possibility of the polluted air of one ward passing into another.

5th. In the wards, each man should have not less than from 1800 to 2200 feet of cubic space.

6th. A much more efficient, and at the same time much less costly ventilation, may be obtained by natural than artificial means: therefore, it should be dependent upon the movement of the outer air, and on inequalities of weight of the external and internal air. In a properly constructed ward, sufficient ventilation can at any time be obtained by open doors and windows. The windows in the wards should be numerous, opposite to each other, and should reach from the ceiling to the floor. Additional openings may be made, so as to secure as far as possible a vertical movement of the air from below upwards. And this will best be accomplished by the method recommended by Dr. Edmund A. Parkes, in his valuable *Manual* of *Practical Hygiene*, which is as follows:

A tube opening at once to the external air should run transversely along the floor of the ward to each bed, and should end in a box placed under the bed, and provided with openings at the top and sides, which can be more or less closed. In the box, coils of hot-water pipes should be introduced to warm the air

when necessary. The area of the tube should be not less than 72 square inches to each bed; and the area of the openings in the box at least four times larger. The fresh air, warmed to any degree, and moistened, if necessary, by placing wet cloths in the box, or medicated by placing chlorine, iodine, or other substances, will then pass under each bed, and ventilate the space, so often left unaired; and then ascending round the sides of the bed, will at once dilute and carry up the products of respiration and transpiration to the ceiling. It would be possible to arrange the hot-water pipes, so as to cut off all or some of the pipes under a particular bed from the hot-water current, if desirable, and so to give a fever patient air of any temperature, from cold to hot, desired by the physician. In the low and exhausted stages of fever, warm air is often desirable. By this simple plan, the physician could deal effectually with the atmosphere round his patients, as to warmth, dryness, humidity, and medication: and at the same time the open fire chimney and open doors and windows are preserved. For the exit of the foul air, channels in the ridge should be provided, warmed with gas if possible.

7th. In order to preserve the purity of the air, by immediately diluting and rapidly carrying away the morbid substances evolved from the bodies and excretions of the sick, it must be continually changing: for persons in health, at least 2,000 cubic feet per head must be supplied per hour; and for sick persons, not less than from 4,000 to 5,000 cubic feet per hour. At the same time, the movement of the air should be as far as possible imperceptible, in order to avoid the sensation of draught or chill. The rate at which the movement becomes imperceptible, varies with the temperature of the air, a very considerable velocity being not perceived at high temperatures.

8th. Every ward should be amply supplied with hot and cold water; and baths, both simple and medicated, should be attached to each ward.

The supply of water for all purposes should be at least 65 gallons per head daily; to be expended, if necessary, daily as follows: for cooking, including cleansing of kitchen, 5 gallons; for baths and personal washing, etc., 25 gallons; for laundry washing, 10 gallons; for washing and cleansing hospital and utensils, 10 gallons; for water closets, 15 gallons per head daily.

9th. The wards should be erected upon arches, so as to allow

of free ventilation of the lower floor. The lower corridor, upon which the wards are erected, may be used as a general highway, with a central tramway or railroad, for the conveyance of the food, medicines, patients, clothing and dead.

10th. Each ward should be connected with the lower arched corridor by means of lifts and stairways, so as to permit of the ready distribution of patients, medicines, food, etc. By this means, all unnecessary noise and bustle about the wards will be avoided, and the service rendered by the nurses and attendants will be more efficient. The patients of each ward will thus also have free and ready access to the Hospital grounds. Open-air exercise is an important mode of medical treatment, and open verandahs, on the sunny sides of wards, and also gardens and quiet walks, will conduce to the comfort and health of the patients.

11th. The wards should not be constructed too large nor too small. Only two rows of beds should be permitted ; they should be arranged so as to allow the attendants a general view of each patient ; every contrivance, as lifts, shafts, tramways, and speaking tubes, to save labor, should be employed, in order that the time of the attendants should be expended as far as possible in nursing, and not in other duties.

12th. The water-closets should be arranged in nearly detached, well-ventilated lobbies, at one end of the ward, and separated from it by a thorough cross ventilation.

No urine or other excretion should be retained in vessels, but should immediately be discharged by the urinal.

All excreta should be removed by water ; and the water-closets should have continuous and unlimited supplies.

I have drawn up the following plan, based upon the preceding principles, for a permanent hospital, capable of accommodating 800 patients.

HEAT, REGULATION OF THE TEMPERATURE OF THE WARDS.

The arrangements for heating the Hospital should be ample to meet all sudden changes of temperature, and also to maintain the degree of heat and moisture, best adapted to the proper treatment of certain diseases.

The temperature of hospitals should be regulated in accordance with that of the climate in which they are situated, and the

class of patients by which its wards are supplied. Patients depressed by poverty and privation should manifestly be treated in a different manner from well-nourished and vigorous men in the prime of life and within the military age.

During a period of eight years, 1817–1824, the mean monthly temperatures of Baltimore were as follows: January, 30.9° Fahr.; February, 33.0°; March, 39.2°; April, 52.1°; May, 60.6°; June, 70.9°; July, 75.2°; August, 74.7°; September, 66.6°; October, 54.9°; November, 44.3°; December, 34.4°. Mean temperature for spring, 50.6°; summer, 73.6°; autumn, 55.3°; winter, 32.8°. Mean for the year, 53.1°.

The following table (see p. 120) furnishes the monthly extremes of temperature in Baltimore during a series of years 1841–1852.

Of all exciting causes of disease, there are none more common than extremes or sudden transitions of temperature. It is evident from the preceding record of the changes of temperature in Baltimore during a series of years, that buildings designed in this city for the efficient treatment of the sick should be so constructed as to shield the inmates effectually from the extreme cold, and the sudden changes of the months of December, January, February and March, and the elevated temperature of June, July, August and September.

It is probable that external cold excites internal disease by deranging the circulation and condition of the blood, particularly in the capillaries.

Cold checks the perspiration, contracts and obstructs the vessels of the skin, and thus throws more blood inwardly, so that internal congestions are produced, which impair the functions of the affected organs, especially if they are such as are concerned in excretion: and in other ways lays the foundation of disease. It is well known that this intropulsive effect of cold takes place more rapidly and in a more injurious degree when the capillary circulation is weak and sluggish, whilst on the other hand the injurious effect of cold is lessened or prevented by a vigorous state of the capillary circulation and healthy condition of the blood. It is evident, therefore, that the poorer classes are peculiarly liable to the injurious effects of cold, and require in sickness a higher and more uniform degree of heat, than strong, well-fed individuals.

However, huts and wooden buildings may have served a use-

Monthly Extremes of Temperature in Baltimore, Maryland, during a period of 12 *years,* 1841–1852.

Year.	January.		February.		March.		April.		May.		June.		July.		August.		Sept'ber.		October.		Nov'ber.		Dec'ber.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	Fahr.																							
1841	50°	0	64	5	70	19	66	30	82	34	94	59	95	62	84	65	88	55	67	25	67	22	55	15
1842	57	16	66	13	76	24	80	32	78	42	85	47	92	62	86	53	90	35	76	34	58	15	49	10
1843	60	10	51	10	53	63	72	26	78	45	85	52	92	65	88	68	88	43	73	32	64	25	50	17
1844	48	5	55	6	63	25	78	28	83	52	87	50	94	55	89	55	85	42	69	38	64	24	49	19
1845	56	20	61	13	75	24	80	27	84	39	94	45	97	55	91	57	85	43	79	27	63	19	42	9
1846	63	14	57	8	73	16	82	33	88	40	89	52	95	55	93	58	91	45	85	30	69	20	56	20
1847	54	10	52	18	64	20	84	26	89	46	97	52	98	58	94	57	94	51	81	32	78	16	66	13
1848	59	12	52	24	74	15	82	35	93	45	99	50	97	60	95	60	92	42	81	40	67	26	71	26
1849	56	6	46	11	72	26	78	28	87	44	100	55	93	59	89	60	89	51	74	42	76	34	55	16
1850	65	12	64	13	70	27	72	32	81	48	92	52	89	68	89	62	82	52	70	46	61	36	56	26
1851	50	15	52	17	73	33	69	40	85	43	90	52	92	63	90	53	93	54	80	34	65	30	56	7
1852	50	–5	58	15	70	22	69	32	83	42	94	50	96	63	91	57	95	46	86	36	62	28	60	25

ful purpose during periods of excitement and war, in the treatment of the sick of armies, who as a general rule have been well nourished, well clad, and in the vigor of manhood and in robust health, at the time of the attack of disease, and the supernation of wounds, they are not adapted to the treatment of the destitute sick of large cities.

One of the first requisites in the treatment of the sick poor, in permanent hospitals, is the power of controlling the temperature of the wards and maintaining a uniform and sufficiently warm temperature during the severe cold of winter and spring.

The temperature of each ward may be regulated to a certain extent by open fire-places, and by this means also efficient ventilation is promoted ; but the temperature can only be regulated with efficiency by a central heating apparatus, attached to each Hospital Pavilion, or located so as to supply the entire Hospital.

The degree of warmth should vary in accordance with the age and condition and the class of diseases treated in the different wards.

It is well established, that the lowering of the external temperature, especially when rapid, acts injuriously upon the very young and old ; and that both infants and old persons require much artificial warmth, in addition to warm clothing and nutritious food. On the other hand, the degree of temperature of the house does not appear to be so material to well-fed and well-clothed men in a state of health.

While for new-born children and old people a temperature of from 65° to 75° F. may be necessary : on the other hand, for well-fed and well-clothed adults, any temperature over 48° up to 60° may be comfortable.

For sick persons, it appears to be generally held, that the air of the sick-room or hospital should be about 60° Fahr. ; but no arbitrary rule of this character should be enforced in the conduct of a large hospital, in which a vast number of different diseases in different stages are received. One advantage of gathering certain diseases in certain specific wards, is that we are thereby enabled to regulate with greater accuracy the temperature in accordance with the nature of the diseased states.

Much has yet to be accomplished in the investigation of the influence of the external temperature on the progress and results of disease.

In acute febrile diseases and in the active stages of pneumonia, and even in some cases of phthisis, a temperature of air as low as 40° to 55°, is not only well borne, but even appears to be beneficial; on the other hand, spasmodic affections of the larynx and bronchial tubes, and chronic diseases of the heart and kidneys, attended with pulmonary congestion and difficult respiration, require a certain degree of both warmth and moisture.

In convalescence from fever and other acute diseases, the forces having been reduced by the active chemical changes and rapid metamorphosis of the blood and tissues and organs, sudden changes of temperature, and especially cold, act injuriously.

The rule, therefore, established by the results of the observations in both Civil and Military Hospitals, that *convalescents from fever and acute diseases must be kept warm*, should be rigidly enforced.

A well-constructed hospital, therefore, should have wards of different temperatures, and the proper regulation of the heat should be considered as equally important with the regular and abundant supply of light, fresh air, pure water, and wholesome food and efficient remedies.

The plan of ventilation proposed by Dr. Edmund A. Parkes, to which we have already referred, viz., heating fresh air under each bed, by hot-water pipes (the passage of hot water through certain of which can be stopped, if desired), offers the means of giving a certain temperature to a bed even in a large ward, or in a small ward, of bringing the whole air in the ward to any desired temperature.

By supplying each ward with two large, well-constructed, open fire-places, we obtain the advantages of radiant heat, which, so far from adding any impurity to the air, promotes wholesome and efficient ventilation. But from the limited amount of heat which can thus be supplied to large wards, other measures, as those of conduction and convection, must also be employed; it will be found that the open air fire-places will add greatly to the cheerfulness and comfort of the patients in cold weather.

The radiating grates should be constructed upon the rules indicated by Desaguliers, and applied by Count Rumford:

The width of the back of the grate should be one-third the width of the hearth recess; the sides should slope out to the front of the recess; the depth of the grate from before backwards

should be made equal to the width of the back. The sides and back should be made of non-conducting material; the chimney throat should be constructed so as to lessen the draught, and ensure more complete combustion. The grate should be brought as far forward as possible, but still under the throat.

Of the various means of heating, water appears to be the best, as it is more under control; and in the low-pressure system, in which the water is not heated above 200° F., and in which there is a central boiler, from which the water circulates through the pipes and returns again, outlets being provided at the highest points for the exit of the air, the danger of explosion is avoided, and the supply of heat is much more regular.

Steam furnishes an equally efficient supply of heat, but it is more expensive, less under control, subject to greater variations, and when water at high temperatures, ranging from 250° to 310° F., is employed, the pipes are subjected to great pressure, and destructive explosions may occur.

If the low-pressure system is employed, with water at 200° Fahr., the relation of the tubing to the capacity of the ward should be carefully calculated.

According to Hood, if the pipes be four inches in diameter, and the water be at 200°, then divide the cubic contents of the room by 200, and the quotient will be the number of feet of pipe, in length, to keep the room at 55° F., when the external air is 32° F.

The plan proposed by Desaguliers, one hundred and forty years ago, may be applied to the open fire-places in each ward; viz., to have an air chamber round the back and sides of the radiating grate, and to pass the external air through it into the room, thus securing the passage of a considerable quantity of gently warmed air into the ward, and effecting a great economy of heat.

The Meissner stove of Germany acts upon this principle, but it is without the open, cheerful fire, and on this account is inferior to the open grates.

DISINFECTION.

If the floors, sides, roof and walls of the wards be constructed in the manner which we have advocated, and covered with glazed

tiles or slabs, it is impossible that they should ever absorb or retain organic poisons and impurities.

When the wards are periodically evacuated, not only the floors, but the windows, walls, roof and furniture, should be well washed and cleaned, and cleansed with a solution of carbolic acid.

The fumes arising from burning sulphur and charcoal (mixed), as well as from chlorine gas, generated either from black oxide of manganese and hydrochloric acid, or from black oxide of manganese, common salt and sulphuric acid, and also a solution of carbolic acid, injected into the confined space, in the form of steam or spray, appear to be the most efficient means of disinfecting vacant wards at stated intervals.

Carbolic acid alone should not be relied on, to the exclusion of such destructive agents as sulphurous acid and chlorine gas ; for the first agent, whilst destroying animal and vegetable life, and arresting putrefaction, may at the same time preserve the organic materials, which may, after a certain time after the carbolic acid has been dissipated, again enter into putrefaction.

As the organic matters exhaled by the lungs and skin tend to form a coating, in the form of dust or mould, upon the furniture and walls of inhabited rooms, careful cleansing at stated intervals is important ; and furniture after being cleansed may be rendered practically new by a coat of varnish, which is itself a preservative and disinfectant in virtue of the turpentine, shellac and resin which it contains.

The vapors arising from ordinary *tar*, obtained from the *pitch pine*, may be *daily* employed in the wards with benefit.

A heated mass of iron is plunged into a metallic vessel containing the tar, and the smoke thus generated is allowed to ascend, under and around each bed.

I have found by repeated experiment in those Civil and Military Hospitals with which I have been connected, that the volatile matters, and finely divided matters and carbon, thus arising from *tar*, not only do not irritate the lungs, but may, when judiciously applied, benefit certain diseased states of the pulmonary apparatus. Any extensive disinfection of a ward by chlorine, sulphurous acid, or carbolic acid, whilst it is occupied by patients, is manifestly impossible.

Tar, with its results of distillation, is a complex product ;

wood tar gives out creosote, and coal tar gives out carbolic acid and cresylic acid. These substances differ in composition, but their actions are very similar.

Carbolic acid has acid properties, but its composition is analogous to that of the alcohols. A saturated solution destroys plants rapidly; coagulates blood; is hurtful if allowed to touch the eyes; leeches and fishes die in it without convulsions; animals dry up without decomposing; weak solutions of gelatine are not made turbid by it, but strong are; albumen it coagulates to a mass, soluble in excess of albumen.

According to Mr. Crookes, it does not affect the oxidation or action of inorganic substances; meat steeped in a one per cent. solution of carbolic acid and then dried, preserved a fresh odor. Similar results were obtained with skin, gut, size, glue and albumen; a few drops added to half a pint of fermented sugar and yeast stopped the action; the solution of one per cent. stopped the activity of yeast, but produced no change in its appearance; caterpillars, gnats, cheese mites, fish and infusoria were destroyed.

There is neither life nor decay without motion. Tar acids arrest that motion which takes place in decay; they therefore antisept, and are antiseptic; as soon as the decay ceases, the putrid gases cease to rise, and they are therefore disinfectant.

Pettenkofer finds that although carbolic acid arrests fermentation, the ferment preserves its power, and acts when the carbolic acid is gone; if this be true, the disinfectant must be used *continuosly*, and the *impure matter must be cleared away continuously*.

It is difficult to use enough of any disinfectant to destroy organic poisons, when human life must be preserved; but the tar acids render fermenting matter inert, and this is the great object to be first attained in hospitals.

Creosote is found in the products of distillation of wood, and of benzoine resin used in fumigation; and the tar-barrels burnt in the time of epidemics, from the earliest date, give out this body, and would give out more, if the flames were suppressed, and distillation only allowed, as in the method proposed for the fumigation of the hospital wards with tar smoke.

Gmelin says that water, impregnated with 1 part of creosote in 10,000, smells of smoke. Its most wonderful property is its pre-

servation of flesh: it stops flow of blood, and kills and preserves beasts, fishes, insects, infusoria, fungi, and plants. Liebig says that it was used long before Reichenbach discovered it. As *aqua Binelli*, kept a secret in Italy. The *aqua empyreumatica* of Silesia contained some of it, made by distilling crude vinegar with lime.

Speaking of the great value of tar as a disinfectant, Dr. Robert Angus Smith says:

"The world has admired this substance without knowing its existence, and sought it in every corner, using various names to express it, wrapping it in bundles to carry around them, burning it in pastiles for fumigation, and sometimes in public in great bonfires. Savages use petroleum for their wounds and their cattle, and the most civilized of old times kept in products of tar the dead that they desired to preserve to a joyful rising. Bishop Berkeley tells us that it was used as tar-water in America, the tar being merely stirred up with water, and the water drunk, a glass at a time. He himself had tried it in many diseases, and tells us of small-pox, erysipelas, skin diseases, and ulcers being cured by it; quotes the pitching of wines by the Romans as a proof of its value, and Jonstonus, in his *Dendrographia*, as saying that it is wholesome to walk in groves of pine-trees which impregnate the air with balsamic particles. The learned writer then goes on to say, that although he may be ridiculed, he suspects tar-water is a panacea; and as the old philosopher cried aloud from the house-tops to his fellow-citizens, '*Educate your children*,' "so I confess, if I had situation high enough, and a voice loud enough, I would cry out to all the valetudinarians upon earth, drink tar-water." What, then, is the wonderful agent, after which men have hunted, in tar-water? Like all such hopes of men, it becomes less when it is found, but it is still of great value. It is not one thing only, there are many things to be found. We have the tar-acids and turpentine, benzole, aniline, acetic acid, and many other things from tar, and each has its place."

Absolute cleanliness, the immediate removal of all excretions, offensive matters, and soiled clothing and bedding, together with free ventilation, are the great measures for the preservation of the purity of the atmosphere, and the prevention of any injurious effects arising from the exhalations from the sick themselves.

The water-closets and urinals should be cleansed at least once a day, with a solution of sulphate of iron and carbolic acid, and when such a disease as cholera is prevailing, the mixture of carbolic acid and sulphate of iron should be freely used, and all the dejections from the bowels should be received into vessels containing sufficient quantities of the solution.

When a cheap process for the manufacture of the peroxide of hydrogen has been devised, it will without doubt prove to be one of the most valuable, pleasant and innocuous disinfectants.

When the peroxide of hydrogen, which resembles water, is poured on the filthiest substance, the smell of putrefaction ceases, and in many cases is replaced by a fragrant perfume; it has given up its oxygen, and only pure water remains.

If water could be compelled to take up 100 volumes of oxygen in combination, it is probable that no impurity could resist it; but the great objection to the peroxide of hydrogen for hospital use is its cost.

It is well known that *Air* is one of the greatest disinfectants; but it should be remembered that mere filling of a room with fresh air is not sufficient to render it pure: it seems necessary that air should be filled and refilled repeatedly. This is explained upon the supposition that a very small portion of the oxygen of the atmosphere is in that active state which favors the destruction of the organic matters adhering to the walls and furniture. When, therefore, wards are periodically evacuated, all the windows and doors should be left open and a sufficient time should be allowed for the frequent and complete renewal of the air of the ward.

Water, next to *air*, is the greatest disinfectant, and the supplies for cleaning and cleansing the Hospital, the patients, the clothing and the water-closets should be unlimited.

In disinfecting the water-closets and urinals, one pound of sulphate of iron, dissolved in half a gallon of the solution of crude carbolic acid, as it is most generally obtained from the gas-works, should be employed daily in each ward.

DISTRIBUTION OF PATIENTS AND CLASSIFICATION OF DISEASES AND ACCIDENTS.

In the Plan of Hospital Construction which we propose, the Surgical Wards should occupy the central portions of the

Hospital, in order to secure the most efficient treatment and attendance and the most prompt surgical aid.

On the other hand, the fevers and other *so-called* contagious diseases, as erysipelas, hospital gangrene, pyæmia and puerperal fever, should be treated in the wards removed from the central portion of the Hospital.

The observations on the relations of temperature to certain diseases have shown the propriety of grouping together certain diseases. It will be admitted that *venereal diseases* should be isolated as far as possible, and that separate wards should be devoted to children. By placing the male wards on one side and the female on the other of the executive central building, the efficiency of the service as well as the discipline of the Hospital will be promoted.

Special attention should be devoted to the *nomenclature of diseases*, in the wards and in the general records and reports of the Hospital.

The Resident Surgeon, Resident Assistant Surgeon, and the Attending Physicians and Surgeons, should be required to record the diseases, wounds, etc., in the classification and provisional nomenclature of the Royal College of Physicians of London.

The *Annual Reports* of the Hospital, as far as they relate to the nature of diseases and deaths, should be drawn up in accordance with the classification of the nomenclature of diseases prepared by a Joint Committee appointed by the Royal College of Physicians of London, England.

The importance of a uniform system of the registration and classification of diseases is best shown by the following quotation from the Preface to the Original English Edition:

"For perfecting the statistical registration of diseases, with a view to the discovery of statistical truths concerning their history, nature and phenomena, the want of a generally recognized nomenclature of disease has long been felt as an indispensable condition. The advantages accruing from accurate statistics of disease are likely to be the greater and the surer, in proportion as the field of investigation is the wider. The statistics of a single town may be instructive; but more instruction will be obtained from the compared statistics of various and many towns. This is alike true of different districts of the same coun-

try and of different countries and climates; and the most instructive sanitary statistics would be those which relate to the whole of the inhabited portions of the globe.

"For the registration of such statistical facts, it is clearly requisite that there should be a uniform nomenclature of diseases coextensive with the area of investigation, and taking the largest area, the universal globe, the nomenclature would need to be one that can be understood and used by the educated people of all nations.

"Among the great ends of such a uniform nomenclature must be reckoned that of fixing definitely, for all places, the things about which medical observation is exercised, and of forming a steady basis upon which medical experience may be safely built.

"Another main use of the statistical registration of diseases, on a wide scale, is that it must tend to throw light upon the causes of disease, many of which causes, when duly recognized, may be capable of prevention, removal, or diminution.

"When a general and uniform nomenclature of diseases has once been carefully framed, when we are sure that medical observation is occupying itself everywhere with the self-same diseases, the value of statistical tables becomes very high, as representing the course of events in disease under various circumstances of time, place, season, climate, manners and customs, age, sex, race, and treatment. . . .

"The Committee appointed by the Royal College of Physicians of London have prepared a nomenclature, suitable to England and to all countries where the English language is in common use. For each name they have supplied the corresponding Latin term, which is the language of ancient science, and probably the fittest language for a nomenclature common to all the world; and also the equivalent term in the three modern languages which are the richest in medical learning and literature—the French, the German and the Italian languages; and in this way they hope to have laid the foundation for a nomenclature of diseases in any language extant on the earth."

In America this nomenclature was adopted in the classification of diseases; in the statistics of mortality of the ninth census of the United States; it has been practically adopted by the Medical Department of the United States Army, and it has been

officially adopted by the United States Marine Hospital Service; it has been endorsed by the profession through the action of the American Medical Association; and its provisional adoption was formally recommended by the American Public Health Association in 1873.

The office of the Clerk, and of the Resident Surgeon and Resident Assistant Surgeon, as well as each ward, should be furnished with printed copies of this system of nomenclature.

As this work has been recently published, for the use of the medical officers of the United States Marine Hospital Service, by Dr. John M. Woodworth, supervising surgeon, it is probable that the necessary number of copies could be readily obtained from the bureau of the United States Marine Hospital Service.

HOSPITAL ADMINISTRATION.

PRESIDENT AND BOARD OF TRUSTEES.

The entire organization and conduct of the Hospital shall be in accordance with the rules and regulations established and promulgated by the Board of Trustees, through their executive head, the President.

All officers and employés of the Hospital shall be responsible for the proper discharge of duty to the Board of Trustees, through the President.

All irregularities, all grievances, and all violations of law and order, or discipline, and all subjects of disagreement among the medical officers, if such should arise, must be referred to the President for arbitration and settlement.

All estimates for expenditures in the different departments must be submitted to the President and Trustees, for their final adoption and execution.

In all important questions of administration and discipline, the final appeal must be to the Board of Trustees.

The President and Trustees shall have the power of suspending and discharging any officer or employé, for neglect of duty or improper conduct injurious to the interests of the Hospital.

All reports from the various officers must be made to the Board of Trustees, through the President.

It shall be the duty of the President to make monthly reports to the Board of Trustees, setting forth all matters of importance relating to the financial, hygienic, and medical condition of the Hospital.

The President shall also present an annual report to the Board of Trustees, embodying the reports of the Treasurer, Purveyor, Secretary, Resident Surgeon, Resident Assistant Surgeon, and Attending Physicians and Surgeons, with the classified surgical and medical and mortuary statistics of the individual wards, and of the entire Hospital, and the meteorological register, with all matters and cases of interest relating to hygiene, medicine and surgery. If such reports should be published, an exchange might be established, with similar reports from all the leading hospitals of the world, and thus an important measure might be inaugurated for the extension and perfection of the Library, and the gradual concentration and preservation of the most practical and important contributions to the hygiene and conduct of hospitals.

The President shall cause a copy of the most important rules, governing the officers and employés, to be framed and suspended in each ward, in the Library, Museum and Dispensatory, and in the offices of the President, Treasurer, Resident Surgeon, Resident Assistant Surgeon, and Clerk.

Success in the management of a large hospital will manifestly depend upon a just distribution of labor, and the absolute subordination of officers, employés and patients to just law, the ultimate end of which shall be the efficient relief of human suffering, and the speedy cure of disease.

TREASURER.

The Treasurer shall keep careful and accurate accounts of all the moneys, property claims and revenues, and secure and preserve the same for the benefit of the Hospital.

The Treasurer shall make all necessary payments authorized by the President and Board of Trustees, and not otherwise.

He shall preserve vouchers for all moneys expended.

The Treasurer shall make full monthly and yearly returns of

the receipts and expenditures, to the President and Board of Trustees.

The reports of the Treasurer shall contain a minute account of all the individual items of expenditure, including the moneys expended for drugs, chemicals, surgical instruments, supplies and fixtures of all kinds, and salaries of officers and employés.

The books of the Treasurer shall be at all times open to the examination and inspection of the President and Board of Trustees.

It is desirable that the Treasurer should be distinguished for financial ability, thorough business training and habits, and irreproachable integrity.

PURVEYOR.

It shall be the duty of the Purveyor to make all the purchases of drugs, medicines, instruments, chemicals, disinfectants, wines, liquors, and hospital supplies of meat, flour, sugar, vegetables, clothes, bedding, etc., under the direction and in accordance with the orders of the President and Board of Trustees.

The Purveyor shall present monthly and annual reports to the Trustees of all the supplies consumed, and those remaining on hand.

The Purveyor shall exercise due diligence in gathering information as to the market price, as well as to the quality of all articles of food or clothing required for the use of the Hospital.

The mental and moral requirements of the Purveyor should be similar to those of the Treasurer.

SECRETARY.

The Secretary shall keep in substantial volumes duplicate copies of the records and transactions of the Board of Trustees. One copy shall remain permanently in the office of the Secretary, and the other be deposited in the Library so as to be at all times accessible to the examination of the President and Trustees.

The Secretary shall, under the direction of the President, conduct the correspondence of the Board of Trustees. He shall also, under the direction of the President, superintend any publications ordered by the Trustees.

The preservation, classification and consolidation of all official records and correspondence of the Trustees and Hospital shall devolve upon the Secretary.

It shall be his duty carefully to preserve at least fifty copies of all published documents, over and above those distributed to the officers of the Hospital, and to other institutions. At least five copies of each published report shall be annually bound in substantial Russia binding, and deposited in the Hospital Library, under the care of the Librarian.

It is unfortunately true that the statistics of many large hospitals are not accessible, on account of the neglect to file and preserve the annual records.

CLERK.

The Clerk shall record the name, occupation, age, nativity and disease of each patient entered into the wards of the Hospital; also of all patients prescribed for in the "*out-door*" dispensatory.

The Clerk shall preserve the records of each ward separately, in books devoted to this purpose. In these books shall be entered all facts likely to be of importance to the friends of patients, as well as the causes of death.

The Clerk shall prepare monthly and annual reports, containing a classified record of the diseases and deaths, and such other information relating to the different branches of the service, as the President and Board of Trustees may direct.

In the discharge of the preceding duties the Clerk shall be entitled, if necessary, to the aid of *two assistant clerks*, to be appointed by the Board of Trustees.

RESIDENT SURGEON.

The general medical and surgical management, the classification and distribution of patients, and the general direction of the hygiene and nursing of the Hospital shall be entrusted to the Resident Surgeon.

The entire time and attention of the Resident Surgeon shall be devoted to the discharge of his official duties; and he shall be directly responsible for his acts to the President and Board

of Trustees. He must reside permanently in the central executive building, and act upon all emergencies requiring medical or surgical aid, in the absence of the Visiting Physicians and Surgeons. Together with the Assistant Resident Surgeon, he shall have charge of the pay wards, and be responsible for their proper conduct.

When a consultation is deemed necessary in any medical or surgical case, the Resident Surgeon shall constitute one of the Consulting Physicians or Surgeons.

The general management of the Dispensatory, both Hospital and "Out-door," and of the Resident Students, Nurses, and employés, shall devolve upon the Resident Surgeon.

The Resident Students and Nurses shall report directly to the Resident Surgeon, and receive their instructions from him.

All cases of difference between the Resident Students shall be referred to the Resident Surgeon, and his decision shall be subject only to the approval of the President.

The Resident Surgeon shall make monthly and annual reports to the President and Board of Trustees, which shall include the reports of the Assistant Surgeon and Visiting Physicians and Surgeons, and embrace the medical and surgical statistics of each ward, and all matters relating to the hygiene, and medical and surgical history of the Hospital.

ASSISTANT RESIDENT SURGEON.

The Assistant Resident Surgeon shall aid the Resident Surgeon in the discharge of his official duties, and shall perform such labors as may be assigned to him in the general medical and surgical management of the Hospital.

In the absence of the Resident Surgeon, the Assistant Surgeon shall be clothed with his authority and act in his place.

He shall reside permanently in the central executive building, and be ready to meet every emergency which may arise amongst the medical and surgical patients.

It shall be the duty of the Assistant Resident Surgeon to inspect each ward at least once a day, and report their condition to the Resident Surgeon, whose inspections shall be at such times as may be necessary to the proper regulation of the Hospital.

In the temporary absence of any Visiting Physician or Surgeon the Resident Surgeon and Assistant Surgeon shall provide for the medical attendance of the patients.

The President and Board of Trustees shall elect to the offices of Resident Surgeon and Assistant Surgeon men eminent for both surgical and medical attainments and administrative ability.

The successful conduct of the Hospital will depend to a large extent upon the *administrative ability of the Resident Surgeon.*

As the Resident Surgeon and Assistant Surgeon should be required to reside permanently in the Hospital, and to be ready to meet all emergencies, by day or by night, with the assistance of the Resident Students, these officers should be either unmarried, or if married, without the encumbrance of a family of young children.

RESIDENT STUDENTS.

Not less than fourteen Resident Students shall be appointed by the Board of Trustees, to serve for a period of not less than *two years.*

The applicant for the position of Resident Hospital Student must be twenty-one years of age, and must have attended *two full courses* of medical lectures in a "first-class," reputable, recognized, regular Medical College or University.

The position of Resident Hospital Student shall not be confined to the natives of Maryland, but shall be open alike to all the States and Territories of the Union, and the appointments shall depend solely upon medical and surgical acquirements and moral worth.

The applicants for the position of Resident Hospital Student shall be subjected to a rigid written examination, embracing Chemistry, Pharmacy, Materia Medica, Therapeutics, Anatomy, Surgery and Obstetrics.

The questions relating to the respective departments must be printed, and all the answers written out by the applicants, in a room in which there can be no access to printed books nor any communication with each other.

The Resident Students shall be assigned to wards; *two wards* or *one pavilion* being assigned to each student.

The remaining four students shall be assigned as follows:—One student to the Dead-House, for the performance of post-mortem examinations; one student to the Dispensatory, to act as assistant to the Druggist; one student to the Chemical and Pathological Laboratory, to act as an assistant to the Chemist, Pathologist and Microscopist; and one student to the Museum, to act as an assistant to the Curator of the Museum, in the preparation and preservation of anatomical and pathological specimens.

Rotation shall be established in these different positions, so that each Resident Student shall serve at least six months in each position, and thus the great advantages afforded for the acquisition of a *thorough practical* knowledge of the science and art of medicine be shared equally by all the Resident Students.

The entire time and attention of the Resident Students shall be directed to the discharge of their duties, except such intervals as may be necessary for meals and recreation.

They shall sleep in the building and be at all times ready to assist the Resident and Assistant Surgeon, and the Visiting Physicians and Surgeons, in the discharge of their medical and surgical duties.

The Resident Surgeon shall assign the Resident Students to the different Wards and to the different Visiting Surgeons and Physicians, in regular rotation.

Each Resident Student shall accompany the Physician or Surgeon to whom he may be assigned in his morning and evening visits, and shall write down in a book preserved in each ward all the directions with reference to treatment, medicines and diet, and see that the medical and surgical treatment is properly carried out by the Nurses.

They shall, in accordance with and under the direction of the Physicians and Surgeons, perform all the minor operations, as bleeding, cupping, blistering, leeching, bandaging, and the dressing of wounds, stumps, fractures, etc.

The Resident Students shall keep in each ward an accurate register of the cases, in which the following particulars shall be entered:

Name of patient.
Age.
Nativity.
Occupation.
Race.
Sex.
Number of ward.
Number of bed.
Name of Attending Physician or Surgeon.
Nature of disease or injury.
Prognosis.
Previous diseases.
Date of present disease or injury.
Supervening diseases.
Result, death or discharge.
Date of death.
Date of discharge.
Condition at date of discharge or transference.
Results of post-mortem examination.
Treatment.
General remarks.

All important cases, which may be indicated by the Attending Physician and Surgeon, must be carefully reported by the Resident Students.

Such reports should embrace the following records:

Pulse.....	morning and	evening.
Respiration..	do.	do.
Temperature.	do.	do.
Symptoms...	do.	do.
Treatment...	do.	do.
Diet.....	do.	do.

Results of treatment or operation.

Observations upon urinary and other excretions, and upon the blood. Record of post-mortem examination.

Each ward should contain two or more large case-books, upon which the Resident Students should be required to enter all cases and matters of medical and surgical importance indicated by the Attending Physician or Surgeon.

No student shall be permitted to remain in the Hospital for a longer period than *three* years, nor for a shorter period than *two* years.

The Resident Students shall be under the immediate control and direction of the Resident Surgeon, who shall assign them to their respective positions and wards, and instruct them in the performance of their duties. They shall report all cases of neglect or insubordination, on the part of the nurses, employés or patients, to the Resident Surgeon.

The Resident Students shall not be allowed to leave the Hospital, except at such times as may be specified by the Resident Surgeon, and they shall be ready at all times to respond to the calls of the Resident Surgeon, Resident Assistant Surgeon, and Visiting Physicians and Surgeons.

No Resident Student shall prescribe for any patient in the Hospital; neither shall it be lawful for the Resident Students to prescribe for out-door patients, nor to attend any cases in "*private practice*," out of the Hospital.

Attention to cases out of the Hospital will surely tend to demoralize the Resident Students, and, sooner or later, lead to the neglect of official duty.

The Resident Students shall be furnished with sleeping apartment in the central administrative building, as indicated in the plan; and they shall also be furnished with board, fuel, light, and washing, by the Hospital, free of expense.

Upon the completion of their term of service, each student shall receive a diploma, setting forth in general terms the nature and period of service, and advantages enjoyed, and bearing the broad seal of the Hospital, and the signatures of the President, Trustees, Resident Surgeon, Assistant Surgeon, and Visiting Physicians and Surgeons.

The position of Resident Hospital Student is one of *honor* and *trust*, and will furnish superior advantages for the acquisition of thorough knowledge in the art and practice of Medicine in all its branches.

DRUGGIST AND ASSISTANT DRUGGIST.

The Dispensatory shall be in charge of a thoroughly educated and accomplished Druggist,—a graduate of a regularly chartered School of Pharmacy.

The requirements shall be the same for the Assistant Druggist.

Applicants for these positions should, as in the case of the Resident Hospital Students, be subjected to a rigid written examination. One of the Resident Students shall act as an Assistant to the Druggist in the preparation of medicines and compounding of prescriptions.

All prescriptions for the Hospital, as well as for "out-door patients," shall be filled at the Dispensatory. The prescriptions from the various wards of the Hospital shall be delivered to the Druggist, by the nurses or appointees charged with this duty, at an hour each day not later than 10 A.M. During the evening visit, the Physicians and Surgeons shall prescribe only those remedies which are actually needed during the night.

The Druggist shall as far as possible manufacture all the standard preparations in the laboratory, and he shall also keep on hand, ready prepared, such mixtures and compounds as may be agreed upon by the Resident Surgeon and Attending Physicians and Surgeons; and the formulæ of these *standard house preparations* shall be carefully preserved in the Dispensatory and in each pavilion or ward.

The Dispensatory shall be under the immediate direction and control of the Resident Surgeon.

The Druggist shall make his requisitions for drugs, chemicals and disinfectants through the Resident Surgeon, upon the Purveyor, subject to the approval of the President and Board of Trustees.

The Druggist shall preserve an account of the drugs used by each Ward; and he shall present to the President and Trustees weekly and monthly and annual reports of the amounts consumed and of the stock on hand.

PATHOLOGICAL CHEMIST AND MICROSCOPIST.

A competent Chemist and Microscopist and Histologist, who has devoted special attention to Organic Chemistry in its application to Physiology, Pathology and Toxicology, shall be placed in charge of the Chemical and Pathological Laboratory.

It shall be the duty of the Chemist to examine morbid products, secretions and excretions submitted to him by the Medical Officers of the Hospital, and to report the results in writing.

He shall also keep a daily record of the state of the weather: changes of temperature, barometric pressure and moisture, direction and force of the wind, variations of ozone and of electricity, and rainfall; and he shall be provided with the necessary apparatus. He shall make monthly and annual reports to the Resident Surgeon, and through this officer to the President and Trustees, of all chemical work of importance performed in the Laboratory, for the elucidation of the chemistry and pathology of disease.

He shall have as his assistant one of the Resident Students.

A limited number of students may be received into the Laboratory by the Chemist, upon such terms and for such length of time as may be determined by the President, Resident Surgeon and Chemist.

LIBRARIAN.

The Librarian shall be a graduate of a regular medical college or university, and shall be appointed by the President and Trustees in consideration of his learning, ability and devotion to the literature of the medical profession.

He shall have charge of the Library, and carefully preserve the works, establish exchanges, and report from time to time to the President those works which will be of the greatest value to the Medical Officers and Resident Students in the discharge of their duties.

The Library shall be kept open at such times and under such regulations as the Board of Trustees may adopt.

It shall be unlawful for any book to be taken out of the Library. But the Medical Officers of the Hospital and the Resident Students, as well as members of the medical profession generally, shall have free access to the library, for purposes of research and study.

CURATOR OF THE MUSEUM.

The Curator of the Museum shall be a graduate of a medical college or university, and shall be selected by the Board of Trustees in consideration of his proficiency in, and devo-

tion to the studies of Physiology, Anatomy and Pathology.

It shall be his duty to inject, prepare and preserve all pathological specimens placed in his hands by the Medical Officers. He shall label all specimens, and classify the entire Museum, and preserve accurate catalogues, with full descriptions, for the reference of the Medical Officers and Students of the Hospital. The Curator of the Museum shall, when practicable, institute exchanges with similar institutions.

NURSES.

Twenty Head Female Nurses and Forty Assistant Female Nurses (or in the ratio of one Head Female Nurse and two Assistant Female Nurses to each ward) shall be appointed by the President of the Hospital.

The Assistant Female Nurses shall be under the direction and instruction of the Head Female Nurses.

The Head Female Nurses shall occupy the rooms attached to each ward, with a window commanding the entire ward; and the Assistant Female Nurses may be quartered in the detached portions of the pavilion across the corridor, occupied by the mess-room, lift and stairway. If the dimensions in the plan do not allow of sufficient room, those buildings might readily be increased in length from 5 to 10 feet.

If possible, each Head Nurse and her assistants should be permanently attached to a specific ward, and limited rigidly to the discharge of specific duties.

The rooms occupied by the Nurses should be comfortably and pleasantly furnished.

The association of the Nurses in large dormitories is to be condemned, as it tends to corrupt the good and to make the bad worse.

In many cases the *convalescent patients* may be made available as *assistant nurses.*

The administration of the diets and medicines, the making of poultices, and the management of the ventilation and warming of the ward, should be in charge of the Head Nurse, whose room should be so situated as to command a view of the interior of the ward, and also of the entrance.

The cleanliness of the ward, bed, bedding and utensils of the

patients, as well as their personal cleanliness, the fetching of diets, the warming and ventilation of the wards, and the watching ill patients during the night, are to be attended to by the Assistant Nurses, under the Head Nurse's superintendence and superveillance, and she is to have power of reporting disobedience on their part to the Resident Surgeon.

All provisions, food, poultices, dressings, medicines, clothing, bedding, utensils, fuel, etc., should be as much as possible brought into the wards or to the doorways by lifts, and nothing should be fetched by the nurses; in order to enable the nurses to do their duty more effectively, and also to obviate the inconvenience and demoralization consequent on the congregating together in numbers of the nurses, patients, and men servants.

Whilst the patients should be made as useful as possible, consistently with their capacities inside the ward, they should not be sent out upon missions of any character whatever; and nothing in the way of food or drink or clothing should be brought into the ward, nor any visitors allowed, without the knowledge and approval of the Head Nurse.

There should be one Head Female Nurse to every 40 patients (one ward), and one Assistant Female Nurse to every 20 patients (two to each ward).

The proper place for the instruction of Nurses in the discharge of their duties is in the ward and with the patients, and no separate school for nurses appears to be needed.

If, however, the President and Board of Trustees should deem special instruction necessary, the Resident Surgeon, and one or more Attendant Physicians and Surgeons of the Hospital, might instruct the nurses by lectures and practical demonstrations, at regular appointed hours, in the Amphitheatre of the Hospital.

Such practical course of instruction should be accompanied by examinations, to test the capacity of the nurses.

No Assistant Nurse should be kept on duty each day in a ward more than twelve hours altogether.

Twelve hours each day is not too much for rest and recreation; and if the health and strength of the nurses be not carefully husbanded, their efficiency will sooner or later be impaired.

The nurses who sleep before and after a night watch should be enabled to do so quietly.

A night ration should always be provided for night-watchers.

The Head Nurses should be responsible for the bedding, clothing and utensils of their respective wards.

All irregularities amongst the Nurses, Assistant Nurses and patients must be reported directly to the Resident Surgeon, who will at all times issue the necessary orders and instructions, to the Head Nurses.

The wards must be cleaned and placed in order, and every patient be required to be at his bed, before the morning and evening visit of the Physicians and Surgeons.

The Head Nurse of each ward must accompany the Physician or Surgeon-in-Charge in his morning and evening visits, and receive his orders.

Specific hours of rest and recreation for the nurses shall be devised and promulgated by the Resident Surgeon.

The Head Nurses and Assistant Nurses shall wear such dresses and distinctions as may be prescribed by the President.

Nurses should be of not less than twenty-five nor of more than sixty years of age, of strong, active habits and sound health, and of established unblemished character.

We have advocated the employment of *female* and not *male* nurses, without entering into any argument, but simply presenting the results of our experience.

Sir J. Ranald Martin, *Examining Medical Officer to the Secretary of State for India in Council*, has well said:

"It should seem obvious enough that the virtues which in all ages and all countries have ruled the domestic circle; that 'she who looketh well to the household, and eateth not the bread of idleness;' that she whose 'tongue is the law of kindness,' should have a natural and a large share in the tending of the sick and maimed. To the natural care of the sick and wounded we must add the natural care of the infant and the aged, along with the household cares and the rearing and training of children.

"Requirements of so extended and important a character, capable of such infinite development, cannot be limited to the household affairs of common life. They must be brought systematically in aid of the sick in hospital, for purposes of nursing and of general administration.

"One of these ends, whether in private or public relation, would appear to be the care of the sick—an occupation for which woman, whether taken from the instinctive tuitions of the sanc-

tuary of home, or from the trained service of the Hospital, possesses unequalled aptitudes and capabilities. Everywhere and at all times the number of nurses to be employed in a hospital must be regulated by the nature of the prevailing diseases, whether epidemic, acute or chronic."

Miss Nightingale, who is one of the highest authorities in all that relates to the conduct of hospitals, thinks that the woman is superior in skill to the man in all of sanitary domestic economy, and more particularly in cleanliness and tidiness. Sanitary civil reformers will always tell us that they look to the woman to carry out practically their hygienic reforms. She has a superior aptitude in *nursing* the well, quite as much as in nursing the sick.

CONDUCT OF PATIENTS.

The patients shall be governed by such rules and regulations as may be devised and promulgated by the President and Resident Surgeon.

Regular hours shall be fixed for exercise and recreation in the grounds of the Hospital.

CONVALESCENT PATIENTS.

If the Hospital be constructed in the manner indicated, with elevated, well-ventilated and well-lighted pavilions, with verandas at the sides, one or more wards may be devoted to convalescent patients, and a separate building will be unnecessary.

VISITING PHYSICIANS AND SURGEONS.

Not less than four surgeons, and not less than six physicians, shall, in conjunction with the Resident Surgeon and Resident Assistant Surgeon, constitute the Surgical and Medical Staff of the Hospital.

The Visiting Surgeons and Physicians shall be elected by the Board of Trustees, to whom their written applications and testimonials must be addressed, through the President.

The Visiting Surgeons and Physicians shall be selected in accordance with and in consideration of their known and well-

established ability and professional attainments, and enlarged experience in the treatment of diseases and injuries, and in clinical teaching.

One or two wards (not exceeding two wards) shall be assigned to each physician or surgeon, and the treatment shall be conducted in attendance with his direction.

The Visiting Physicians and Surgeons shall have nothing to do with the administration of the Hospital, but their duties shall be strictly confined to—

1st. The treatment of the sick and wounded.

2d. The clinical instruction of the Resident Hospital Students.

3d. The clinical instruction of the Students of the Medical Department of the University founded by the late Johns Hopkins, of Baltimore.

The Attending Physicians and Surgeons shall visit their wards at least *twice* during the twenty-four hours, and shall spend at least *four* hours, each day, in the examination of and prescribing for the patients, and in the impartation of clinical instruction to the medical students, by the bed-side; viz.: from 9 A.M. to 11 A.M., and from 5 P.M. to 7 P.M.

They shall cause their prescriptions, as well as all directions as to diet and treatment, to be written by the Resident Student assigned to the wards by the Resident Surgeon, in a book specially devoted to this purpose. The Head Nurse and the Resident student shall be guided by these written directions; and it shall not be lawful for the Resident Student to prescribe or in any manner alter or add to the directions dictated by the Attending Surgeons and Physicians.

During at least six months of the year, the Visiting Physicians and Surgeons shall lecture clinically to those medical students who may be assigned to them during the morning visit; and they shall also, at such time as may be determined by the President and Board of Trustees, deliver lectures and perform operations before the entire medical class assembled in the Amphitheatre.

It shall be the duty of each Visiting Physician and Surgeon to preserve careful records of all important cases and operations, and also a record of all the cases, giving nature of diseases, results of treatment, and post-mortem examinations, in their respective wards. And they shall, at such intervals as may

be determined by the Board of Trustees, present a written report, containing the medical and surgical statistics of the ward, together with all matters of importance relating to the science and art of medicine, which may be illustrated by the cases under their charge.

Each Visiting Physician and Surgeon shall have the privilege of appointing a medical assistant, who shall act as his chief of clinic, and aid in the clinical instruction of the students.

The Attending Physicians and Surgeons should receive *liberal* and *just compensation for their services*, and should be held to a rigid accountability for the discharge of their official duties.

If from any cause a physician or surgeon should be absent from his wards, the Resident Surgeon shall appoint some one to fill his place temporarily.

OUT-DOOR PATIENTS, AND DISPENSATORY FOR OUT-DOOR PATIENTS.

The out-door patients shall be prescribed for in the central administrative building, alternately by the medical officers of the Hospital, two of whom shall perform this duty in rotation for the period of two months. The hours for prescribing shall be fixed so as not to conflict with those assigned to ward practice and clinical instruction ; viz. : from 11 A.M. to 1 P.M.

A careful register of the name, age, sex, occupation, nativity, residence, and disease of each patient, shall be kept. The prescriptions should be filled at the general Hospital Dispensatory, and a careful record should be kept of the amount and cost of the medicines used.

CLINICAL INSTRUCTION.

The Medical Students attending the Medical Department of the Johns Hopkins' University shall be divided into sections, and assigned respectively and in rotation to the Visiting Physicians and Surgeons.

Each student assigned to a special ward for clinical instruction may have one or more beds placed in his charge for observation. The student to whose observation cases are confided should be

required to record histories, noting accurately the pulse, respiration, temperature, characters of the urine, etc. Each report of an individual case should be submitted to the examination and inspection of the attending medical officer of the ward, and if deemed worthy of preservation, should be entered upon the case-book of the ward.

Every facility should be afforded by the Attending Physicians and Surgeons to perfect the students in auscultation and percussion, and in the operative procedures of Surgery and Obstetrics, and in a practical knowledge of the symptoms and pathology of various diseases.

Clinical Lectures at appointed times should also be delivered in the Amphitheatre, to which all students should have access free of charge.

MEDICAL DEPARTMENT OF UNIVERSITY: ITS LOCATION AND DIDACTIC LECTURES.

The Lecture-room within the Hospital grounds, which we have designated as the Amphitheatre, should be devoted to the illustration of clinical medicine and clinical surgery, and the diseases of women and children.

The clinical instruction, by the bedside, and within the walls of the Hospital, whilst constituting one of the most important branches of medical education, should not by any means supersede the regular didactic lectures delivered in a building or medical college, especially adapted for this purpose. This building should be located as near as possible to the Hospital, and if space permitted upon the same square or upon an adjoining square.

This building should contain not less than two large, well-ventilated lecture-rooms, in which the didactic lectures, on chemistry, anatomy, physiology, materia medica, pharmacy, therapeutics, practice of medicine, hygiene, surgery, and obstetrics should be delivered.

The Professors connected with the Medical Department may at the same time fill the positions of Visiting Physicians and Surgeons in the Hospital.

The Hospital Museum and Library may serve for the Medical College also.

OBSERVATION AND REGISTRATION OF CASES.

Each ward should be provided with *three Record Books*, as follows :—

1st. Prescription and diet book.

2d. General record of all the cases.

3d. Case-book, or record for cases of special interest.

In the book devoted to the general record of all the cases, the following particulars should be entered, and the pages of the book should be ruled and headed accordingly.

Cases treated in Ward No. —, Johns Hopkins' Hospital, Medical Service of —— ——, M.D., from —— to ——, 187–.
Recorded by —— ——, Resident Student.

Number of Case.	Number of Bed.	Sex.	Age.	Height.	Weight.	Name of Patient.	Nativity (where born).	Length of Residence in Baltimore.	Date of Admission.	Disease.	Date of Disease.	Prognosis.	Supervening Diseases.	Treatment.	Result.		Length of time in Hospital.	Remarks, Results of Post-mortem, etc.
															Discharged.	Died.		

The cases of special interest should be reported fully, and recorded in the special case-book.

The cases recorded in the special case-book may be registered in accordance with the following general plan :

Cases Treated in Ward No. —, Johns Hopkins' Hospital, Service of — —, M.D. Reported by — —, Student.

Number of Case.		
Number of Bed.		
Date of Admission.		
NAME.		
History of Case, Age, Sex, Temperament, Weight, Height, Date of Attack, Supervening Disease.		
Pulse.	Morning.	
	Evening.	
Respiration.	Morning.	
	Evening.	
Temperature.	Morning.	
	Evening.	
State of Intellect.		
State of Tongue.		
State of Bowels.		
Character of Urine.	Specific Gravity of Urine.	
	Reaction.	
	Albumen or other Abnormal products.	
	Amount of Urea excreted in 24 hours.	
	Uric Acid.	
	Phosphoric Acid.	
	Sulphuric Acid.	
	Chlorine.	
	Chloride of Sodium, etc.	
Character of Blood and Secretions.		
Results.		
Treatment.		
Remarks, Post-Mortem Examination, etc.		

DISPOSAL OF DEAD, STRUCTURE AND CONDUCT OF DEAD-HOUSE, POST-MORTEM EXAMINATIONS.

The dead should be quietly removed from the wards to the dead-house at the earliest practicable moment.

In the removal of the dead, the lifts and the central railroad in the central basement corridor should be employed. After being washed in a solution of carbolic acid, and subjected to the fumes of a burning mixture of charcoal and sulphur, the dead should be laid upon lead-covered or marble-covered tables in the dead-house.

The dead from the "*pay wards*" should be placed in a special division of the dead-house, and should receive such burial as their means and the wishes of their friends may indicate.

The dead from the charity wards shall be allowed to remain in the dead-house for six hours, or longer, as the Trustees may direct; and at the end of the specified time, if the bodies be not claimed by any friend or relation, it shall be lawful for the Attending Physician or Surgeon of the ward in which the death took place, to hold a post-mortem examination. Medical students attending the Hospital, and pursuing clinical medicine and surgery, shall have free access to these post-mortem demonstrations; and it shall be the duty of the medical officer present to illustrate and explain as far as possible the character of the anatomical lesions.

The bodies destined for post-mortem examination shall be removed, by means of a lift, from the general dead-house to the upper dissecting or post-mortem room.

Those bodies which have not been used for post-mortem examinations, and which have not been used for coroners' inquests, nor been claimed by friends, shall be devoted as far as possible, and as far as may be necessary, to the study of practical anatomy in the medical department of the Johns Hopkins' University. To serve this purpose in the most efficient manner, the bodies should be carefully injected and conveyed to the dissecting rooms.

The Attending Physician and Surgeon shall have the first and chief right to the post-mortem examination of any body from the ward under his charge.

No dead body shall be examined by any medical officer until a certificate of death has been furnished to the clerk.

The Visiting Physicians and Surgeons shall have the right to examine or cause to be examined in the chemical laboratory, any organ, tissue or fluid which they may believe to have been involved in the diseased process.

All specimens illustrating clearly the nature of diseased processes, and which may be deemed worthy of preservation, shall be delivered to the Curator of the Museum, for injection and preservation.

Careful records of all post-mortem examinations shall be made in books preserved in the post-mortem room and in the Museum, according to the following plan (page 152).

If the medical staff be well chosen, the credit of the institution and the welfare of the inmates will be best promoted by a generous trust on the part of the governing power towards the executives; whilst an intelligent and chastened zeal in the discharge of duty is thus secured in the medical staff, the great curse of interference and intermeddling—a cold performance of duty—will be avoided.

By a wise and generous system of administration, it will be possible to secure in the medical staff cheerful subordination, a deep sense of personal responsibility, and such a union of dispositions and pursuits as to make the talents of the medical officers co-operate to the greatest advantage for the public good.

In the administration of the Hospital there should never be any medium between confidence and the want of it; and should any medical officer forfeit the confidence of the Trustees, he should at once be withdrawn.

Mr. Fonblanque observes, that "it is not the *personnel*, but the *morale*, upon which a sound administrative system hinges; a system based on the personal integrity of its agents."

And Sir J. R. Martin has wisely remarked, that the objects and ends to which everything in an hospital should tend are—economy in expenditure, ease and expedition in labor, and exactness in the results. These great objects are attained by regulating the order of labor, and by dispensing with useless labors which consume precious time, obstructing and postponing the results; by the establishment of a system, in fact, in which economy and

Post-mortem Examination of ——, Died ——, Ward —, Service of —— ——, M.D., Johns Hopkins' Hospital. Disease, ——. Date of Death, ——. Length of time after Death, ——. Reported by ——, Resident Student.

	Number of Case.	
	Age.	
	Ward.	
	Name.	
	Disease.	
	Exterior.	
	Head—Brain.	Nervous System.
	Spinal Cord.	
	Sympathetic System.	
	Mouth, Throat, etc.	Alimentary Canal.
	Stomach.	
	Small Intestines.	
	Large Intestines.	
	Lymphatic System.	
	Liver.	
	Spleen.	
	Kidneys.	
	Circulatory System—Heart, etc.	
	Respiratory System—Lungs, etc.	
	Characters of Osseous System—Blood, Urine, etc.	
	Results of Chemical and Microscopical Examinations of Solids and Fluids.	

humanity shall be equally respected. The success of the treatment of the sick in hospitals depends less on the remedial means, than on the care, the vigilance, the regularity, and the order with which service is performed. Without that order, the sick run the greatest risks, even in the hands of the most able and the most practised. By a perfect administration—by proportioning the number of trained servants to our wants, by regulating their various functions, by uniting economy with success, in fact we may in some measure overcome imperfections in structural arrangements. But on the other hand, when administration is ill-ordered, and the hospital building ill-constructed, it is death to the inmates. Borne down by such overwhelming disadvantages—odds of our own creation—the highest talents and the best exertions of the physician and surgeon are set at nought.

HOSPITAL COOKING AND DIET OF THE SICK.

The kitchen should be furnished with the best and most convenient stoves and ranges, in order that economy of fuel and labor, and at the same time the most efficient means of preparing food, may be secured.

It would be foreign to our purpose to enter into any critical examination of the many excellent forms of cooking stoves and ranges which have been invented and perfected during the present century. The officer charged with the arrangement and furnishing of the culinary department will, without doubt, receive from the learned directors of the Hospital the necessary instructions and facilities for testing the relative merits of the various arrangements for cooking.

We will simply remark in passing, that the Charity Hospital of New Orleans is fitted with a range of the manufacture of Bramhall, Deane & Co., of New York, at a cost of about two thousand dollars. The apparatus does all the cooking for the thousand inmates of the Charity Hospital, and keeps a constant supply of hot water for kitchen use and similar purposes. It has been estimated from actual experiment, that the daily cost of the fuel consumed in this range does not exceed sixty cents.

The kitchen, as well as the supplies, should be intrusted to

the immediate care of an intelligent and responsible female *head cook* and *female* housekeeper.

The culinary department, as well as the Hospital food supplies, should be under the general direction and control of the Hospital Purveyor. Careful tables of diet should be constructed by the Hospital Purveyor, by and with the advice and direction of the President and Resident Surgeon.

Absolute cleanliness and thorough order should be enforced at all times in the culinary department, and the best mechanical arrangements be adopted for the rapid and efficient distribution of food to all parts of the Hospital, at such times as may be determined by the President and Resident Surgeon.

It is believed that the location of the kitchen in the basement, near the centre of the Hospital, and its free connection with all parts by the central railroad and lifts of the central basement corridors, will be adapted to the regular, efficient, and rapid and almost simultaneous supply of all parts of the Hospital with food, at any hour that may be indicated.

With reference to the diet of the sick, an elaborate volume would not exhaust this important subject, and in the limited time and space at our command, nothing more can be accomplished than the presentation of a general outline drawn up from the experience of the best observers, which may furnish materials for definite calculation and final action.

If the original deduction of Prout be accepted, four great classes of elements are necessary for perfect nutrition; viz.:

1st. Nitrogenous substances or albuminates (including albumen, fibrin, casein, hæmatoglobulin, legumen, gluten, etc.), which contain also sulphur and phosphorus.

2d. Fatty substances (including animal and vegetable oils).

3d. Carbo-hydrates (including starch, sugar, pectin, and allied substances).

4th. Salts (potash, soda, magnesia, lime, iron, chlorine, phosphoric acid, fluorine, and water).

The albuminates, fat, and salts are indispensable, and the carbohydrates are so universally taken and so eagerly sought after, that no diet should be considered as perfect without them.

In addition to these classes, the accessory foods or condiments are useful in giving flavor and aiding digestion.

These classes should not be confounded together, and are not

convertible, as they serve different purposes in the animal economy.

The albuminates nourish all the tissues which give rise to mechanical force of any kind, and probably also those connected with mental action. It has been announced by physiologists, that the mechanical force evinced by the human machine, either in carrying on its internal movements, or in acting on external objects, is proportional to the amount of albuminates which can be digested, absorbed, and properly applied to nutrition. The digestive power in the stomach and intestines, the formative power in the nitrogenous tissues, and the eliminating processes in the after stages, have to be balanced so that one shall equal the other, otherwise health is destroyed. Acute diseases are not only attended with derangement of digestion, but also by increased chemical change of the blood and tissues, and even under the most favorable system of diet the waste of tissue and the loss of force is greatly in excess of the supply.

Lessening the supply of albuminates leads to a decline of force, and if the supply is entirely cut off the decline is very rapid, affecting the muscular system first, including the heart, and at a later date the nervous system and mental powers. This result may to a certain extent be delayed by an increase in the supply of fat and starch, which limit the disintegration by absorbing oxygen and developing heat, and also by perfect rest. These principles have been applied in treatment, and the albuminous tissues and the blood itself brought under control by a judicious adaptation of diet and exercise alone, without the employment of drugs.

By oxidation, the nitrogenous elements also contribute to animal heat, after they have formed parts of tissues.

Fatty aliments, like the nitrogenous, are both plastic and heat-giving, being essential to the formation of both muscular and nervous tissues, and to the production of heat and mechanical force. Starch and sugar are supposed by many physiologists to be entirely heat-giving, and not formative.

The salts and water are equally essential; lime, chiefly as the phosphate, is absent from no tissue; both lime and magnesia are essential for bone growth and repair; potash and soda in the forms of phosphates and chlorides, form parts of almost all tissues; and iron, sulphur and phosphorus appear to be essential

to the proper constitution of certain constituents of the blood and tissues.

The preceding well-established facts render it evident, that the diet of the sick as well as of healthy individuals should have due proportions of the four great alimentary classes.

A complete consideration of the important subject of diet, as applied to the inmates of a large hospital, embracing men, women and children, would embrace the determination of the quantity of the different classes of alimentary substances required for persons of different occupations, different sexes and ages, during and after the period of growth and pregnancy, and under all the varying conditions of disease, convalescence and health, and variations of climate; the determination of the best articles of food in each class, their digestibility, and the best mode of cooking them.

Some approximation to the supplies required by the sick in hospitals may be made by an examination of the quantity and composition of food which has been found by long experience and by experiment to be necessary for healthy men, and especially for soldiers between the ages of 20 and 40 years.

Whilst it is true that it is not possible, in the absence of direct observation and experiment, to determine how much food is sufficient for the maintenance of the highest health and physical and intellectual power, in any particular person, at the same time it is of importance to fix the *average* amount, as in a hospital fixed quantities of food must be supplied and issued, to a great extent in accordance with the number and character of the patients.

It has been calculated that a man of average size and activity will, under ordinary conditions of moderate work, take in twenty-four hours, in solid and liquid food, from $\frac{1}{25}$th to $\frac{1}{20}$th of his own weight. As solid food contains a certain percentage of water, if this be eliminated, the average amount of anhydrous food for a healthy man in twenty-four hours varies from 19 to 25 ounces, which in its ordinary state combined with water would range from 34 to 46 ounces. The water consumed during the twenty-four hours, on the other hand, ranges from 50 to 80 ounces. Therefore from 80 to 120 ounces of both solids and liquids are ingested by a healthy man in 24 hours.

A man will take on an average, in twenty-four hours, when nearly

at rest, 18.5 ounces anhydrous solid food, 70 to 90 ounces water; when in moderate and usual exercise, 23 ounces of anhydrous solid food, 70 to 90 ounces water; under great exertion, 26 to 30 ounces anhydrous solid food, and 80 to 100 or more ounces of water.

A man of mean height, weight, and activity requires in twenty-four hours from 250 to 350 grains of nitrogen, from 3,500 to 5,000 grains of carbon, and about 400 grains of salt; during rest, about 198 grains of nitrogen and 4152 grains of carbon.

A working-man of average height and weight requires daily, in avoirdupois ounces and tenths of ounces, nitrogenous substances (dry), 4.2; fat, 1.4; starch, 18.7; mineral matters, 0.71.

Dr. Edmund A. Parkes has given the following Table for the Calculation of Diets.

Articles of the Soldier's Diet.	In 100 Parts.				
	Water.	Albumen.	Fats.	Carbo-Hydrates.	Salts.
Uncooked meat of the kind supplied to soldiers, beef and mutton. Bone constitutes one-fifth of the soldiers' allowance	75.	15.	8.4		1.6
Uncooked meat of fattened cattle. Calculated from Law's and Gilbert's experiments. These numbers are to be used if the meat is very fat	63.	14.	19.		3.7
Cooked meat; roast, no dripping being lost. Boiled assumed to be the same.	54.	27.6	15.45		2.95
Bread; white wheaten of average quality	40.	8.	1.5	49.2	1.3
Flour, average quality	14.	14.6	1.2	68.6	1.6
Biscuit	8.	15.6	1.3	73.4	1.7
Rice	10.	5.	.8	83.2	0.5
Oatmeal	12.	16.	6.8	63.2	2.
Maize	13.5	10.	6.7	64.5	1.4
Peas (dry)	15.	22.	2.	53.	2.4
Potatoes	74.	1.5	.1	23.4	1.
Carrots (cellulose excluded)	85.	.6	.25	8.4	.7
Cabbage	91.	.2	.5	5.8	.7
Butter	6.	.3	91.		2.7
Egg (10 per cent must be deducted for shell for the weight of the egg)	73 5	13.5	11.6		1.
Cheese	36.8	33.5	24.3		5.4
Milk (sp. gr. 1030 and over)	86.7	.4	3.7	.5	6.
Do " " 1026	90.	.3	2.5	3.9	5.
Sugar	3.			96.5	5.

The mode of using the table is as follows: The quantity of uncooked meat or bread being known, and it being assumed or proved that there is no loss in cooking, a rule of three brings out at once the proportion. Thus, the ration allowance of meat being 12 ozs., 2.4 ozs., or 20 per cent., is deducted for bone. The quantity of water in the remaining 9.6 ozs., will be $\frac{75 \times 9.6}{100} = 7.2$, and the anhydrous solids 2.4 ozs. In the case of salt beef or pork, it is not certain how their value should be calculated, as many of the important nutritive constituents have been partially abstracted by the brine; perhaps salt beef may be reckoned as equal to two-thirds the quantity of fresh beef.

The English soldier on home service receives: meat, 12 ozs.; bread, 24 oz.; potatoes, 16 ozs.; other vegetables, 8 ozs.; coffee, 0.33; tea, 0.16; salt, 0.25; sugar, 1.33; milk, 3.25; total, 65.32 ozs.; total value 8*d*.

The French infantry soldier of the line, in time of peace, receives: munition bread, 26.5 ozs.; white bread for soup, 8.8; meat uncooked, 8.8; vegetables, 5.6; salt, 0.5; pepper, 31 grains; brandy, 1¾ ozs.; total, exclusive of brandy, 50.27 ozs. In time of war the French soldier receives: meat without bone, 7 ozs.; bread, 26.5; rice, 2; dried vegetables, 2; salt beef or pork, 8.75; salt, ½ oz.; wine, ½ pint; beer, 1 pint; brandy, ¼ oz.; sugar, 1 oz.

The Prussian soldier in time of peace receives: bread 25.5 ozs.; meat without bone, 5.5 ozs. On the march: bread, 33 ozs.; meat, 8.25. In time of war: bread, 29 ozs.; fresh meat, 8 ozs.; rice, 3 ozs.; barley, rye or buckwheat, 3 ½ ozs.

In calculating sick diets, two modes may be employed: 1st. The average diet of healthy men may be halved or quartered, the relations of the different classes remaining the same, but the amount is lessened. Tables can be kept of the nutritive value of the diet, to avoid trouble in calculation, and the physician can know at once the exact amount his patient is taking. 2d. The relative proportions of the several classes may be altered; the nitrogenized substances may be increased or lessened; or the fatty or starchy substances or salts may be thus dealt with, and certain tissues may be fed or brought into a state of inanition, at the option of the physician.

In many cases of disease, the point of digestibility of the food

is the one mainly to be considered, as the nervous and muscular powers of the stomach and the supply of gastric juice are often lessened.

It must be remembered that the numerous wants of the sick cannot be met by rigid scales, however numerous; and they must be used in hospitals for convenience and be subject to changes, according to the age, disease and stage of disease, and varied according to the power of the patients.

In the British army there are altogether ten diets—tea, spoon, beef-tea, milk, low, chicken, half, fish, roast, entire. The following table shows the quantity, in the chief diets of the English military hospitals, and the proportions of carboniferous and nitrogenous aliments, as calculated by Dr. De Chaumont:

Nutritive Value of English Military Hospital Diets, as fixed by Regulation.

Name of Diet.	Amounts of different constituents in ounces and tenths of ounces.						
	Albumen.	Fats.	Carbo-Hydrates.	Salts.	Water, free weight.	Water.	Total weight.
Tea Diet	.880	.342	6.648	.153	8.023	8.477	17
Spoon Diet	.960	.342	8.288	.173	9.763	8.737	18¾
Milk	3.620	2.446	12.517	.557	19.140	57.850	77
Beef-tea	2.400	1.074	7.651	.828	11.953	16.047	28¼
Low	3.503	2.792	11.531	1.004	18.845	31.450	49½
Half	3.072	2.112	12.966	1.306	19.446	27.607	47¾
Entire	3.792	2.446	14.838	1.450	22.526	36.267	59¼
Chicken	3.411	1.554	10.603	1.279	16.847	18.403	35½
Fish	3.134	2.384	12.475	1.394	19.387	24.863	44½

Miss Florence Nightingale has given some practical, common-sense views on nursing, from which we quote the following:

"In laying down rules of diet by the amounts of solid nutriment in different kinds of food, it is constantly lost sight of what the patient requires to repair his waste, what he can take and what he cannot. You cannot diet a patient from a book; you cannot make up the human body as you would make up a prescription—so many parts 'carboniferous,' so many parts 'nitrogenous,' will constitute a perfect diet for a patient. The nurse's observation will here materially assist the doctor, the patient's 'fancies' will materially assist the nurse. Organic chem-

istry is useful, as all knowledge is, when we come face to face with nature; but it by no means follows that we should learn in the laboratory any one of the reparative processes going on in disease. Chemistry has as yet afforded little insight into the dieting of sick. All that chemistry can tell us is the amount of 'carboniferous' or nitrogenous elements discoverable in different dietetic articles. It has given us lists of dietetic substances arranged in the order of their richness in one or the other of these principles; but that is all. In the great majority of cases, the stomach of the patient is guided by other principles of selection than merely the amount of carbon or nitrogen in the diet. No doubt, in this as in other things, nature has very definite rules for her guidance; but these rules can only be ascertained by the most careful observation at the bedside. She there teaches us that living chemistry, the chemistry of reparation, is something different from the chemistry of the laboratory."

The quantity and quality of food should be varied in hospitals in accordance with the nature of the disease, whether acute or chronic, sthenic or asthenic; age; sex; previous habits of life; employment; season and weight and endowment of body.

In acute diseases, the activity of the functions of digestion and absorption are impaired; whilst at the same time there is a great change in the chemistry and vital acts of the blood and tissues, attended with elevated temperature, aberrated nervous and muscular action, and rapid waste of the tissues. In this state the nutriment should be capable of easy digestion and ready absorption; and it has been observed that milk, beef-tea, wine and alcoholic stimulants will most readily sustain life and at the same time repair the waste of tissue.

As far as my experience extends, in many cases of acute disease, attended with high temperature, rapid pulse and great muscular and nervous prostration, alcohol acts not only as a food, and is destroyed in the blood and tissues, and by its oxidation diminishes the waste of tissue, and thus preserves the strength, but it also reduces the animal temperature to a marked degree.

The great objection to the use of alcohol in the treatment of disease is that it may lead to intemperance. This danger may to a great extent be avoided by giving the alcohol in combination with milk, and also by ceasing the remedy as soon as the

patient is so far convalescent as to be able to subsist comfortably without it.

In the treatment of Bright's disease of the kidneys and of chronic dysentery, milk appears to be absolutely essential, and of the greatest value.

The so-called extracts and elixirs of beef are practically valueless, except for the salts and small quantities of soluble nitrogenous matters which they contain. They may support life for limited periods, when the digestive functions are greatly impaired, but they can never take the place of fresh beef-tea, milk, soft-boiled eggs, etc.

The claims set forth by the inventors and vendors of the so-called extracts of meat have not been sustained by clinical observation.

The multiplication of dietaries in a hospital is to be avoided. The surgeon should write on the ward book when special articles are required, as milk, milk punch, soft-boiled eggs, etc.

The dietary should be constructed in accordance with the age, sex, and diseases of the patient; and various minor changes may be made in accordance with the changes of the season.

In acute cases, where the digestive function is so impaired as to preclude the use of solid food, the breakfast may consist of half pint of milk or beef tea, 4 ozs. of bread, and one fourth of a pint of tea; the dinner and supper should not vary materially from this, except that when necessary milk punch and beef-tea may be given in small quantities at regular intervals (every two, three, or four hours).

As soon as convalescence has been established, one or two eggs, with toast and butter, may be added to breakfast and dinner.

When convalescence has been fully established: breakfast—1 pint fresh milk, 10 ozs. bread, 6 ozs. hominy or oatmeal, 2 soft-boiled eggs, tea, coffee or cocoa, with sugar. Dinner—6 ozs. meat, 6 ozs. bread, 4 ozs. rice, 4 ozs. potatoes, sweet or Irish, 4 ozs. fresh vegetables, ½ pint of soup or broth, 1 oz. cheese, 4 ozs. dried fruit. Supper—½ pint fresh milk, 8 ozs. of bread, 3 ozs. hominy, tea or cocoa with sugar.

In hospital service, the *quality* of the meat is even more important than the quantity.

Whenever fresh vegetables and ripe fruit can be obtained at

reasonable prices, they should be served to the convalescents and chronic cases.

Moderate supplies of vinegar and light wine or ale will prove beneficial in many cases.

I have thus endeavored to present to your honorable body a definite outline of my views with reference to the construction and administration of a hospital, destined to receive chiefly the sick poor of a large American city.

The time to which my reply was limited by your learned President was so short, that many of the subjects have not perhaps received that elaboration which their importance demands. I may be permitted, however, to hope that the preceding suggestions may prove worthy of your consideration, and at least lead to the discussion of definite lines of action in the execution of your most honorable and responsible trust.

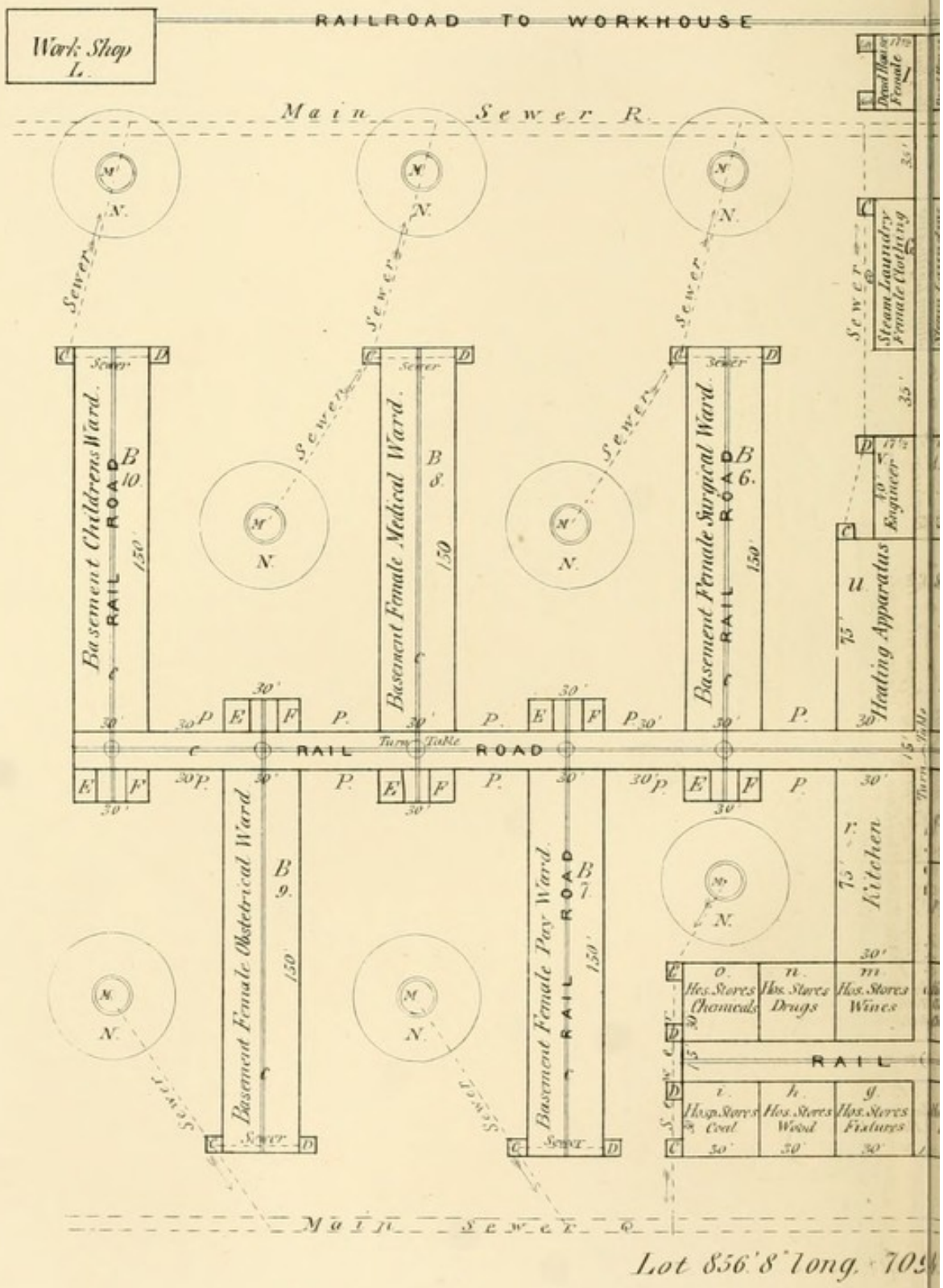
With great respect,

Your obedient servant,

JOSEPH JONES, M.D.,

Professor of Chemistry and Clinical Medicine, Medical Department University of Louisiana; Visiting Physician, Charity Hospital, New Orleans; Formerly Surgeon, Provisional Army, Confederate States.

GROUN

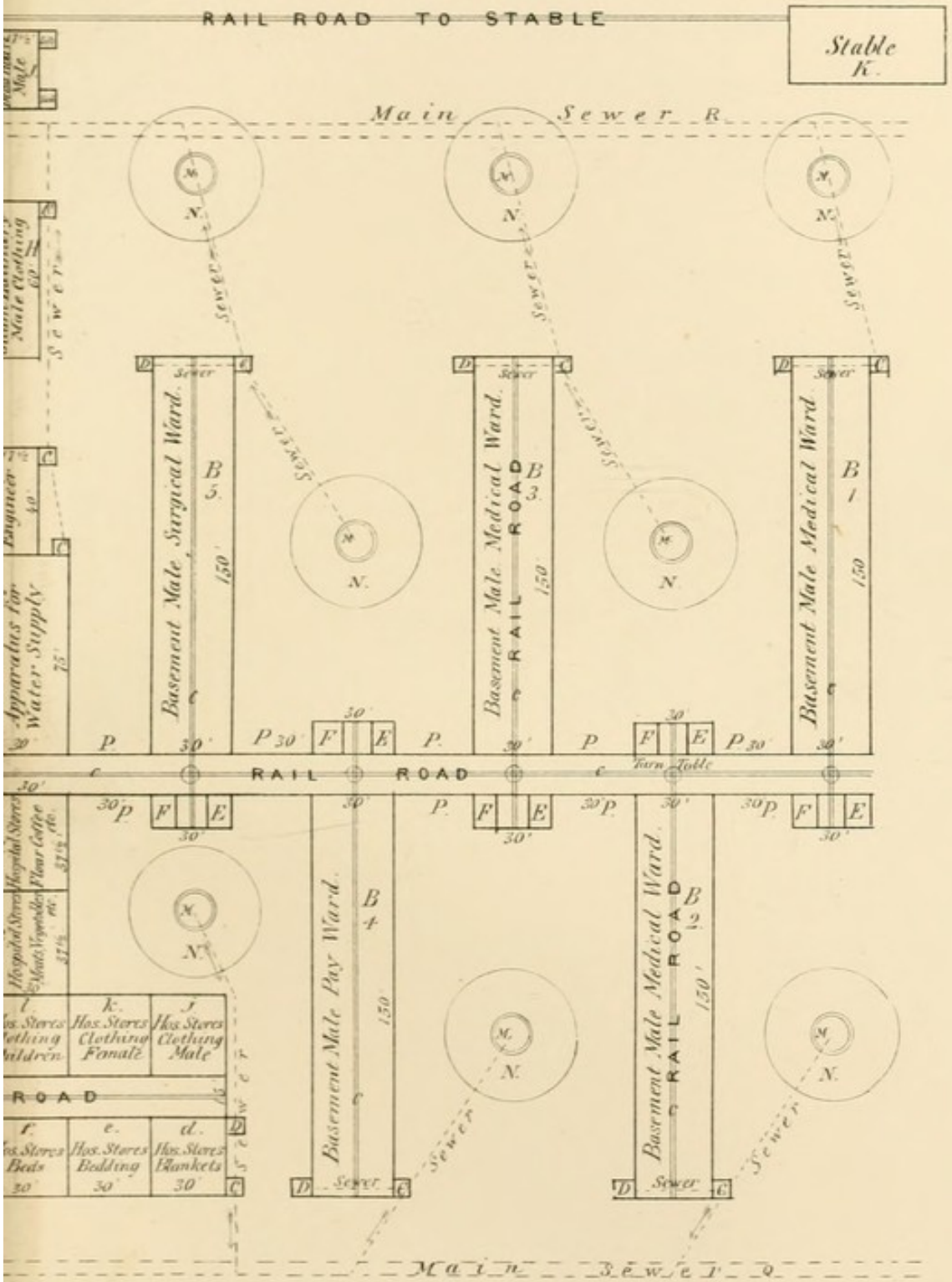


DR. JOSEPH JONES SUGGESTIONS
FOR
JOHNS HOPKINS HOSPITAL.

1.

PLAN.

SCALE 80 FT TO AN INCH.



EXPLANATION OF PLATE I.

GROUND PLAN OF HOSPITAL, FRONT VIEW.

Total length of Hospital, 675 feet.
Total breadth of Hospital, 440 feet.
Total capacity of Hospital, 800 beds.

A. *Central* Administrative building, 195 feet in length, 75 feet in breadth.
Height of basement, 12 feet.
Height of corridor, 12 feet.

d. Room for Hospital stores, blankets, sheets, towels, etc., 30 × 30 feet.
e. Room for storing Hospital bedding, 30 × 30 feet.
f. Room for Hospital beds, 30 × 30 feet.
b c. Central hall or corridor dividing the basement at right angles.
Height of basement, 12 feet.
Height of corridor, 12 feet.
g h i. Rooms for storing coal, wood and fixtures, 30 × 30 feet.
j k l. Rooms for Hospital stores of male, female and children's clothing, 30 × 30 feet.
m. Room for storing wines, cordials, etc., 30 × 30 feet.
n. Room for Hospital stores,—drugs for Dispensatory, 30 × 30 feet.
o. Room for chemicals, acids, etc., for Dispensatory and Chemical Laboratory, and for the manufacture of disinfectants, 30 × 30 feet.
p. Store-room, for meats, vegetables, etc., for Hospital, 37½ × 30 feet.
q. Store-room for flour, sugar, tea, coffee, etc., 37½ × 30 feet.
r. Kitchen, 75 × 30 feet; height, 12 feet.
s. Room for apparatus regulating supply of water to Hospital, 75 × 30 feet.
t. Room for engine, 40 × 17½ feet.
u. Room for heating apparatus and artificial ventilation, 75 × 30 feet; height, 17 feet.
v. Room for engine, 40 × 17½ feet.
b b b, c c c c c. Main corridors, running through the executive building and Hospital at right angles, and connecting all parts by means of a central railroad provided with *turn-tables.*

All the business of the Hospital, such as the conveyance of sick and wounded to the different wards; distribution of food, medicine and clothing, removal of the dead, etc., should be accomplished by means of the central railroad in the basement corridor.

B B. Basement of wards.

The basement of the wards should be arched, with open sides, and railroad or tramway in centre.

Height of basement of wards, 12 feet.
Width of basement of wards, 30 feet.
Length of basement of each ward, 150 feet, exclusive of central transverse corridor and addition beyond corridor for lifts and stairway. Total length, 180 feet; breadth, 30 feet. If verandas be erected along the sides of each ward 10 feet in width, then the total breadth would be 50 feet.
Height of basement of wards, 12 feet.

C C C. Vaults, or receptacles of water-closets.

D D D. Bath-room vaults or receptacles, the water from which should be directed into and through the privy vaults.

E E. Stairway for wards.

F F. Lifts and shafts for wards.

G. Steam laundry for females, $60 \times 17\frac{1}{2}$ feet.

H. Steam laundry for males, $60 \times 17\frac{1}{2}$ feet.

I. Dead-house for females, $30 \times 17\frac{1}{2}$ feet; 12 feet high.

J. Dead-house for males, $30 \times 17\frac{1}{2}$ feet; 12 feet high.

K. Stable for horses, etc.

L. Workshop for refitting beds, repairing furniture, etc.

M M. Fountains. The waste water of the fountains should be conducted by sewers to the vaults of the water-closets, as shown by the red lines, 1 1 1 1 1. The arrows indicate the directions of the various currents in the sewers.

N N. Grass and flowers.

O O. Main arched corridor, connecting all the Hospital wards.
Length of main corridor, 675 feet; breadth, 15 feet; height, 12 feet.

The main corridor should be appropriated to the business of the Hospital—removal, transference of patients, medicines, supplies of food, clothing, bedding, dead bodies, etc.

P P. Spaces between the wards, 30×30 feet.

The wards being arranged alternately on each side of the central corridor, the distance between opposite wards on each side will be 90 feet. If verandas 10 feet in width be built on the side of each ward, then the distance will be 70 feet. This distance will be ample for perfect ventilation; and the sunlight will fall fully upon each structure.

Q Q. Main sewer, running in front of Hospital.

The front main sewer should receive all the water and fecal matters from the water-closets, bath-rooms, etc., of wards 2, 4, 7 and 9, and of the main central executive building, dispensatory and kitchen. In the plan, six fountains are connected with the main front sewer.

The diameter of the main sewer should be not less than four (4) feet, and the diameter of the smaller tributary sewers connected with the fountains, privies, water-closets and bath-rooms should range from one to two feet.

R R. Main sewer, running in the rear of the Hospital.

The rear main sewer should receive all the water and fecal matters, etc., from wards 1, 3, 5, 6, 8 and 10, and from the laboratory, steam-laundry, dead-house, dissecting-room, work-shop and stables.

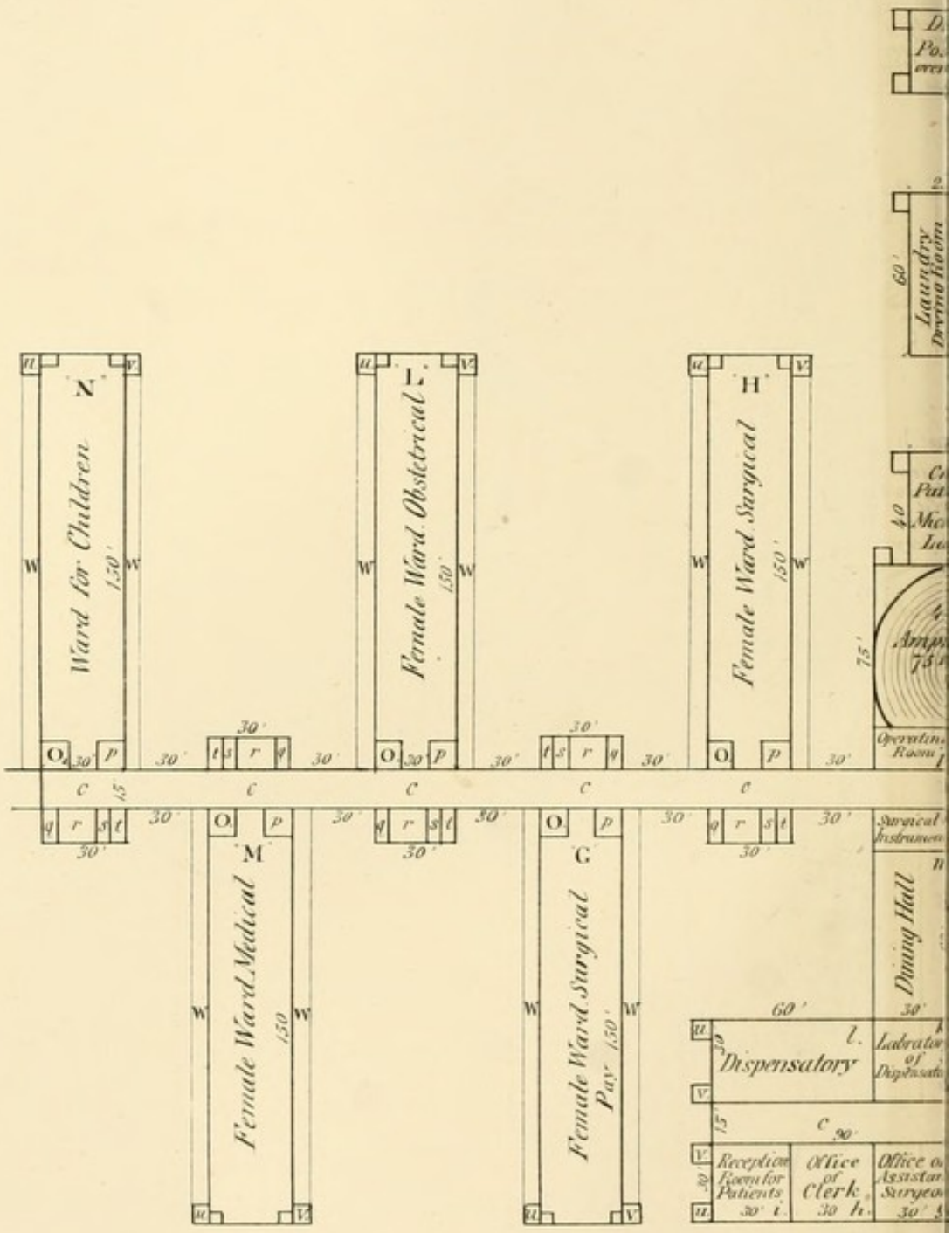
It will be observed, that in the preceding plan *no sewer passes under any ward or portion of the Hospital buildings.*

It will also be observed that the central portions of the Hospital are occupied by the kitchen, and the arrangements for heating and supplying the Hospital with hot and cold water.

The dead-house is removed 35 feet to the rear of the steam-laundry, but is accessible to all parts of the Hospital by the railroad or *tramway.*

The following is the plan of the *first* floor of the Hospital. (Plate II.)

PLAN OF

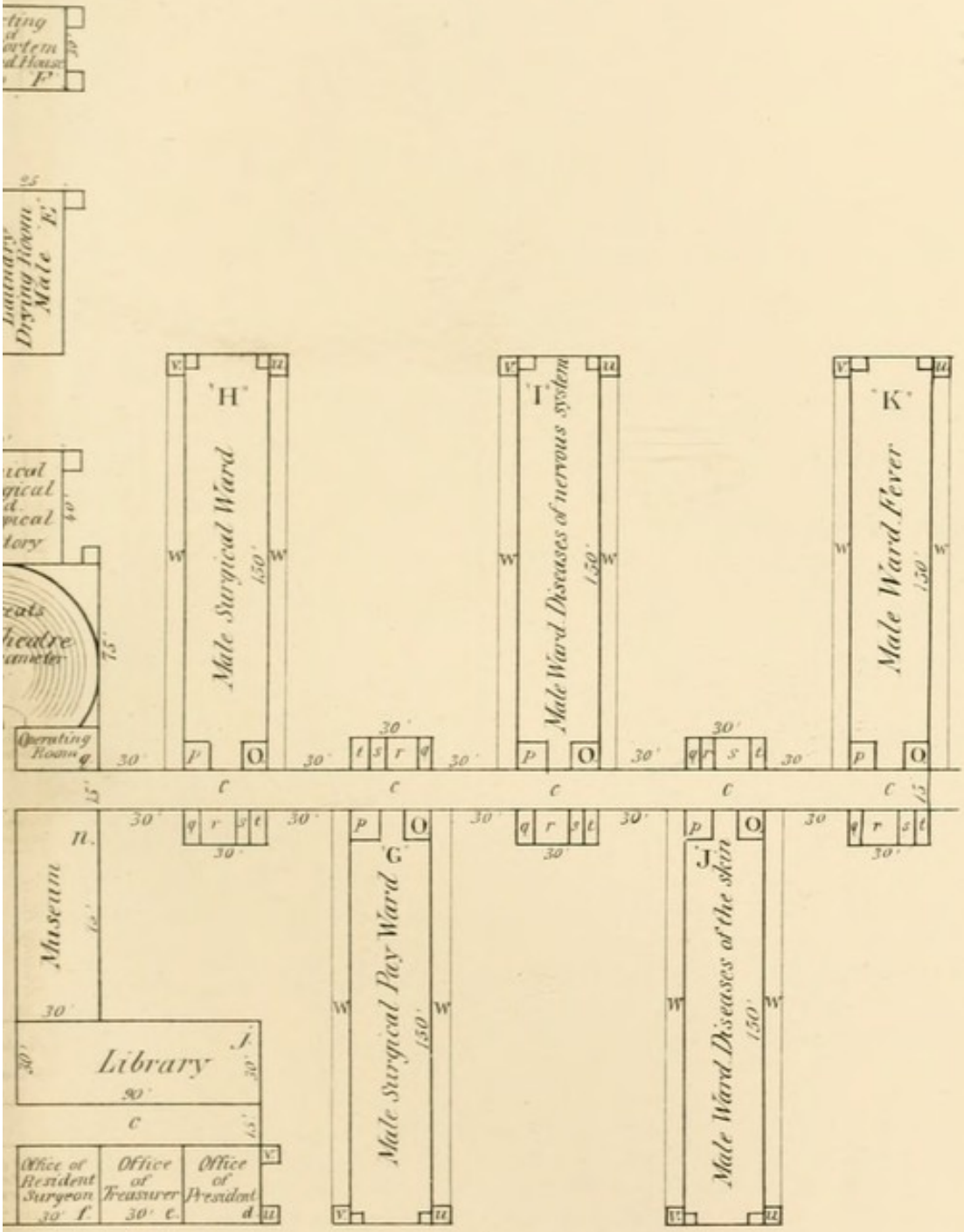


10 WARDS, 40 PATIENTS EACH = 400 PAT

DR. JOSEPH JONES SUGGESTIONS
FOR
JOHNS HOPKINS HOSPITAL.

.2.

IRST FLOOR



NTS. TOTAL LENGTH OF FRONT 675 FT.

EXPLANATION OF PLATE II.

PLAN OF FIRST FLOOR OF HOSPITAL.

A. Central Administrative Building, first floor.

b b, c c c. Central corridor or passage-way, dividing the central administrative building at right angles, and communicating with library, museum, dining-hall, and amphitheatre, operating rooms, dispensatory, and the pay, surgical, obstetrical and medical wards.

Width of central corridor, 15 feet.

Height of central corridor, 18 feet.

d. Office of president, 30 × 30 feet; height, 18 feet.

e. Office of treasurer, 30 × 30 feet; height, 18 feet.

f. Office of resident surgeon, 30 × 30 feet; height, 18 feet.

g. Office of assistant resident surgeon, 30 × 30 feet; height, 18 feet.

h. Office of clerk, 30 × 30 feet; height, 18 feet.

i. Reception room for patients, when they are examined for admission into the various wards, 30 × 30 feet; height, 18 feet.

Out-door patients may also be examined and prescribed for at certain hours in this room, by the resident surgeon and assistant surgeon, and attending physicians and surgeons.

The three rooms, *g h i*, should communicate freely with each other, and especially during the examination, admission, and registration of patients.

The reception room for patients should communicate freely with the corridor of the basement, by a lift and stairway.

In like manner, the offices of the president, surgeon and treasurer should communicate directly with the central corridor in the basement.

j. Library, 30 × 90 feet; height, 38 feet.

The Library should extend up to the roof of the building, through the second story, and in addition to the windows at the side, may be lighted from above. Galleries should run around the walls, at intervals of 12 feet, so that the whole space may be utilized for the preservation of the Hospital records, and works of reference.

k. Laboratory of dispensatory, for the manufacture of medicinal preparations: tinctures, syrups, extracts, etc.

Dimensions of dispensatory laboratory, 30 × 30 feet; height, 18 feet.

l. General dispensatory for entire Hospital, and for the out-door patients, where all medicines, prescriptions, etc., shall be prepared, in accordance with the rules of the Hospital, by competent druggists, and dispensed according to the directions of the resident surgeon, assistant surgeon, and attending surgeons and physicians.

Dimensions of general dispensatory, 60 × 30 feet; height, 18 feet.

m. Dining-hall for officers and resident students of Hospital, 30 × 60 feet; height, 18 feet.

n. Museum for the preservation of anatomical and pathological specimens. Dimensions of museum, 75 × 30 feet; height, 38 feet.

The museum should extend up to the roof of the building, through the second story, and in addition to the windows at the side, should be lighted from above by a dome, or otherwise, as in the case of the library. Two galleries, at intervals of 12 feet, should run around the walls of the museum, so that the entire space may be utilized, and ample room afforded for the gradual growth and perfection of the anatomical and pathological collection.

The museum is located near the great amphitheatre or lecture room, so that the professors charged with the conduct of the medical and clinical lectures may avail themselves of the specimens, preparations, dissections, models, and drawings, in the illustration of their cases and lectures.

o. Room for the preservation of surgical instruments, bandages, appliances, etc., 15 × 30 feet; height, 18 feet.

In like manner, this room should occupy a central position, in order that the appliances may be readily available to the entire Hospital, and also to the surgeons, when performing operations before the class in the amphitheatre.

p q. Operating rooms, 30 × 15 feet; supplied with operating tables, gas, hot and cold water, ether, chloroform, diffusible stimulants, and surgical appliances for reducing fractures, etc. In these rooms the patients to be operated on may be prepared before being introduced into the amphitheatre. These rooms may communicate, by means of lifts and stairways, with the lower basement corridor, so that at all times they may be used in the reception and immediate treatment of patients, when they are brought to the Hospital, with wounds or accidents.

B. Amphitheatre, or central operating and lecture room. Diameter, 75 feet, height, 40 feet. The seats should be so arranged as to accommodate at least 400 students.

1. Main entrance from central hall or corridor. 2. Lecture and operating table and bed for surgical and medical cases. The amphitheatre should be supplied with gas and hot and cold water, and be well lighted by a dome above.

C. Chemical, pathological and microscopical laboratory, 40 × 50 feet; height, 18 feet.

The chemical laboratory should be devoted to the microscopical and chemical examination of the blood and urine, and of the morbid products of disease, and should be supplied with water and gas, and should be well lighted at the sides and above.

The chemical laboratory should communicate freely with the amphitheatre, in order that the results of the processes, instituted in the investigation of disease, may be immediately available to those delivering clinical lectures in the amphitheatre, for the illustration of the pathology and therapeutics of the various diseases brought before the medical students.

The laboratory should be furnished with two or more microscopes of standard power and accuracy, together with those reagents and apparatus which are specially adapted to the investigation of physiological and pathological chemistry, and to pharmacy and toxicology.

D. Laundry.—Drying-room for clothing of females and children, 60 × 25 feet; height, 18 feet.

E. Laundry.—Drying-room for clothes of males, 60 × 25 feet; height, 18 feet.

The laundry building should be situated at least 35 feet in the rear of the laboratory (C). The basement of the laundry should be fitted up with the most approved machinery for washing by steam, and the most effective and improved methods should be employed in drying the clothes.

F. Dissecting and post-mortem room, attached to dead-house, and situated immediately over the basement, in which the dead are received and prepared for burial, and which communicates with all parts of the Hospital, by means of the central railroad in the central basement corridor. The bodies should be raised by a *lift* to the upper post-mortem and dissecting room. Post-mortem examinations should not be permitted in the lower rooms. The post-mortem and dissecting room should be freely ventilated by side windows, and should also be lighted and ventilated from the roof above. The floor should consist of colored tiles, and the dissecting and post-mortem tables should be covered with lead or zinc.

In all large hospitals, situated in or near large cities, many cases may demand the presence and investigation of the *coroner*, and the room now indicated would be the proper place for such inquests, where they might be conducted quietly, thoroughly, and without any interruption.

In cases of poisoning, demanding medico-legal investigation, the laboratory (C) would furnish all the necessary facilities.

The dissecting-room should be supplied with water, and every arrangement should be made to attain and preserve the utmost cleanliness.

It is impossible to over-estimate the value of careful post-mortem examinations to the progress and perfection of medical science.

Thorough clinical instruction is impossible, without post-mortem examinations, and chemical and microscopical investigation of the pathological products.

Dimensions of dissecting and post-mortem room and dead-house, 50 × 30 feet; height, 18 feet.

The dead-house should be surrounded by a substantial iron railing, enclosing a small space around, and no patient should be permitted within or around this enclosure.

G G. Male and female surgical pay ward, situated on the right and left of the central administrative building.

Length of ward, 150 feet; breadth, 30 feet; width of veranda, 10 feet; height of ward, 18 feet. Capacity, 40 beds.

H H. Male and female surgical wards, situated on the right and left of the amphitheatre, and contiguous to operating rooms, 150 × 30 feet; 18 feet high.

I. Male ward for treatment of diseases of nervous system, 150 × 30 feet; 18 feet high.

J. Male ward for treatment of diseases of skin, 150 × 30 feet; 18 feet high.

K. Male ward for the treatment of *fevers*, 150 × 30 feet; 18 feet high.

By this arrangement the ward devoted to the treatment of fevers will be as far as possible isolated from the remainder of the Hospital.

L. Female obstetrical ward, 150 × 30 feet; 18 feet high.

M. Female medical ward, 150 × 30 feet; 18 feet high.

N. Ward for children, 150 × 30 feet; 18 feet high.

O O. Nurses' rooms, attached to each ward, with window commanding ward, 10 × 10 feet; 18 feet high.

P P. Ward library and reading room for preservation of *case books*, small test chest, instruments, also books for patients, 10 × 10 feet; 18 feet high.

Q Q. Stairway communicating with basement and with second story, 5 × 15 feet.

R R. Mess-room and scullery, 15 × 15 feet.

S S. Press-room for clothing, etc., 5 × 15 feet, arranged with shelves, etc.

T T. Lift, or elevator, extending from basement to second floor. If it should be practicable to arrange the lift and stairway together, in the space indicated on either side, or in the centre, and so as to occupy not more than 15x5 feet, then the other space might be made available for the assistant nurses, as a dormitory.

U U. Privies, or water-closets, and ward sinks, with entrance and windows.

Dimension of water-closet and ward sink, 10 × 10 feet; of ventilated lobbies connected with water-closet, 5 × 5 feet.

V V. Bath and ablution rooms, 10 × 10 feet; ventilated lobbies connected with bath-rooms, 5 × 5 feet.

Total length of detached building or Hospital pavilion, including central corridor, and extension beyond corridor for mess-room, etc., 180 feet.

Length of each ward, 150 feet; breadth, 30 feet; height, 18 feet; capacity, 40 beds; cubic space per bed, 2250 feet; 20 beds on each side of ward.

Ten windows on each side of ward and two windows at each end.

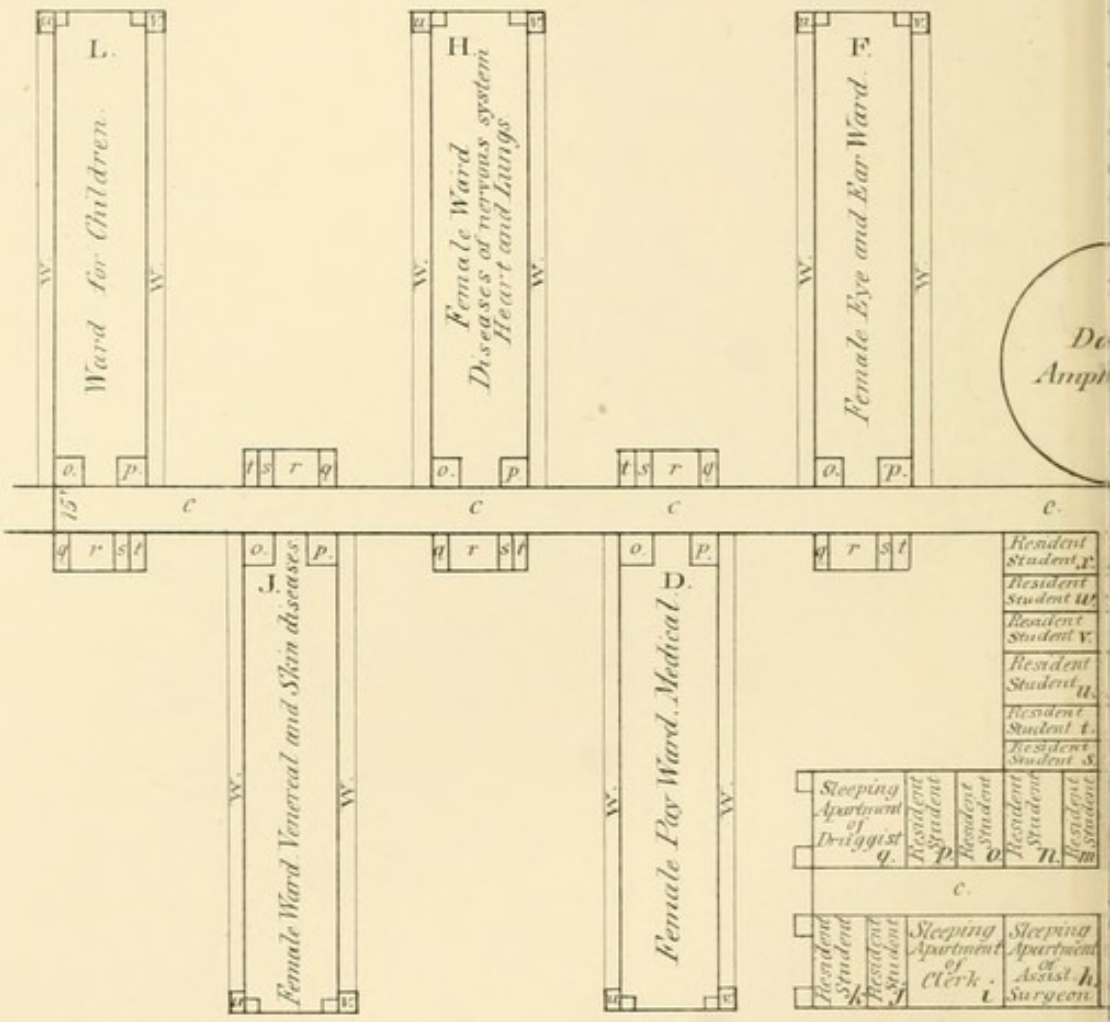
Breadth of windows, 5 feet; height of windows, 17 feet. One window to two patients.

W W. Piazza, or open gallery or veranda, on each side of ward: length, 140 feet; breadth, 10 feet; height, 18 feet. The verandas may be used for the exercise of the patients, and also for sitting and reading.

Capacity of first floor of Hospital, 10 wards, 40 beds each: total, 400 beds.

The following is the plan of the second floor of the Hospital;

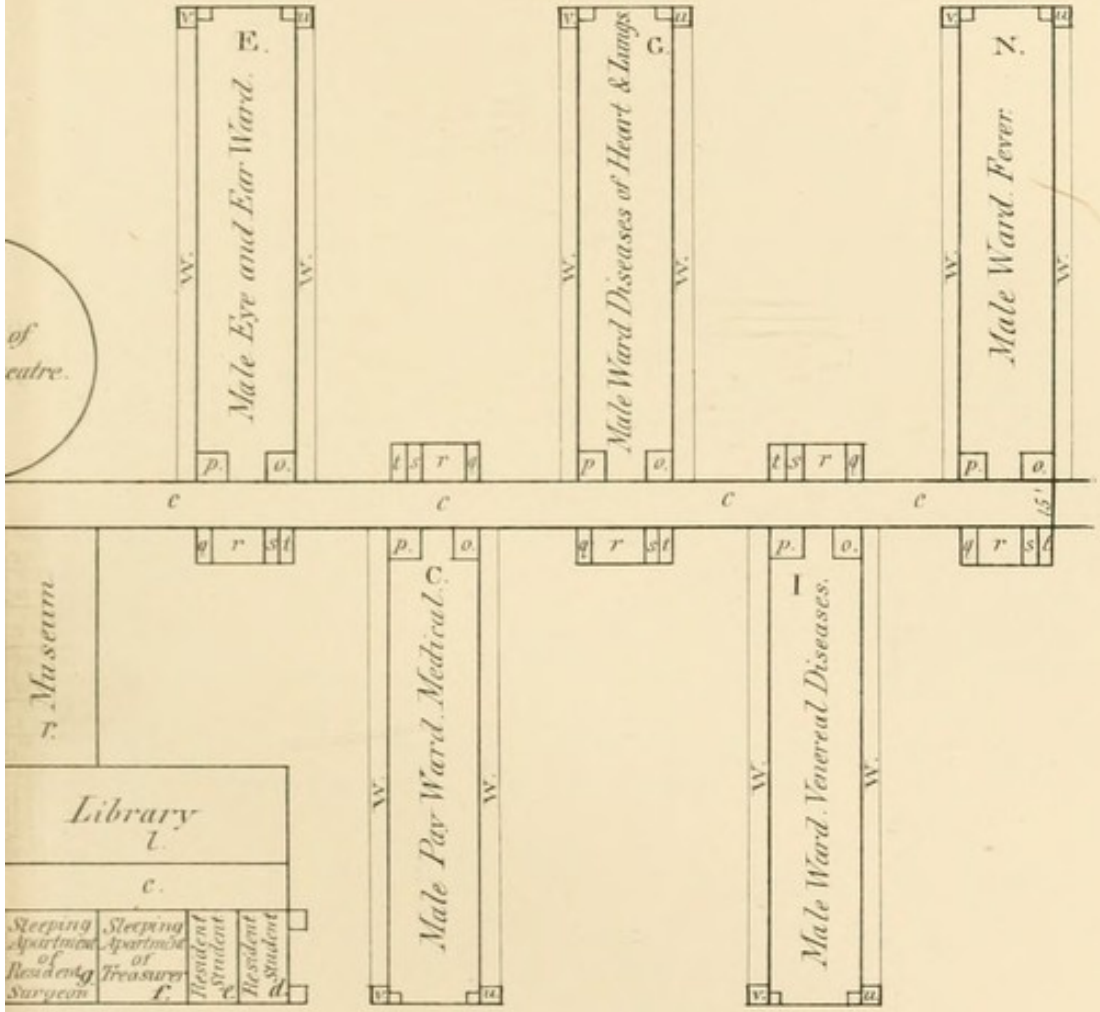
PLAN OF SE



10 WARDS, 40 PATIENTS EA

DR. JOSEPH JONES SUGGESTIONS
FOR
JOHNS HOPKINS HOSPITAL.

ND FLOOR.



. TOTAL PATIENTS = 400.

EXPLANATION OF PLATE III.

PLAN OF SECOND FLOOR OF HOSPITAL.

A. Central Administrative building, second floor.

b b, c c. Central hall or corridor, connecting all parts of Hospital: width, 15 feet; height, 18 feet.

d e j k m n o p s t u v w x. Sleeping apartments of resident students. Dimension of each student's room, 30 × 15 feet; 18 feet high.

g. Sleeping apartment of resident surgeon, 30 × 30 feet; 18 feet high.

h Sleeping apartment of assistant resident surgeon, 30 × 30 feet; 18 feet high.

f. Sleeping apartment of treasurer, 30 × 30 feet; 18 feet high.

g. Sleeping apartment of druggist, 30 × 30 feet; 18 feet high.

l. Library.

r. Museum.

B. Dome of amphitheatre, 75 feet diameter.

C. Male medical pay ward, 150 × 30 feet; 18 feet high.

D. Female medical pay ward, 150 × 30 feet; 18 feet high.

E. Male eye and ear ward, 150 × 30 feet; 18 feet high.

F. Female eye and ear ward, 150 × 30 feet; 18 feet high.

G. Male ward, diseases of heart, lungs, kidneys, etc.

H. Female ward, diseases of heart, lungs, kidneys, etc.

I. Male ward, skin affections and venereal diseases.

J. Female ward, skin affections and venereal diseases.

K. Male ward, fevers.

L. Ward for children.

Of course the relative distribution of the patients and diseases to different wards must depend to a great extent upon the number and character of the prevailing diseases.

O O. Room for ward nurse, 10 × 10 feet; 18 feet high.

P P. Room for ward library, etc., 10 × 10 feet; 18 feet high.

Q Q. Stairway communicating with basement, 5 × 15 feet.

R R. Mess room and scullery, 15 × 15 feet.

S S. Press room for clothing, etc., 5 × 15 feet.

T T. Lift, or elevator, extending from second floor to basement, 5 × 15 feet.

U U. Water-closets, 10 × 10 feet.

V V. Bath and ablution rooms, 10 × 10 feet.

W W. Verandas, 140 × 10 feet.

Large iron tanks should surmount the central administrative building for the distribution of water to all parts of the Hospital, in case the water-works of the city are without the necessary power.

The apparatus and engines for the regulation and circulation of the hot and cold water should be situated centrally under the amphitheatre and laboratory, as indicated in the preceding plans.

The plan of each ward in the entire Hospital is represented in the following Plate, No. IV.:

EXPLANATION OF PLATE IV.

PLAN OF EACH WARD IN ENTIRE HOSPITAL.

Length of each ward, 150 feet.
Breadth of each ward, 30 feet.
Height of each ward, 18 feet.
Capacity of each ward, 40 beds.
Cubic space per bed, 2250 cubic feet.
Two open fire-places in each ward.
Twenty beds on each side of ward.
Two beds between each window.
Ten windows on each side.
Two windows at the end.
Breadth of windows, 5 feet.
Height of windows, 17 feet.

The windows should extend from six inches of the floor to six inches of the ceiling of the ward.

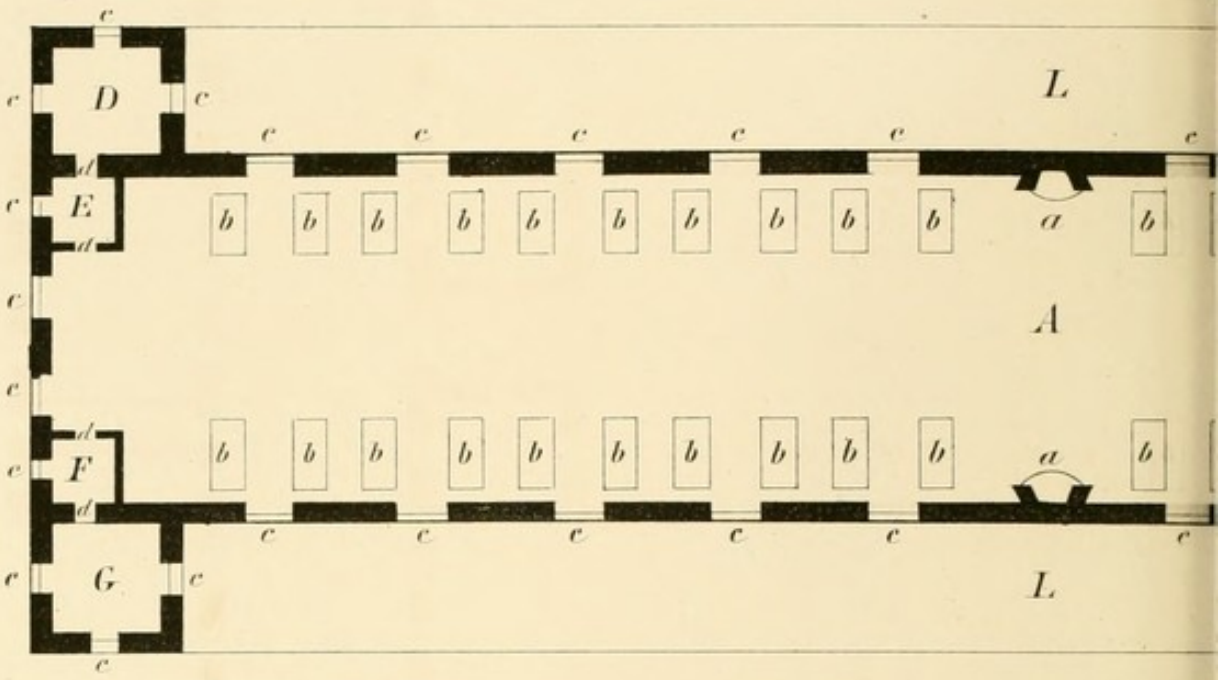
Nurses' room, 10 × 10 feet.

The nurses' room should command a view of the entire ward by means of a window.

Ward library, 10 × 10 feet. If deemed desirable, this room may also be used for one or more assistant nurses.
Water-closet, 10 × 10 feet.
Bath room, 10 × 10 feet.
Ventilated lobby leading to privy or to bath-room, 5 × 5 feet.
Length of ward veranda, 140 feet; breadth, 10 feet.
Width of central corridor, 15 feet.
Length of addition to ward beyond corridor, and devoted to mess-room, press-room, lifts and stairway, 15 feet; breadth, 30 feet.

See also explanation accompanying Plate IV.

The following Plate V. gives a profile view of each detached building or pavilion:



PLAN

SCALE 20

A. *Ward. Length of ward 150 ft. Breadth 30 ft. Height 18 ft. Capacity 40 Beds. Cubic*

a.a. *Open Fireplaces.*

b.b. *Beds. 20 beds on each side. Cubic space per bed 2250 cubic feet. 2 beds betwe*

c.c. *Windows. The ward proper should have 10 windows in each side and 2 a 6 inches of the floor to 6 inches of the ceiling.*

B. *Nurses Room, with ward window (c) commanding ward, (d) entrance into*

C. *Ward Library and Sitting Room, for preservation of clinical records of cases, small chemical chest on table. this small chest or rack should contain 2 U as Litmus. Nitric Acid, Sulphate of Copper, Liquor Potassa, etc. as are employe*

D. *Water Closet and Ward Sink with entrance (d), windows (c.c) dimensions of*

E. *Ventilated Lobby connected with W. Closet (D) size 5×5 feet.*

F. *Ventilated Lobby connected with Bath and Ablution room. 5×5 feet.*

G. *Bath and Ablution Room. dimensions 10×10 feet.*

H. *General Corridor or Hall into which all the Wards open, dimensions 15 fe*

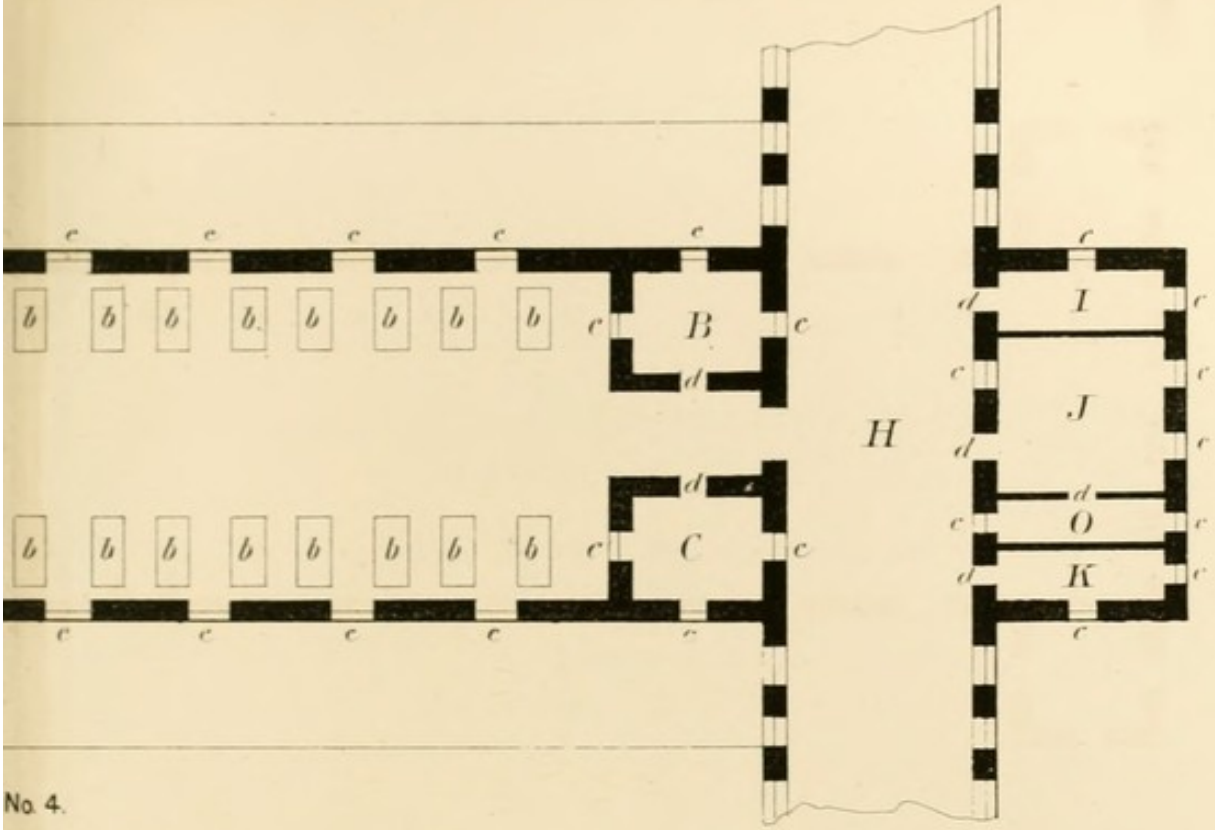
I. *Stairway 5 feet wide. 15 Long.*

J. *Mess Room and Scullery. 15×15 feet.*

O. *Press Room for Clothing, etc. 5×15 feet arranged with shelves.*

K. *Lift or Elevator extending from Basement to 2d Floor, dimensions of Lift Roo*

L. *Piazza or open Gallery for exercise of Patients. Length of Ward galleries 140 fe*



No. 4.

OF WARD.

EET TO ONE INCH.

ee per bed 2250 cubic feet.

ach window. The beds should be of Iron and at least 3 feet in width.

e end. Breadth of windows 5 feet. Height 17 feet. The windows should extend from

es room. Dimensions of room 10 ft. square.

should be provided with Book Case. Desk for writing, Pens, Ink and paper, also a

meters, 4 Clinical Thermometers, Stethescope, Symphograph, etc. and such re agents

testing the urine. (d) entrance to Library. (c.c.) windows.

ter Closet and Ward sink 10 × 10 feet.

ide.

5 × 15 feet

eadth 10 ft. height 18 feet.

DR. JOSEPH JONES SUGGESTIONS
FOR
JOHNS HOPKINS HOSPITAL.

EXPLANATION OF ELEVATION,

OR PROFILE OF EACH DETACHED PAVILION OR HOSPITAL BUILDING AS IN PLAN NO. 4.

Each detached pavilion or Hospital building, including the central corridor and mess-room, would present the following dimensions:

Total length, 180 feet.
Breadth without verandas, 30 feet.
Breadth with verandas, 50 feet.
Length of wards, 150 feet.
Breadth of wards, 30 feet.
Breadth of corridor, 15 feet.
Length of detached portion for mess-room, etc., 15 feet.
Breadth of detached portion for mess-room, etc., 30 feet.
Capacity of each ward, 40 beds.
Capacity of each detached building or pavilion, 80 beds.
Capacity of first floor of entire Hospital, 10 wards, 400 beds.
Capacity of second floor of entire Hospital, 10 wards, 400 beds.
Total capacity of entire Hospital, 20 wards, 800 beds.
Height of basement, 12 feet.

The basement beneath the wards should be entirely open, so as to admit of the freest circulation of the air.

The basement of the wards should be used for communication as specified, and also for exercise of patients in hot and wet weather. The basement of each pavilion should communicate directly with the central executive building.

Height of first floor of wards, 18 feet.
Height of second floor of wards, 18 feet.
Total height of each pavilion or detached Hospital building, including roof and floor, 60 (sixty) feet.

HOSPITAL CONSTRUCTION
AND ORGANIZATION.

CASPAR MORRIS, M.D.

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HOSPITAL CONSTRUCTION

AND ORGANIZATION.

CASPAR MORRIS, M.D.

THE subject of hospital construction is one which has recently claimed great attention, yet not so great as its importance demands. There has been much discussion of theoretic principles, and many buildings have been erected in which these have been brought to the test of practical experiment; not always with successful results. The interests at stake, the expenditure involved, and the irremediably injurious influence of errors in construction, give rise to a sense of serious responsibility, assumed in the expression of opinion and suggestion of plans, especially at a period when views are so unsettled as at present; when one who had devoted much time to its consideration, and enjoyed unusual advantages for the accumulation of knowledge on the subject, declares that no permanent or costly building will ever be erected hereafter for the treatment of disease, except as a monument to the pride of some aspirant for posthumous fame; when we are told by competent and honest observers that the massive and costly buildings erected within a few years in Paris, for the Hotel Dieu, will never be occupied; and that the extensive and imposing structures put up, without any restriction upon the money expended, for St. Thomas's, in London; those constructed by the commissioners of the British nation at Netley,

and those under private local auspices at Leeds, have each some serious defect in arrangement or construction. Yet the growth of population requires that additional accommodation shall be provided; advance in social science demands that the improvements in architecture and economy shall be made available for the benefit of the sick; and the dilapidation of old structures requires that new ones should be substituted for them.

It becomes necessary to take a survey of a wide field before determining on any plan of action, and one cannot indulge the expectation of avoiding all error in conclusions, or hope that in the experiments of improvement there may not be some point in which change may fail to be an advance; and it is certain that our experience will afford a fresh starting point for progress, and that future improvements will be based on our failures. The problem to be solved, in this as in all other human interests, is, how the largest amount of good may be secured with the smallest amount of disadvantage for any given expenditure of power: and here, as in most cases, money is the representative of power.

It is not my design to engage in debate upon the principles involved, nor to enter into scientific discussions or statements; knowing only too well my want of qualification or ability for either. Having been conversant with the inception, construction, and development of a hospital, which, within fifteen years, has grown from a few beds in a private house to a structure with a capacity for three hundred beds; having participated in the conferences over the plans adopted, and watched the practical working in conformity with them, it is my simple purpose to offer to you these plans, with some suggestions of change in accordance with the requirements of the position in which you are placed, and others which present themselves as probable improvements.

I have myself as an individual no claim to any originality. The plan presented as the basis of this paper is essentially that of the *Hospital of the Protestant Episcopal Church of Philadelphia*, which plan was the result of much laborious thought and consultation between the accomplished and experienced architect Mr. Samuel Sloan and the committee to which was entrusted the construction of that building. Messrs. John Welsh and John C. Cresson brought to the service the benefit of intelli-

gent and cultivated minds, with great practical ability and clearness of perception, and much experience in detail of building; to which Professor Cresson added rich scientific stores, accumulated during a life devoted to such pursuits. Bishop Stevens, then Rector of St. Andrew's church, and retaining still his interest in the medical profession, in which he had acquired eminence before entering holy orders, was also an earnest fellow laborer.

Dr. Edward Hartshorne added to similar endowments and acquirements the advantage of many years' experience as physician to the Eastern Penitentiary, and one of the surgeons of the Pennsylvania Hospital and the Wills' Hospital, and contributed also the results of much study of the subject of hospital construction, and very extensive observation of the buildings of Europe devoted to the service of the sick, and of the modes of administration. Nor was it only in the original preparation of the plan on which fifteen years ago the central building for administration was erected with one pavilion of two stories with an attic, that these gentlemen manifested their ability. The experience of those fifteen years of actual use was brought into service in the construction of the pavilion now in process of erection.

The result of those many years of trial suggested but few modifications; and those not essential. The changes in the detail of that plan, which are here proposed, are such as approve themselves to my own judgment, as improved application of the principles on which that hospital was undertaken, and the extension of the application of the same principles to the wider service required in the present case. The object has been to present a plan which should combine simplicity of arrangement, with adaptation to the various services to be performed; solidity and durability with lightness and airiness of construction; compactness, with enough of extension to secure the combination of ease of administration with ample space; and to avoid everything which should promote vitiation, or contamination of the atmosphere, or afford points at which there might be possible any accumulation or concealment of foul or refuse matter to become a cause of depravation of the air.

Dr. Robert S. Knight, who has devoted many years to the practical working of the Hospital of the Protestant Episcopal Church, as Superintendent, has kindly furnished many valuable hints, the result of his intelligent and careful observation.

With these preliminary remarks we are prepared to enter into the consideration of the questions propounded in your letter of inquiry.

The first question proposed in your letter, requesting opinions on the best plan for the construction of a hospital for city service, "is the choice between the *pavilion* system, which admits build-"ings of two or more stories in height permanently constructed, "of which the Herbert Hospital in England, and several in this "country, may be considered good modern types, and the *bar-"rack* system of one story structures, destructible in whole or in "part, which were so successfully used in the late war, but of "which no extensive and prominent example is now in opera-"tion."

Two subjects, not necessarily connected, are included in this question. A building of only one story may be easily destructible, and designed for only temporary use, or may be more permanent in its character; and some of the arguments advanced in favor of the single story do not of necessity involve the question of its being destructible; while the most permanent two-storied structure is susceptible of removal of the plaster and floors whenever necessary, and is thus made virtually a new building. One answer to both is spontaneously suggested by the term "City" in the proposition.

A *city* hospital must be adapted to the requirements of city life, and must be constructed on the same principles as the city itself.

Light, air, and space are essential to life; and a *certain amount* of each is absolutely necessary to existence. The more ample the supply of air and light and the wider the range of space enjoyed by each individual, the more robust the health and the greater the enjoyment; provided in securing these, one does not sacrifice other interests, each also important, though not in the same degree.

The healthy residents of a city are well aware of this, and as they possess the ability, avail themselves of the advantages of wider space to secure increase of light and air, and only abandon it to obtain other advantages.

But the necessity of concentrating action, and combining in concerted effort for business purposes, compels a majority of them to sacrifice the comfort, and elegance, and superior advan-

tages in relation to health, of villa and suburban dwellings, and to mass their houses on the smallest area which furnishes the requisite amount of light and air, in order to economize time and strength in the co-operative pursuit of common purposes. So must the sick and wounded of such a population submit to similar concentration in order to secure advantages which cannot be had without such sacrifice. As this concentration is necessary for the business of life during health, so is it equally in times of sickness in order to secure the greatest amount of provision of means for recovery of health. The supply of medical and surgical attendance and nursing is limited, and cannot be spread out indefinitely in proportion to the increased demand consequent upon this aggregation of the population in masses for the sake of convenience in the transaction of business.

As in active life, wide spaces between dwellings and large sized apartments promote the comfort and health of the occupants, but the necessities of business convenience, and economy of labor and expenditure, require the surrender of all that is not absolutely essential, and the construction of houses which occupy a smaller extent of surface, and are placed floor above floor; and the mutual benefit derived from this compression of population into the smallest space compatible with health, more than compensates for the sacrifice of other advantages which it involves; so in the *city of the sick* it is necessary to submit to as much concentration as can be secured without an undue abandonment of that which is of fundamental importance, the proportion of light and air, and space essential to the restoration of impaired health. It were as impracticable to distribute the number of sick and wounded accumulated within the densely populated precincts of a city, with its proportionably increased causes of disease and accident, over such an area as would provide for each the amount of space they would enjoy in a rural district, as it would be to carry on the mercantile operations of a great emporium of commerce, or the labors of a great mechanical or manufacturing centre, with a similar disregard to the requirements for concentrated action. It is readily granted that a village of cottages, with commodious arrangements, and airy, large apartments appropriated to the use of the sick, with a nurse for every half dozen cases, and proportional supply of medical and surgical skill, would return a per centage of mortality vastly less than

that supplied by crowded wards; just as a rural district or village does less than large towns. Utopian in the highest degree as such a suggestion is recognized to be, it is scarcely less practicable than the plan of one-story barrack buildings for city hospitals. But concentration and crowding are not synonymous terms, and no argument is presented for crowded wards. When the ample floor and air space of properly constructed wards in modern hospitals, and the convenience, and appliances for the comfort and nursing of the sick collected there, are placed in contrast with the dark and illy ventilated rooms and houses to which the poor, for whom these hospitals are provided, are accustomed, and in which they are compelled by the necessity of their occupations to dwell, it must be acknowledged that they are furnished with advantages in them, which, in comparison, are almost as great as those of the imaginary village.

Carefully conducted observations, made in a wide field and through many years, by numerous and unconnected persons well qualified for the task, have furnished us with data on which to found our calculations; and these have been adapted, not to the production of a minimum, providing for every patient the smallest amount of comfort compatible with existence, but to the provision of the largest amount consistent with due economy of labor and expenditure. In wards such as are proposed the most ample supply of light, air, and space is afforded. The economy practised is only in the grouping the patients in common wards, in order to diminish the number of nurses required, and lessen the labor; and by grouping many wards together to curtail expense. Every bed in a well-constructed hospital is provided with at least 100 square feet of floor space, in order to furnish ample room for the comfort of the patient and for the convenience of the nurses in rendering the necessary services; and from 1,200 to 1,600 cubic feet of air space for each patient is believed to be no more than sufficient for the maintenance of the proper purity of the air, with the best arrangements for constant change.

From twenty-four to thirty is the number of patients that it is found proper to place under the supervision of one head nurse, and this number is collected in one ward; while in conjunction with the various apartments accessary to such a ward, room for ten more may be found within the area necessary. Every such

ward is in truth a hospital in itself; and every general hospital is but an aggregation of such, each being repeated till a sufficient number of structures is provided for the patients it is designed to accommodate. The question now before us is, shall the number of wards necessary be spread out upon the one level, each ward separated from the other by a space at least double its height? or shall the same amount of floor and air space be furnished by superimposing one ward upon another?

"It has been laid down as an axiom by the Chirurgical Society of Paris in 1864 that the clear space in which a hospital should stand, should not afford a less area than nearly 540 square feet to each patient, that is to say, that a hospital for eighty patients should stand in the centre of an acre of ground; and they further said that the proportional area should be greater as the number of patients increases."

This calculation has reference to the usual system of many-storied buildings. It cannot be conceded that surface covered by buildings occupied by sick, even though they be of only one-story, can be reckoned as vacant space. The same proportion of space unoccupied must be allotted to one-story structures as to those of greater elevation, and thus an acre of ground would be required for every separate building. The original outlay for land, always a very important item of expenditure, must therefore be double for one-storied structures to that which would be necessary for two. The consideration of the question of permanent or temporary buildings is distinct from that of one or more stories, and will claim attention hereafter. In the case of the Johns Hopkins' Hospital the land having been already acquired, the cost of purchase need not be taken into consideration.

But in grading of grounds, excavation for foundations and sewerage, provision for conveyance of heat and artificial light, for the distribution of food, and nearly all the various forms of service, and for roofing, the cost is the same for the building of one story as for that of two. The cost of nursing and support might almost be said to increase with the square of the distance, and the difficulty of supervision and administration in the same proportion.

The safety of the surrounding neighborhood, and the probability of restoration of patients themselves, should not be placed in jeopardy by any considerations of economy in expend-

ture either for land or building, or in subsequent administration; but if it is possible to secure the requisite floor and air space for any given number of patients without the disadvantages connected with this diffusion over an unnecessarily wide extent of surface, and without incurring the risk of injurious results from position or crowding, it is certainly proper to do so.

There can be no justification of undue crowding; but this may be effected as certainly in one-story buildings, placed side by side, as when wards of the same capacity are built the one above the other. No greater number of patients can be received into the same sized ward in the one position than in the other; and the fact that two wards are supported by the same foundation and sheltered by the same roof, is no objection, provided they are properly separated from each other. *Isolation* is the object aimed at; and, if this be secured, economy, in construction and convenience of service, may be perfectly justifiable. The objection to placing one ward above another is founded chiefly on the supposed increased facility for the transmission of foul or contaminated air from one to the other in this position; and on the increased freedom of ventilation afforded by ridge openings, which cannot be had in the lower wards of two-storied buildings.

The transmission of miasmal influence, whatever that may be, is not any more in an upward than in a lateral direction. It is carried by currents of air, or on the persons and clothing of those exposed to it, and in sponges, and dressings, and instruments; and if these pass laterally from the source of contamination, the effect will be transmitted by lateral passages as surely as by vertical. In illustration of this, it may be proper to refer to the fact asserted by good authority, that at the Royal Victoria Hospital at Netley near Southampton, England, where the wards and corridors are so improperly constructed as to *favor* communication, the opening of an abscess filled with a peculiarly offensive fluid in one ward was promptly recognized in another on the same floor at the distance of one-third of a mile. If the corridors are made sufficiently long, wide, high, and open, and the system of ventilation in the wards is properly arranged, all the currents will be *from the corridors into the wards*, and thus there will be no communication from

one ward to another, whether they be placed above or beside each other.

This arrangement of currents is the only available mode of preventing diffusion. Even with the most perfect arrangement it is impossible to secure absolute immunity. An incident, occurring within my own knowledge, will exhibit the potency of the cause of contamination and the facility of diffusion.

A passer on the street heard a tap at a window, and, pausing, it was thrown up, and a gentleman, seated within, said: "Are you afraid of varioloid?" the passer replied: "Yes, but draw down the sash and I will talk to you." It was done immediately, yet in due time to prove the source of poisoning, he sickened with the disease. This was lateral diffusion; and while it shows the subtle nature of the miasm, and the necessity for adopting every guard against it, proves that all that can be done is ineffectual to annihilate the influence. The outer air rushing into the room, that from within escaped by a counter current through the same opening.

There should be no channels of communication between wards, which it is possible to dispense with, whether the connection be lateral or vertical, and the warming and ventilation of each should be entirely independent and isolated. In proportion to the freedom of escape of the air of a ward, by combustion in open fires with vertical chimneys, and through properly adjusted flues, will be the necessity for the supply of an equal amount of that which is fresh and pure, which will flow in by every opening. With such currents setting strongly toward the fire-places and ventilating flues, the products of respiration and cutaneous exhalation and other contaminating influences will be carried by them to these points, and will have no opportunity for escape to other wards by corridors or other channels of communication.

When the subject of heating comes under consideration, it will be found that the difficulty of supplying properly warmed air to one-storied structures, with ridge openings, is much greater than to wards of the same area with appropriate substructions to afford accommodation for the arrangements to furnish moderately heated pure air from without; while the open fire-places, with tall chimneys in two-storied pavilions, create a demand for this fresh supply more uniform in its operation and more subject to control, and less disturbing to the sensations of the occu-

pants than ridge openings. With the arrangements which are proposed, and which will be described when the construction of the ward is under consideration, it is believed that the flow of air outward will be through the chimneys and fire-places and flues; and thus the air which has been exhausted of its vitalizing principles, and contaminated by the exhalations of the sick, will be carried off by them without transmission to other wards, whether above, below, or at the one side.

The experience not only of private dwellings but of public institutions, in which many persons are brought under one roof, is very strongly in favor of the superposition of one story upon another. Not only are the upper rooms more light, and cheerful, and airy, but they are also more healthy. Army experience confirms this also. In buildings provided for troops, even in miasmatic districts, those men who occupy the upper floors, are less subject to disease than those on ground floors, which would not be the case if that malarious influence ascended; and travellers are aware that in foreign cities the upper floors of hotels are appropriated to the best apartments; those on the two lower floors being considered less healthy than those above. It is a well established fact that prisoners confined in upper stories, enjoy better health than those on ground floor apartments.

We thus come to the investigation of the second point in the question proposed.

Within the last few years there has been much discussion whether permanent structures for hospital purposes, or temporary buildings erected at comparatively slight cost, and easily removed and replaced, are to be preferred. The controversy is still actively urged; and you reasonably ask for an opinion. The question has yet been brought to the test of actual experience only in military hospitals, except so far as the percentage of death in old hospital buildings, proves that when well conducted they are equal to new. There is no doubt about the fact that walls improperly constructed, floors imperfectly laid, furniture allowed to become dilapidated, and clothing and bedding allowed to become foul from the effluvia and discharges, the result of disease and emanations from the persons of the sick, become themselves contaminated; and thus render the atmosphere within and around them unhealthy; and give rise

to modifications of the symptoms of all cases subjected to their influence; and render them more difficult of cure, or may even give origin to special diseases.

Such results can be averted only by the exercise of unceasing vigilance in the maintenance of the integrity of structures; and by cleanliness; and the prompt removal of all secretions and discharges; and articles imbued with them; even though their injurious influence should not be attended by offensive odor. This is not the measure of their poisonous power. A lethal influence may lurk in the atmosphere and no sensible odor betray its presence, while a foul and offensive smell may give rise to nothing more serious than nausea or disgust. "*Vigilance essential to success*" should be the motto of hospital management. It embodies a principle applicable equally to the professional treatment of the sick and injured, the nursing of the patients, and the police of the establishment. Upon this more even than upon construction, arrangements, or age of buildings—it might almost be said more than upon the skill of professional attendants—depends the result of hospital treatment. Without it the most judicious plan of buildings which can be suggested, with the largest expenditure in original construction, will be rendered valueless; and the newest hospital will yield the largest percentage of unsuccessful and fatal results. With intelligence, vigilance, and energy on the part of the various officers in charge, an old building in which purity and neatness are maintained, is greatly to be preferred to a new one without such care. A close ill ventilated corner, an accumulation of foul clothing, or careless slopping of floors, or the obstruction of a drain, would contaminate the atmosphere of the best planned and best constructed building, however recent. Captain Galton of the British Army, in his admirable address on the construction of hospitals, quotes from a report of Mr. Simon, the medical officer of the Privy Council of Great Britain, the following clear expression of these views:

"That which makes the healthiest house, makes likewise the healthiest hospital; the same fastidious and universal cleanliness, the same never-ceasing vigilance against the thousand forms in which dirt may disguise itself, in air, and soil, and water, in walls, and floors, and ceilings, in dress, and bedding, and furniture, in pots and pans and pails, in sinks and drains and dust

bins. It is but the same principle of management, but with immeasurably greater vigilance and skill; for the establishment which has to be kept in such exquisite perfection of cleanliness, is an establishment which never rests from fouling itself; nor are there any products of its foulness, not even the least odorous of such products, which ought not to be regarded as poisonous."

It must not be assumed that all the peril of what is termed *hospitalism* rests lurking in old buildings; much less can it be admitted that it is found only there, and can be escaped or annihilated by adopting barrack buildings of one-story and of cheap construction, easily erected and quickly destroyed. Hospital gangrene, the most formidable malady supposed to originate peculiarly in old, illy ventilated, and over-crowded wards, was found in one-story newly constructed barracks during our late war. Cheapness of construction and facility of removal may lead to a want of vigilance, both in original construction and subsequent administration, which will be productive of the worst consequences. In truth, cheapness of construction *involves* the use of inferior materials, and less care and skill in building. Such a barrack after three or four years' use, may have more cracks in illy plastered walls, more open seams and fissures in badly laid floors of inferior wood, more pockets for the accumulation of fomites, and be more saturated with poisonous influences, than a solid structure which has resisted the storms of centuries and been kept in proper repair, and has afforded relief to the sick and wounded of successive generations.

This is not a mere conclusion deduced from theoretic principles, but the result of actual observation. In one of the great London hospitals the largest death rate was furnished by the new wards recently added to the older structure; and the most satisfactory practical refutation of theoretic arguments against permanent hospital buildings, is furnished in the highly interesting and intelligent paper of Dr. William Hunt, contributed to the *Medical Times* of Philadelphia, for Nov. 20, 1874, in which he furnishes the statistics of the Surgical Mortality of the *Pennsylvania Hospital*, for the year 1872–3, as follows: "The entire number of cases treated, during the twelve months in the house, 2,155: of whom there died, 172, or 8.59 per cent. Of these cases, 768 were medical, and 1,387 surgical. The whole number of Surgical deaths was 90. Of these there died within 24 hours

(that is were killed by the accident for which they were brought to the hospital) 35; within two days, 7; within three days, 4; within four days, 1; within five days, 2. Of troubles inevitably fatal, as spine and brain injuries, burns, wounds, etc., there died in periods from six to ninety-three days, 9; of cancer, 3; tetanus, 2; cases fatal in themselves, in or out of hospital, 63, leaving a mortality of 27 to account for, of whom 4 are put down to pyæmia. The others were made up of very severe cases, such as compound fractures, exhaustive suppurative troubles, necrosis, etc; and it is certainly fair to presume from the social status of most of them, that their lives were prolonged and their sufferings ameliorated as well within, as they would have been without, a hospital." Well may Dr. Hunt propose the question, "How many of these cases died of hospitalism?"

Now the wards in which the male patients of the Pennsylvania Hospital are treated (and a very large proportion of the surgical cases are males), are in the oldest part of the building, bearing on its front the date 1755; and those parts of most recent construction were erected in the last century. The entire interior was replastered, and new floors were laid about twenty years ago.

It were unwise to claim for that building the merit of perfection of arrangement; those most familiar with it, are most ready to recognize its defects, and are constantly renewing efforts to remove them. But if with reasonable vigilance, such results of treatment can be obtained in a hospital which has been occupied more than a century, notwithstanding the defects in construction, which grew out of the imperfect knowledge of the period at which it was built, it is only reasonable to claim that it is safe to build hospitals with all the improvements the result of modern progress, with the design and expectation that they may be safe still when they shall have been in use by as many generations, only let them be as solid in construction. There is moreover, as has been already noticed, actual experience that exemption from diseases supposed to be especially attached to old hospital structures, cannot be claimed for those of most recent construction. Hospital gangrene, that most formidable of them all, has not only occurred in the one-story temporary barracks of our military hospitals, but is found also in private, isolated dwellings. Two patients suffering with it were recently brought from different quarters to the

hospital of the Protestant Episcopal Church, in this city, for treatment, where they were received and treated successfully without injury to other patients. Then, again, cheapness of construction and facility of renewal, so far from guaranteeing exemption from hospitalism, may favor its production. Slightly built barracks must be liable to early decay, and a degree of dilapidation productive of the most injurious influences on the sanitary condition of a hospital, might be reached in a few years, which would not result from a prolonged occupation of buildings carefully constructed of good materials, in which the knowledge they were to be perpetuated would add an additional motive for care in present administration.

The rate of mortality in the hospital of the Protestant Episcopal Church in Philadelphia, which furnishes the basis of the plan herewith submitted, has been remarkably small. In a note furnished for the preparation of the annual report, it is stated that in 1873, it was 7 per cent. of all admissions, including a large number of cases confessedly incurable when brought there, either from the violence of the injuries received, or the nature or stage of the disease with which they were afflicted. An endowment for the special support of incurable cases, and another for a ward for diseases of the lungs, brings to it a larger proportion of cases seeking only care, not cure, than is found in most hospitals.

"The death rate of Philadelphia (one of the healthiest cities "in the world), is about 2½ per cent. If it be assumed that one "fourth of the population of the city, are during the year subject "to disease or injury, as all are who are received into hospitals, "then the rate applied to that part only would be ten per cent., "which is largely in excess of the hospital rate."

Granting all that is claimed by the advocates of cheap structures and frequent renewal, the application of the principle to the case of hospitals for large cities is attended with grave if not insuperable difficulties. While the reasons which render proper the use of shelter-tents and temporary barracks for troops in the field, or encamped for limited periods in given localities, with the constant expectation, and strong hope of a speedy termination of the combination of events which causes them to be collected, justify also the resort to similar arrangements for the reception of the sick and wounded of an army; by a parity of reasoning permanent locations and substantial buildings, are demanded for

the proper reception and treatment of the sick and wounded of a settled permanent population, as that of a great city must always be. Succeeding years only increase its density at a given point, and spread still more widely the causes of disease, while they increase the number of claimants for hospital relief, who are stationary and if they receive hospital relief at all must have it of easy access. An army hospital changes its location necessarily with the removal of the troops; a military hospital, though it may remain longer in one place, ceases to be needed when the return of peace renders it no longer useful.

Such hospitals should be temporary, and can be and are, more conveniently and better located at a distance from great towns, where ample space can be procured at comparatively small outlay, and appropriate sites abound. Even in the event of pro longed war, creating prolonged need; and granting that consequent dilapidation, or the invasion of disease renders renewal necessary, it is an easy affair to remove such an hospital. New sites are readily found; but they must be in immediate proximity to the forces for the accommodation of the sick and wounded of which they are designed. The troops themselves would be moved also; new sites would be sought for the army as well as for the hospital. Such territorial migration for a city, may be compatible with the savage tyranny of Central Africa, it is impossible for us; and as the army hospital must follow the troops when moved, so must the city hospital retain its relative position to the population which needs its relief, and is permanently fixed. It should secure such ample space around it as will prevent the encroachment of growing numbers; but it cannot be removed from the heart of the town because the population becomes dense around it. That very increase of density creates an additional need for hospital service. The sick and the wounded cannot be transported to indefinite distances in the hour of sickness and accident. Such transportation would in many cases, and those of a character most urgently requiring hospital treatment, and susceptible of restoration to health, result in inevitable death. The suggestion of temporary receiving wards in centres of population with rural or suburban hospitals is not practically available. Neither grave cases of disease nor serious injuries would bear the changes necessary in such an arrangement. They must remain at whatever inconvenience where they are first taken.

The hospital must be in immediate proximity to the population it is designed to relieve, surrounded by as large a space of open ground as can be secured for it. This population is fixed; so must the hospital be: for suitable sites in such near vicinage are rare and costly. To purchase a new one every ten years (the term fixed by some of the advocates of temporary structures as the utmost limit of safe occupation of buildings,) would involve a very heavy outlay of funds which could not be raised by the sale of the ground already occupied; nor would it be possible to erect new wards on the site of the old without serious detriment to the sick occupants, even granting that there were space enough to permit; while the argument for necessity of change is as fully applicable to the soil on which the building stands as to the structures themselves. To rebuild the whole group of wards at the same time would be impossible, without an entire abandonment of the hospital service during the time; and to renew them one by one would perpetuate the confusion, disorder, and uncleanliness, necessarily connected with the work of construction. With proper vigilance and constant care both buildings and land may alike be kept free from contamination; and solid walls, and good roofs raised on substantial foundations, permit the entire renewal of floors and plastering and other interior parts of the structures, whenever age has caused dilapidation, or other influences call for renovation; and thus all the practical advantage of new structures is actually obtained.

While thus advocating the erection of solid buildings for permanent use, it is not right to overlook the fact that there are certain cases in which it is desirable for the advantage of some patients themselves that they should be withdrawn from the general wards, and enjoy the benefit of exemption from the vitiation which is unavoidable notwithstanding the utmost vigilance and care. Temporary structures may be pitched for such cases, to which they can be removed. Such are used in some European hospitals, with great advantage for patients after amputation.

There is another class of cases which should be removed from the general wards, consisting of such as have offensive discharges, which pollute the air and render it disgusting to others. One such case interferes with the comfort of a whole ward. A neat ward in the attic of each two-story pavilion, around the central

chimneys, would furnish ample and convenient accommodation for such cases, greatly to the relief of those left in the general wards. Burns with large suppurating surfaces are peculiarly offensive, and so are cases affected with incontinence of urine. A "foul ward" for the reception of such, might well be placed in the position indicated; and the removal of such cases from the general ward would greatly promote the comfort of all others. The room need not extend beyond the square formed by the central projection; and its immediate and close connection with the stack of chimneys and flues would insure it the greatest freedom of ventilation.

The attention to hospital construction which the experience of recent events in our late civil war has excited, was anticipated by nearly a century, similar causes producing similar results. There is in the library of the College of Physicians of Philadelphia, vol. 2576, O. a copy of a pamphlet printed at Wilmington, Delaware, in the year 1813. "*Economical observations on Military Hospitals, and the prevention and cure of diseases incident to an Army, etc., by James Tilton, M. D., Physician and Surgeon in the Revolutionary army of the United States.*" Dr. Tilton was one of the first graduates in medicine of the University of Pennsylvania, and was a gentleman of great moral worth, and high social standing, and attained an enviable eminence as one of the leading medical men of his day. His account of the overcrowding of the general hospitals, during the war of the Revolution and the consequent mortality among the inmates, is very sad. He asserts that "in 1777 and 1778 at least half our army was swallowed up owing to a fatal tendency to throw all the sick of the army into general hospitals where crowds gave rise to infection and consequent mortality too affecting to mention." (page 13).

Dr. Tilton describes the expedient to which he resorted to remedy the evil; and is fairly entitled to the honor of having been the first to introduce the system of temporary hut hospitals, as distinguished from large and permanent buildings for general hospital purposes.

Dr. Tilton says (page 47), "As to the construction of hospitals "I would observe that wood above all other materials of which "they are made, retains infection most permanently. Wooden "houses therefore, and especially wooden floors should be

"avoided. Earthen floors are best, and *tents* are better than "sheds or wooden houses. . . . . The surface of a tent floor "may be scraped off, or a new covering of fresh earth may be "spread over it, as often as occasion may require, or, what is "still more expedient, a tent may be removed to a fresh surface "as often as you please. The walls of a tent may be sluiced "with water and thus freed from all infection as often as you "shall think it necessary. A wooden building can not be so "cleansed. The best expedient hitherto discovered for cleansing "wooden buildings is founded on the Mitchillian doctrine, by "whitewashing. This may serve for the walls, but wooden "floors once infected are irreclaimable. The more you wash "them with water, the worse they are. You must abandon "them. Tents I should suppose would be particularly proper "in warm climates, as well as in our warm seasons. They may "be opened at pleasure so as to admit the most free current of "air. It is much easier to pitch the number of tents necessary "than to prepare houses. The number of tents also may be "proportioned to the number of sick so as to run no risk of "crowding them. I have used common horsemen's tents, and "long tents formed like the roof of a house prepared expressly "for hospital purposes. But in cold climates and winter seasons, "some better protection than tents afford, may be necessary. "In such cases the best hospital I have ever contrived was "upon the plan of an Indian hut. The fire was built in the "midst of the ward without any chimney, and the smoke circu-"lating round about, passed off through an opening about "four inches wide, in the ridge of the roof. The common "surface of the earth served for the floor. The patients laid "with their heads to the wall round about, and the feet were "all turned to the fire. The wards were thus completely "ventilated. The smoke contributed to combat infection, with-"out giving the least offence to the patients, for it always "rose above their heads before it spread abroad in the ward, "and more patients could be crowded with impunity in such "wards, than in any other I have ever tried. This was the "expedient I employed in the hard winter of 1779–80 when the "army was hutted near Morristown, and I was well satisfied "with the experiment."

Dr. Tilton gives rude wood-cuts of these hospital huts. Three

pavilions are connected together, a larger one with two smaller crossing it, one at either end, each having its own entrance and a separate fire-place. "All the air and light are let in from the "south front. . . . . .

"The walls were built of rough logs, without hewing. The "chinks were daubed with mortar made of common clay and "water only. The middle or main ward, 31½ by 19½ feet in the "clear, was assigned to febrile patients, and the smaller end-"wards, 35½ by 16 feet clear, were occupied by the wounded, and "other cases of topical affection."

We may claim for these rough structures, adapted only to the rudeness of those "times which tried men's souls," the merit of being the prototypes of the temporary barracks and hut hospitals, for which some are disposed to claim advantages over well-built and properly contrived structures of permanent character. Better adapted to the advance and comfort of our own times, even these are suited rather to the circumstances of armies, than of settled centres of population.

Dr. Tilton's experience with regard to overcrowding, and buildings improperly arranged, was similar to that which must everywhere follow such ill-directed efforts; and his description of the French hospital at Williamsburgh in Virginia, exhibits a condition which of necessity rendered unavailable all the science and skill of the surgeons of those forces. There was a total disregard of the first principles of hygiene, and one cannot wonder that the ravages of disease were more dreadful than those of the most deadly conflict; and that, as Dr. Tilton states, the proportion of surgeons who sacrificed their lives in the cause of their country, was greater than that of officers in the field.

GENERAL CONSTRUCTION.

Having thus presented the grounds on which a preference for permanent buildings and *pavilions* of two stories elevation is based, it will be proper to advance to the consideration of the detail of construction and administration.

The site has been determined for you by the intelligent and judicious selection made during his life by Johns Hopkins himself —a site which combines in a preëminent degree the advantages most essential to the purpose entertained: facility of access from

all parts of your rapidly growing city; elevation which lifts it above all possible future encroachment by surrounding buildings, even though the district immediately adjacent should become densely populous; proximity to that part of your city occupied by those whose pursuits and habits render them specially liable to injuries and diseases requiring hospital relief; easily accessible for those to whose professional care the beneficiaries are committed, as well as to those who are entrusted with the supervision of the administration; while the beneficent and wise direction of the munificent founder of the charity, that you shall provide in the country an appendage to the hospital proper in a retreat for those who are convalescent, will relieve you from a great embarrassment which oppresses kindred institutions, obliged to limit the number of their patients suffering under acute disease, on account of the difficulty of discharging such as no longer require active treatment, but who would lose much if not all the benefit gained, if returned prematurely to the crowded apartments and inadequate diet and attendance of their own homes or lodging-houses; and who are themselves retarded in their progress to health by the surroundings which are appropriate and necessary for those who are still sick and suffering.

It is important to secure all the advantage of elevation you possess. High as is your location, overlooking a wide extent of territory in every direction, the lots immediately east of you, separated from you only by a street of 60 feet between the curb, have for a short distance a slightly higher level. It is therefore essential that you should secure all the advantages of your own elevation, by placing the front of your central buildings on the level of your highest point, and maintain that level for all the extension of the structure. This highest point is found at the northeastern corner of your grounds, from which the descent, at first gradual, eventually becomes rapid as it approaches the southwestern corner, where a retaining wall, embankment, and terraces will be required. The entire area occupied by the buildings, except that on the south line appropriated to buildings for heating, and laundry, and other kindred purposes, which should be sunk to the level of the street, should be graded by an uniform slope, if it can be accomplished; though one terrace on a line with the southern end of the front pavilions may be admissible, or even desirable.

To secure the utmost available freedom of circulation of air for the hospital, diminish the liability to intrusion from without, and at the same time give to the neighborhood a participation in the benefit of the open space by which the buildings are surrounded, the grounds should be enclosed by a wall not more than three feet in height, surmounted by an open iron railing; the ground within being graded to the level of the top of the wall, thence rising by slopes and terraces to the highest level. The streets bounding your lot on the north and south and east are all of reasonable width, while the noble avenue lying beside your western limit has a grandeur in its breath, as well as in its extent, which renders them in comparison contracted. If possible without encroaching on the space necessary for your structures, Monument Street, which forms your northern boundary, and on which your buildings should front, should be widened to correspond with Broadway on the west. Such an abandonment of ground on the part of the hospital would not diminish the air space of the institution and might invite the erection on the opposite side, of buildings of such character, as would be attractive if not imposing. Every effort should be made by means of enclosure, grading, planting, and embellishment, to render the hospital grounds attractive in appearance, not only to the patients within but also to the neighbors surrounding; and thus to enhance the value of adjacent property and keep as far removed as may be, all sources of contamination, moral as well as physical. It is essential to secure all the advantages possible with regard to light and air. With this view not only should the buildings be placed on the highest level of the ground but should be themselves elevated above it by a lofty basement.

The greater the elevation above the surface, the more cheerful and healthy will be the wards. This consideration renders useless the direction that the rooms in the basement shall not be used for the sick. They should be, however, to whatever use they may be put, as well-lighted, as well-ventilated, and as well-finished as any other part of the building; and no wooden floor should be allowed even in those parts which may have vaults or cellars beneath them. Where there are such vaults they should be furnished with brick arches, and all the floors should be of artificial stone or well laid and smoothly dressed flags. Whether used for heating arrangements, storage purposes, or left unoccu-

pied, the windows should be large, and if left open as they should be in suitable weather, they will secure for the wards above all the advantages claimed for such as are built on open arches while they afford valuable space for various useful purposes. By closing the windows in stormy weather the warmth and dryness of the ward floor is secured.

The generous founder having with great wisdom and justice directed provision to be made for the reception of both sexes without regard to color, it is necessary, in order to meet this requirement, that there shall be at least four separate pavilions, each containing a surgical and a medical ward. Equal convenience and comfort must be secured for all; and yet economy and ease in administration demand that these buildings shall not be scattered over an unnecessarily wide extent of surface, and shall be as nearly as possible equi-distant from the centre. It is hoped the plan on which this paper is founded may meet these demands; neither crowding the buildings so closely as to impede the fullest admission of light, and circulation of air; nor rendering administration and supervision more difficult and costly by unnecessarily wide dispersion; nor giving to any one part superior advantages.

There are certain principles universally conceded which must be kept continually in view while considering any plan for the construction of a hospital; and of these the most important is that light and air are essential to life. Health cannot be maintained without either; much less can it be restored when lost, without an abundant supply of both. The freest access of both is therefore a fundamental necessity to every hospital, and other things being equal the percentage of recovery of health will be in proportion to the perfection of the arrangements for the supply of these. The great problem to be solved is the proper exposure, and adjustment to each other and to the offices for administration, of those parts of the building which are appropriated to the use of the sick, in such manner that they may all enjoy the due amount of exposure to sunlight, and receive a properly graduated quantity of fresh and pure air, uncontaminated by emanations from other sick persons; and yet be so congregated as to economise labor and time in service, and thus diminish expense.

Climatic considerations are of the very highest importance in

this relation. A structure perfectly adapted to the tropics, or to the heated term of our own summers would be wholy unsuitable to the rigor of higher latitudes, or of our winter season. The variations of climate in the temperate zone require that all dwelling houses and other buildings should contain arrangements adapted to *both extremes*. This is preëminently necessary in hospital structures.

Observation teaches us that even plants, except those of the lowest organization, do not flourish in positions which are deprived of sunlight, and of air in *motion* ; and that the conditions which favor the development and promote the growth of these are inimical to animal life. On the north exposure of buildings and of trees, these growths flourish, and the higher order of even vegetables perish.

During the winter months in this latitude the sun is wholly to the south ; and the period of the year in which his rays reach the northern side of a building at any hour of the day is very short. During the cold months of winter, and the damp and uncertain vernal season, the only breezes which can be admitted into our dwellings, whether for invalids or persons in the enjoyment of health, with comfort and safety, are those which blow from the south ; while during the rigor of winter the northern winds must be carefully excluded by every precaution that can be adopted. North walls, even if wholly impermeable to air, become so chilled by wintry blasts that it is difficult to heat apartments bounded by them. No apartments for the sick, requiring as do all such that there should be frequent changes of the atmosphere, and the maintenance of an equable and regulated temperature, should have such an exposure, unless they have also a large southern opening. In prisons it is found that the health of those who are confined in ranges of cells which have the northern exposure, is not so good as that of those in the southern ranges, and those on upper-floors are better than those on the lower. It is therefore laid down as an established principle in hospital construction, in this latitude, that the wards shall be so placed that the greatest possible proportion of their surface shall be exposed to the south, and thus receive all the benefit of the direct rays of the sun, and that even with this advantage there shall be as few *cul de sacs*, in which the freedom of circulation of air is impeded, as is possible ; and that the spaces between parallel

buildings shall have as great width as is compatible with proper concentration.

The various rooms necessary for the purposes of general administration and the residence of officers may easily be placed in a central structure, and so arranged that each shall receive a share of those influences, so essential to the life and comfort of those who occupy them, ample for those in health, engaged in active employment, and able to seek refreshment by out-door recreation. To these, therefore, the considerations so essential to the proper provision of accommodations for the sick, do not apply. It is only necessary to provide space, light, and air, in proportion to their number. The southern exposure is of less importance.

Some general remarks on the subject of construction should precede the consideration of the specific details of the parts of the building. The style of architecture is a matter of taste; the interior arrangements and adaptation of the several parts to the purpose designed, and to each other, is the point of essential importance. Still some regard to appearance and effect is due to the community; and any violation of the rules of proportion of the parts, or of the canons of taste in ornament, should be avoided. Prisons and police-stations should be made forbidding and repulsive in appearance, even though regard for the sanctity of life demands that there should be nothing detrimental to health in the interior arrangements. School-houses and college-buildings should be spacious and cheerful-looking; and so, preëminently, should be the structures designed for the reception of the sick. A hospital should have an expression of comfort inspiring a sense of repose, and tranquillity, and hope of restoration of health. The very exterior should be attractive to the approaching sufferer. Wounded men, brought to the hospital of the Protestant Episcopal Church in Philadelphia, from the terrible discomforts of field exposure, declared it was "like the approach to paradise." Too great display of ornament is out of place, not only as involving a needless expenditure of money better appropriated to provisions for the comfort of the patients, but as repugnant to the inherent sense of propriety. The style of architecture must of course be accommodated to the material used in building, and that will vary of necessity with locality, and be determined by convenience and cost. If stone be used, it should

not be so white as to be glaring to the eyes of the sick, nor so dark as to be gloomy. Whatever be the exterior, the inner walls and the lining of the outer should be of well-burned brick, well laid with strong mortar; and in order to secure entire freedom from dampness, and check the transmission of heat, cooling the wards in winter and heating them in summer, an air space of some inches should be interposed between the outer and the inner walls. The greatest vigilance should be exercised, during the progress of the building, to guard against the carelessness of workmen, who *will*, unless watched continually, fill this space with rubbish and mortar, thus defeating the object. The same vigilance over the construction of flues is absolutely required. The neglect of it has entailed serious inconvenience, and endless expense in the removal of obstructions which may impair the action of the best-contrived plans for heating and ventilation. The ignorance of some, and the indifference of others, require the unceasing oversight of an active and intelligent superintendent during the whole progress of construction. It does not do to commit this to contractors or master builders, too often careless about minor matters of detail. Obstructed flues, or wooden joists improperly placed in contact with heated flues, are too often the result of the ignorance or covetousness of builders, and can be guarded against only by the unceasing watchfulness of those who will be interested in the future success of the institution.

The greatest solidity of construction is necessary. To secure this and guard against the results of settling, the foundations should be deep, broad, and heavy, and of such material as will bear the superincumbent weight. This cannot be too seriously urged. Time should be allowed for the necessary settling before the superstructure is laid upon them.

Grading of grounds, excavation, substructures, construction of sewers and drains should be the work of one season, leaving them well protected during the winter. Another building season will be required for erection of walls, roofing in, and laying of floors. During the second winter much indoor work may be done, and preparation made for the plastering, which should be done so soon as the weather permits. This should be applied directly to the walls; be of the best materials and have what is known as the *hard polish* for the finishing coat. All joints and projections should be rounded. Wooden mouldings are wholly

inadmissible, as shrinkage will allow or form cracks and fissures, harbors for vermin and pockets for the retention of the morbid emanations and exhalations from the sick. Similar objections apply with equal force to all cornices and ornament to the ceiling, of moulded plaster. The base where the wall and floor join should be guarded by a projection of cement, and not by a wooden base strip. No projecting points or ledges, or mouldings, whether for ornament or use, can be allowed in any part of the buildings.

Proper symmetry of proportion will render ornament unnecessary. It is impossible to lay too much stress on the necessity of avoiding, in every part of the building, everything which shall have a tendency to catch dust, conceal dirt, or afford a harbor for vermin of any kind. The disgusting results of want of precaution in this respect are indescribable; to say nothing of the injurious influence on the sanitary state of the hospital.

The material and construction of the floors should command primary attention, and, to avoid shrinkage, should be purchased and subjected to the proper means to promote seasoning before the foundations are laid; and window and door frames should be put together at the same time. Soft woods, or those easily frayed or splintered, are wholly unsuited. They are defaced by the pressure of the feet of bedsteads or chairs, and liable to be scarred by the thoughtless dragging over them of a bedstead or other heavy article of furniture; so that the indiscreet act of a moment may produce permanent and irreparable mischief. Every such bruised or frayed spot becomes a pocket for the reception and emission of pestiferous contamination. The hardest and closest grained wood accessible should be secured without regard to cost; and the *utmost accuracy* in the adjustment of joints should be demanded. Costly and otherwise well constructed buildings will be rendered unfit for hospital purposes if this be neglected. One open seam or splintered edge of a joint, may become an irremediable source of contamination, in a ward otherwise without objection; and thus render useless all the expenditure of thought in contriving, and money and labor and material in construction, and make unavailing the vigilance and neatness of service.

When thus laid and *carefully* planed smooth, the floors should be imbued with oil colored with some material of a sub-

dued tone. No rugs, or floor cloth, or covering of any kind, should ever be allowed. They will, of necessity, become foul, no matter how much care is exerted to guard against it. The naked floor should therefore be made attractive in appearance. The natural color of the wood, it is true, is more pleasing to the eye, but is liable to grave objection. The remark just ventured as to the impossibility of guarding against the soiling of rugs and carpets is equally applicable to the floors. The accidental overturning a cup containing medicine, or some excretion, a wash or a liniment, which cannot always be avoided in the hurried movements often necessary, or a jet of blood from a divided vessel before it can be tied, not only produces a temporary soil, but leaves a permanent stain on a light colored floor, to offend the eye at least, even if free from other evil influence. The effort to remove the soil or efface the stain by scrubbing, diffuses an unhealthy dampness through the entire ward, especially pernicious to the occupants of the adjacent beds. *All wet cleansing is injurious*, and the necessity for it should be guarded against. Floors made of *hard* wood, and then rendered impermeable by being imbued with colored oil or wax, may be kept perfectly clean by dry sweeping, and occasional mopping with an absorbing moistened cloth, without the necessity for scrubbing, which, in careless hands, leads inevitably to the slopping pools of water on the soiled spot, every moment absorbed by the floor only to be emitted in a more subtle form of vapor contaminated by the foulness of the source of the soil to remove which the water was applied, thus diffusing more widely the evil influence. Varnish and paint, while equally effectual with the oil in preventing the absorption by the wood of whatever may be spilled upon it, are liable to objection on account of the facility with which they are worn off by the attrition of feet: not only giving an untidy appearance to the floor, but leaving the portions thus exposed unprotected, to imbibe whatever may be spilled upon them. The colored oil is more deeply imbibed by the wood than the varnish or paint; the application lasts longer without requiring renewal; and the eye is not offended by the strongly marked lines of wear.

Before any floors are laid, or plaster put upon the walls, all flues, and pipes or tubes for gas, or bell, or telegraph wires, should be fixed carefully, that there may never be occasion to raise a

board in the floor or break the continuity of the wall. It is impossible ever to re-adjust a board once raised, or to repair perfectly the fracture of the plaster coat. Applicable to every part of the building, these remarks apply with still greater force to the wards directly appropriated to the sick.

The windows should be large and rise high toward the ceiling, and descend so low toward the floor as to permit a patient lying in bed to look out of that before him without being compelled to assume any constrained position.

Some have suggested that they should open down to the floor. There are many objections to such windows. It is difficult, if not impossible, to make them so close as to exclude draughts, which are always undesirable, and under such circumstances, falling so directly on the beds, would be very injurious. While it is impossible to exclude the outer air, and most improper if possible, its admission should be under control, and not through crevices or cracks. The sashes of windows descending to the floor and rising near the ceiling, are too heavy to be easily moved, and the glass is too liable to be broken. The ward windows should be double glazed, with a space between the inner and outer panes; thus interposing a stratum of air, to interrupt the rapid transmission of heat during the cold weather. All the windows should be furnished with inside, slatted shutters, divided transversely midway in the height, and folding in several divisions longitudinally. The slats should be short and narrow, and lie well over each other, and turn in compartments on pivots. These are absolutely necessary in order to moderate excess of light, and to prevent the falling of the sun's rays directly on the beds, or even faces, of the patients.

Outside awnings of canvas, such as are used in tropical countries and are now being introduced in our own, placed during the summer at the windows of the wards, would contribute greatly to the comfort of patients. They shade the windows effectually, while they afford free access to the air. They must be removed at the approach of winter, during which all the sunlight available is required. The window seats everywhere should be of slate, polished. Wooden seats expand and contract under the drying influence of heat, and crack the plaster where it rests upon them, thus not only giving rise to an unsightly appearance, but affording harbor for vermin. They

should be wide, so as to afford suitable resting-places for flower-pots containing living plants, which enliven the appearance of the ward, and cheer the hearts of the patients. They are not liable to the objection so justly made to flowers which have been cut and formed into bouquets. These decay promptly, and communicate to the water in which they are placed vegetable juices, which undergo putrefactive fermentation and render the air impure.

One of our most distinguished surgeons in charge of a large hospital half a century ago, expressed his opinion that no hospital was complete which was not provided with a green-house, from which flowering plants should be placed about the wards and rooms of patients.

The main central building should contain all the apartments necessary for the comfortable accommodation of the various resident officers, professional and executive, and these should be provided with such liberality as shall promote the cheerfulness and health of those who, in the discharge of their arduous duties, are subject to influences depressing to the feelings, and injurious to the health. No useless expenditure upon ornament or furniture should be indulged. Here, as in the other departments of the hospital, there should be nothing requiring extra service to preserve cleanliness; nothing to occasion needless expenditure, or the employment of more servants than are absolutely necessary. The greater the number of these, the more to be fed and lodged, the greater the difficulty of preserving order and discipline and cleanliness.

The warden or superintendent, and the matron and resident medical officers and apothecary may well form one family, having one parlor and one dining-room in common, while the other employés and servants will have similar apartments in the central basement, or near as may be to the kitchen, but without being allowed access to it, except for service there. They should not be allowed to gather there to gossip and idle. A sitting-room should be provided near the refectory to which they can resort when not engaged in active duty. Ample provision should be made in the basement of this central building for the accommodation of the servants; with arrangements for ablution, bathing their persons, and for water-closets, etc. These should all be light and airy. This should be firmly impressed on the minds

of all in any way connected with hospital buildings. There should be no dark corner or closet or hole of any kind anywhere. Every brush, and pot, and pail should be kept in an open and airy room, subject to inspection at any moment. Even the closets in which clothing is deposited should have open shelves, otherwise foul articles will be shut up in them to elude observation. Dark or illy ventilated water-closets are as exceptionable in the centre building, and for the use of servants, as they are about the wards themselves. They should be abundantly provided everywhere, of easy access, and always subject to observation, that they may be kept pure. Elements of disease engendered there may be transported on the persons of officers or servants to the wards themselves and be productive of the most disastrous results.

There are four services essential to the hospital administration, each of which requires accommodations entirely detached from the wards, for which especial buildings must be provided, all as nearly central as possible. Two of these—the general supervision and the preparation and dispensing of medicines—may very properly be placed beside each other, in the main central building. The other two must each have a detached building.

The kitchen for the preparation and distribution of food must be placed as nearly as possible at the centre of the entire group of buildings to be served from it, but entirely detached from them all.

The building appropriated to the generation and distribution of heat should be placed on the central line, but beyond the extreme southern end of the most southern pavilion, on the line of a street, by which it can receive its supply of coals, and get rid of its ashes without trespassing on the grounds appropriated to the patients. It should open on the level of the street, and should have coal-bins so arranged as to permit carts to drive above them and dump the coal directly into them.

In the same building the laundry should be placed. It should have a flagged floor, and be furnished with a revolving wringer and a drying-room, for use in bad weather; but there should be also an enclosed yard, *well exposed to the sun*, in order that all clothing should be hung in the open air, and receive the direct rays of the sun whenever the weather permits. This purifies the clothing much more than mere washing, however thoroughly

done, and drying in a closed, heated chamber. Machines for saving manual labor in washing should be used, but not to the exclusion of direct application of human hands to the removal of the soils and stains. This cannot be dispensed with, however much it may be assisted by other agencies. In the same building there should be a close apartment, communicating by a flue with the furnace chimney, in which clothing, and bedding, and bedsteads may be subjected to a high degree of heat, for their purification. All these processes of purification should be conducted at this point, the furthest removed from the wards of the sick. The laundry especially, with its damp vapors charged with the foul matter removed from soiled garments and bedding, should be thus detached.

That all patients received into a hospital do not recover their health, is only in conformity with the law of mortality, to which man is subject. Some disposition must be made of the bodies of the dead. They should be removed from the presence of the living sick as speedily as possible after death has been rendered certain. A decent room should be provided in which they shall be kept till claimed by friends; and another where friends may assemble to pay the last tributes of affection and respect.

The proper place for this is in the building appropriated to heating and laundry purposes. Detached from those parts of the hospital occupied by the sick, and fronting on a street which affords ready access, it is yet withdrawn from general observation, and the bodies may be taken to it from any part of the hospital, without exposure, through the basements and tunnel connecting them with the building. Two rooms would be proper, as from so large a number of patients more than one might be lying dead at the same time. The front of this structure on the street should have nothing repulsive in its aspect.

To trace the results of disease in the bodies of the dead, and from them to seek for causes and means of prevention and cure is always an object of much interest to every intelligent medical man, and the opportunities for doing this furnished by hospitals has always been regarded one of the great benefits they confer on mankind. Properly conducted, such investigations have in them nothing repulsive, and are generally recognized as proper. The friends of those who die in hospitals have as much claim to con-

sideration of their feelings in this respect, as any other class. These feelings should always be regarded. But when properly informed of the grounds which render important such an examination, friends rarely refuse it. Some place properly constructed and furnished for the purpose is essential to every hospital. No more appropriate place can be found than immediately adjoining the rooms provided for the reception of their friends. Such rooms should be lighted in such manner as will screen the interior from the inspection of idle curiosity, and have ample provision to secure perfect cleanliness in all its details.

WARD.

Having thus gone hastily over the general arrangement and construction of the buildings required, it is proper to enter into more specific detail.

The ward into which the patients are received, and in which they are cared for, is, strictly speaking, the hospital; and a general hospital is but the aggregation of as many structures, each formed on the same type, as may be necessary to furnish the requisite accommodation for the number of patients the income enables it to support.

There is a limit to the size of a hospital; and the number of patients to be accommodated fixed by Mr. Hopkins himself, is the largest which it is wise to collect in one place and under one management. Better three or four such, scattered in different parts of a large town, than a larger number aggregated in one common institution.

These wards may be quite detached, united together on the same level, or superimposed, the one upon the other; still each is perfect in itself, and should be provided with every arrangement for the comfort and convenience and proper treatment of its inmates, as though there were no others. In describing, therefore, the plan of one, that of all is given, however many there may be.

The size and shape, and adjustment of the various parts to each other, are not subject to arbitrary arrangement, but are developed by the necessities to be provided for. They are the natural outgrowth of the demands of the institution, as decidedly as the form and structure of any living organism is the result of

its nature and wants, and provide the means of supplying them. Hence it will be found that a peculiar shape of the ward is common to all hospital plans of modern date. The variation is in the adjustment of them to each other and to the administration offices.

As the aggregated wards which compose a general hospital must be placed under the control and supervision of one warden or superintendent, and must, therefore, be grouped in such relation to each other as most promotes convenience in supervision; so, in the same manner and for the same reason, each separate ward must be under the charge of one executive officer—the nurse—who, being held responsible to the physician and superintendent for the faithful execution of all orders, must be able to observe with convenience the condition and progress of each case, in order to render such service as each may require, and to report such changes as are constantly occurring. To secure this, the arrangement must be such as brings every part of the ward into proper relation, so that each patient may be under constant observation; and while every one has a due supply of light and air, they may be so concentrated that each is ready of access.

The first act of creation, preceding the existence of living creatures, was the provision of light; and it was not until God "breathed into his nostrils the breath of life," that man "became a living soul." Life and health are, therefore, dependent on *light* and *air;* and the supply of these, with the amount of space in which they may be enjoyed, is the fundamental point around which all ward arrangements cluster. Life may be maintained without fresh supplies of food during many days, while only a few minutes' withdrawal of air is fatal; so important is this to our being; and it should never be forgotten that, in proportion to the vitiation of the purity of the air and the withdrawal of light, is the loss of life-sustaining power.

The size of the ward depends on the number of the occupants, each requiring a given extent of space and a given amount of air; and the number of occupants depends on the ability of one person, with proper assistants, to nurse them.

Under this term—nursing—are included all the various services performed for the sick under the direction of the surgeon or physician in charge. The nurse not only applies the remedies and gives the food, but regulates the temperature, and the supply of air and light, and ministers in every way to the mitigation of suf-

fering and the promotion of the restoration of health. In order that this may be properly done, it is necessary that all the patients allotted to the care of one nurse should be placed in one apartment, and not more widely dispersed than hygienic principles require; and that they should be so distributed that all shall be in sight at the same time from every point, yet not so crowded together as to encroach on the share of light and air appropriate to each, thus gendering disease instead of restoring health.

The result of most careful observation has been to lead to the conclusion already stated, that 100 square feet of floor space is necessary for every patient in a hospital, in order to secure sufficient room for the various services of attendants; and that not less than from 1200 to 1600 cubic feet of air space is required, with all the arrangements for frequent removal of the air which can be made available.

The multiplication of nurses and assistants involves not only increase of expenditure, but, what is still more to be guarded against, division and, therefore, diminution of personal responsibility. To prevent this, each ward should be capable of receiving just so many patients as can be properly cared for by one nurse. It would be impossible for one person to attend to many cases of extreme illness; nor is it desirable for the sick themselves that many severe cases should be collected together. It is more difficult to maintain the requisite cleanliness; and the exhalations from the bodies accumulate in larger quantities and are more injurious; as is proved by the higher death-rate in wards where they are thus grouped. It is therefore on every account better to distribute the more serious cases in the same wards with those of less gravity. Thus in every ward there will be collected cases of disease of various forms and different degrees of gravity, in every stage of advance and decline, and affecting persons of every variety of character, requiring varying degrees of attention, some even capable of rendering assistance to each other by minor acts of service. No fixed rule can be laid down as to the amount of attention any given case shall require, nor is it possible to divide the finite power of the nurse amid an infinite variety of demands. But of such an average of cases, experience has taught that a good nurse, with suitable assistants under her control, can care for about thirty patients. This determines the size and capacity of the ward. It must have at least thirty times the 100 square

feet of floor space, and this must be so arranged as to give also not less than thirty times the 1200 cubic feet of air space; these figures giving the minimum of each. Each patient must have an equal access of light and amount of air. To furnish these, there must be appropriate windows for every bed, and no corners or recesses for concealment.

A parallelogram of greater length than breadth presents the most eligible shape. This, therefore, has been adopted as that best suited for a ward, and the size must be such as affords the necessary space.

But there are certain adjuncts and offices which are essential to the performance of necessary services to the sick which cannot be performed at the bedside nor in the ward; and rooms for these must be so appended as to bring them into the most convenient relation to the ward proper and to each other.

To permit space for some of these, the structure of the parallelogram must be still more elongated, the addition being separated from the ward, and divided into rooms; and, in order to give the sick, especially those confined to their beds, the best advantages of light and air, they must be allowed the southern end and these offices must be added to the northern end. For other purposes, also, suitable appendages must be provided *wholly on the exterior*, yet opening out from the ward.

A nurse's apartment is of prime importance for every ward except those appropriated to children. In those, the nurse should sleep in the common ward, and thus have them directly under notice at all hours of the night and day.

The nurse's room should be large, light and cheerful, so that every opportunity for the recuperation of forces exhausted in duty, should be afforded in the hours of relaxation. This room should be immediately adjacent to the ward, and should have a window for observation opening into it. Next to this, further removed from the ward, should be a kitchen for the preparation of gruels, tea, coffee, toast, or messes of various kinds of special diet, to be furnished at irregular hours, and which cannot be provided for in the central kitchen. There should be in this a good cooking range with circulating boiler so as to supply hot water constantly for washing purposes. There should be also a sink for washing plates, and cups, and bowls, and other vessels used in supplying diet, not medicine. Those used for the latter

purpose, should never be allowed to be taken there for any purpose whatever. There should be simple open shelves on which the vessels used in conveying food to the patients should be arranged when clean. There should be no closet with doors in which anything soiled could be put out of sight for even a moment, no drawers or other places for the concealment of articles imperfectly cleansed. The remark, made when treating of general construction, upon the importance of avoiding everything which should afford harbor for vermin, is especially applicable here. No fixed table nor shelf should rest against the wall. The wall behind the sink should be guarded from soil and the slopping of foul water by a slab of glass. The floor should be of slate, or artificial stone of such composition as will neither absorb fluids spilled upon it, nor wear by attrition. If laid with slate, the flags should be joined accurately, and they should be laid securely, or they will work loose and afford holes for dust and dirt.

Adjoining the kitchen is a space in which a lift for patients may be placed, if it is thought desirable. If not used for that purpose, this affords a most appropriate position for a closet for keeping a supply of clean bed linen, which should be always at hand, and the supply should be abundant. Then comes the stairway by which the ward communicates with its fellow above or below. It must be large and well lighted and of easy grade, each step having a tread of twelve inches and a riser of six. An iron handrail attached firmly to the wall by stays at proper intervals, not let into the wall, should be provided in order to furnish support to the feeble in ascending or descending. These stairs should be of stone. Solid slate affords the best material, as it does not polish and become smooth as metal steps do, nor wear away under the tread and become uneven, as sand-stone and marble do. It has also the great advantage of having little or no capacity for absorption of water or other fluids spilled upon it.

When the stairway is made with a broad tread and easy rise, and the buildings of only two stories, patients of every kind, whether sick or wounded, may be carried up or down on stretchers, or in chairs suspended on a fulcrum between bearing-poles so that they adjust themselves to the level, with less inconvenience and suffering than by an elevator. These stairs may be made to open on the veranda, instead of into the corridor or passage,

and thus if there be no shaft for a lift, there will be no channel of direct communication between the ward below and above. When not in use the shafts are shut up and the air in them becomes stagnant, and the machinery must be kept oiled and thus promote foulness. If possible, they should be avoided. Properly constructed stairs supersede the necessity of an elevator.

These several divisions occupy the entire space on the one side between the inner or northern end of the ward proper, and the south line of the corridor by which it is connected with the other pavilions. The corresponding space on the opposite or outer side of the passage leading to the ward from the connecting corridor, affords room for a *subsidiary* ward capable of receiving some eight beds, which may very properly be used, in connection with the surgical ward, as a private operating room; and, in connection with the medical ward, for those cases which require a little more seclusion than can be found in the long ward. There should, however, be in every ward an ample supply of light movable screens, with good bases and covered with a well glazed material, which can be placed around any bed in order to secure privacy for the occupant at any time it is desirable to do so without removal.

On the north side of the connecting corridor are two rooms, separated from each other by a passage, having a window opening to the north. That on the inner side, should be used as the ward refectory, and should communicate with the basement by a small lift, *to be used only for food.* All patients who can leave their beds should be required to take their meals in this refectory, not only in order to avoid the soiling of the ward by the careless slopping of liquids or scattering of crumbs, but because it is better for themselves that they should take their meals out of the ward atmosphere. The other apartment should be fitted up as a reading or recreation room, and furnished with books and games for amusement in order to draw out of the wards all who are able to leave it.

In describing the adjuncts of the ward it still remains to speak of those exterior to it, the most important of them all—water-closets, urinals, receptacles for slops, bath-rooms, lavatories, etc.

The spaces appropriated to these purposes must be large enough to prevent any crowding; and the accommodation so ample that there shall be no necessity for the detention of any

patient waiting for an opportunity of relief. In this part of the arrangement there should be no stint—want of largeness of provision in the beginning will entail endless trouble. No patient should have any apology for not going to the water closet, who is not confined absolutely to the recumbent position. When the closets are placed at one end only of the ward the distance to be travelled from the other end is too great for a weak patient, and affords an excuse to the indolent for the needless use of vessels about the bed.

They must be so placed as to afford the most ready access from the beds, and yet be as much shut out from the area of the ward as though they had no connection with it.

To accomplish both purposes towers should be built projecting from one side of the parallelogram at either end of that part which constitutes the ward proper, shut off from the ward by light door frames covered with highly glazed impermeable material, such for instance as that known as imitation morocco, closed by springs, the doors double, with an intervening space, one door opening either way, so that one shall close as the other is opened, and that there shall never be an unbroken communication between these apartments and the ward. These should receive their light, air, and heat, each in ample abundance from sources entirely independent of the ward supply. Placed thus at either end of the ward, each range of water closets should contain at least three seats, and for each pan there should be a separate compartment furnished with a door closed by a spring. This door should be attached to the water pipe, so that the mere act of opening it shall cause the pan to be flushed freely with water, independently of the volition of the patient, who may be too weak, too ignorant, or too careless to give proper attention to this necessary act.

No part of the construction of hospitals, or of dwelling-houses, is more important, or should receive more thought in arrangement or more care in supervision than this. From defect in original construction, or neglect in subsequent attention, palaces have been converted into seats of pestilence, and hotels have sent their guests to the grave, or entailed upon them months of painful sickness or permanent valetudinarianism. In hospitals this care is especially required. The inmates are perpetually changing, and are drawn from that class of society absolutely ignorant of the necessity for care on such subjects, and reconciled by habit

to uncleanliness and foul odors. It is practically difficult, if not impossible, to convince them of the injurious influence of that to which they are accustomed; and the constant change of patients requires the unceasing repetition of the same lesson, and extension of the same care. Economy and security from obstruction is consulted by the provision of suitable material for abstersion in proper size; otherwise the pipes will be obstructed by needless quantities of paper, or insoluble masses of rags, oakum, cotton, or whatever comes most conveniently to hand.

Two separate urinals should be provided in each tower. These should be of porcelain, and not of the usual rounded shape, but so formed that the person using it must stand directly over it, and thus have no apology, indeed no opportunity, for soiling the floor. There is no odor more pervading, and few more offensive, than that due to the decomposition of the secretion from the kidneys of even healthy animals; and the urine in disease becomes charged with effete material, the putrefaction of which renders the odor insufferably abominable. No wooden floor is permissible for these apartments. Artificial stone, or well-laid slate flags, affords the best material. The wall adjacent to the urinal should be sheathed with solid glass slabs, and the floor beneath should be guarded with the same.* This is absolutely non-absorbent, but the surface of it should be frequently cleansed by a good sponge. There must be a separate receptacle for slops, lined with porcelain, of globular shape—not conical or square—provided with an ample supply of water, hot and cold, so that all vessels used to receive sputa, or other excretions or secretions, or discharges at the bedside, shall be readily cleansed, and the receptacle itself flushed freely afterward.

In an adjoining room—properly separated by a screen—should be placed the necessary arrangements for washing. Three or more basins excavated in a marble block, each furnished with a water-cock and grated outlet, are necessary at each end of the ward. There should be sufficient space between the basins to allow them all to be used simultaneously without inconvenient crowding; and the wall behind should be sheathed with glass to

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* For the use of this most appropriate material for such purposes we are indebted to the architect of the Presbyterian Hospital.

prevent the absorption of the foul water splashed against it. There should be also a fixed bath-tub, lined with planished copper coated with tin; and a movable bath-tub to be taken if necessary to the bedside of any patient unable to bear being carried to the room. The apartments appropriated to these purposes must be well lighted by windows independently of the ward; and ventilated by a separate stack of flues to be heated either by fire in the basement or by steam coils properly placed within them, or connected by horizontal flues with the furnace chimney. Every seat in the water-closet must have an opening beneath it conducting to a heated flue, so as to furnish a strong downward current beneath every pan.

Similar arrangements for the subsidiary ward should be made in the tower at the north end; which should be made so capacious as to furnish space for this independently of that appropriated to that end of the main ward. In the upper part of each of these towers there must be a room, heated by steam coils in the cold weather in order to prevent freezing, containing iron-tanks capable of holding a supply of water ample to meet the draught necessary for these several services. It is estimated that at least 4,000 gallons is necessary to meet the requirements of the eighty patients it is proposed to provide for in each pavilion.

CORRIDORS AND VERANDAS.

Wards thus constructed must be united to each other and to the main building by passages to facilitate the access of the officers from part to part, and the proper performance of the various services. Patients in various stages and degrees of sickness will also require transference from one ward to another. There must, therefore, be means of communication, and in our variable climate it is important that these shall be capable of being warmed in winter, and kept airy in the summer; and screened from the sun, and protected from the weather at all seasons. There is no difficulty in securing the fulfilment of all these purposes, without risk of obstruction of the freest circulation of air. The corridor should be wide and lofty, and the doors should be large, and open opposite to each other; and the arches should correspond in the same way, and be made as high and wide as is compatible with strength of the walls.

These should be merely strong pillars, occupying as small space laterally as possible. The arches should be glazed, with sashes to open so that the sashes of opposite windows being thrown up when the weather renders it proper, there may be a current through, and a freedom of circulation as entire as though there were no obstruction; while the closure of the doors and sashes, when necessary entirely, excludes the rain or snow. A partial opening or closure, adjusted to the temperature, is always under the control of the officers. The advantages of connection and protection may thus be secured with entire freedom of circulation.

There is still another necessity for the patients to be met. Some escape from the ward must be provided for those who are able to leave their beds; some arrangement by which they can breathe the outer air at intervals; some place to which they may resort for exercise, and where they may indulge in cheerful conversation and merriment without disturbing the repose of those who are so ill that these cannot be permitted in their immediate presence. For this purpose in some hospitals galleries have been constructed running parallel to the wards. This is an *exceedingly objectionable* position. They exclude the light and air from the wards, and not only impair the ventilation, but, opening out of the wards, receive all the impure atmosphere, and retain it; so that the patients who frequent them breathe the same air as that of the ward, only somewhat diluted. The prevalence of the habit of tobacco-smoking is also so general that the appetite for it must be indulged, and the smoke will be carried into the wards through open windows and doors, which transmit also the disturbance of noise from conversation and heavy footfalls. All these are serious objections, and render such galleries entirely inadmissible. Open verandas on the south side of the connecting corridors present every advantage required, and are not liable to these objections. On the same level with the ward floor, they are easily accessible for the feeblest who can walk, and by wheeled chairs for those who cannot but are able to leave their beds. Facing the south, they receive the full benefit of the warm sun in the winter season, and are screened from the cold winds by the closed sashes and doors of the corridors; while, during the warm season these, being thrown open, invite of course, the utmost freedom of the breezes from whatever point they blow. At all seasons, in every state of

the weather, except the most inclement, they are favorite places of resort, and patients unable to rise may be gratified in their desire to be carried there on their beds. There is no adjunct of the ward which contributes more to the comfort of the sick, or is more important in promoting the restoration of health.

A similar veranda may be provided at the south end of each ward, with a large central window opening to the floor. In this, however, smoking should be prohibited, as the fumes would be drawn directly into the ward.

A tower at the side of the south end of the pavilion, corresponding to that in which the various offices are placed, and like it occupying the space beyond the corner chimney, furnishes a small apartment, with a fireplace in the corner and a window at the one side, well adapted to receive a patient in such condition from any cause as to make it desirable to remove him from the general ward.

The wards thus constructed should be made as attractive as possible. The walls properly finished with a hard plaster, well polished, will retain their purity of color for many years, and can at any time receive a coat of paint of some subdued tone. The spaces between the windows and over the fireplaces may be made attractive by cheerful pictures or appropriate sentences of comfort and encouragement.

In furnishing, nothing should be allowed which is not absolutely necessary; and above all other considerations, the utmost care should be taken to exclude everything which may be perverted into a receptacle of any soiled garment or other source of impurity.

The bedsteads should be of iron, closely riveted and strongly but lightly framed, affording the least harbor for vermin that can be. Constantly introduced with patients brought from chambers teeming with such pests, nothing but the most extreme caution against the provision of harboring places, and vigilance in subsequent care, can protect the wards from their presence and disgusting prevalence. There should be no lockers for any purpose whatever. They cannot be kept free from insects.

The mattresses should be of the best curled hair, capable of being purified and renovated frequently; and the warmth of the patients should be secured, not by what are known as "comfortables," wadded with either cotton or wool, but by good woolen

blankets. These afford a much more healthy cover, and may be washed with more ease and less injury. Sheets and pillow-cases should be white; not unbleached, which never look clean and afford an excuse for neglect of change. Each bed should have a white overspread, not colored or checked. Every patient should have a *comfortable* chair with arms; and the width of the ward should be such as leaves a wide passage between them placed one at the foot of each bedstead, while at the same time each bed is drawn at least two feet from the wall, thus leaving a good passage at the head also. This not only facilitates access for the performance of the various acts of service, but also withdraws the patients from the influence of the currents of air which circulate around the walls, and fall from the ceiling by them. Every bed should be so placed as to afford the occupant an outlook through a window to the open sky. Windows placed opposite to each other afford this opportunity to all with their feet turned toward the middle of the ward, except those placed where the central chimney stack interferes. These should be reversed, and have the heads toward the stacks and the feet toward the windows. The grates being placed only in the north and south sides of the stack, will allow this without inconvenience.

It is important that the feet of the bedsteads should be finished with smooth rounded knobs, or be set in turned wooden receptacles. They must not be mounted on castors, which allow them to roll improperly under the movements often necessary in rendering various services to the patients; and, if not thus mounted, rough feet fray the floor. Castors coupled in pairs by bars the length of the width of the bedsteads, and well guarded by rubber tires, should be provided to slip on the feet of bedsteads, when it is desired to roll a patient from one part to another of the same ward, or to another. Such an arrangement renders useless the more complicated and troublesome apparatus sometimes provided for such purposes. The less complicated the various appliances are, the better. They are more easily kept clean and in working order, and are less disturbing to nervous invalids.

All vessels of every kind and for whatever use should be of porcelain or glass. They are more liable to breakage, it is true, and more costly; but it is impossible to prevent the indentation of metal vessels by careless handling, and the consequent break-

ing of the coat of tin; exposing some portion of the iron to corrosion, and rendering cleanliness impossible.

There should be a liberal provision of movable screens which can be adjusted at will around the bed of any patient for whom it may be desirable to provide privacy for any purpose for a short time, or whose condition may be such that the sight of it would be injurious to others, such, for instance, as hemorrhage or convulsions. A dying patient may thus be withdrawn from general observation with no shock to his own sensibility, and great relief to the feelings of others. Attendant friends may be thus protected from needless exposure of their feelings, and religious rites may be performed for which privacy is required.

These screens should be light but strongly framed, and covered with the same material mentioned in connection with the doors.

If the purity of the atmosphere be, as is confessed by all, the one essential for success in the treatment of the sick, every means for the preservation of this purity is of the highest importance. In the language of Mr. Simon, Medical Officer to the Privy Council of Great Britain, already quoted but worthy to be repeated here:

"That which makes the healthiest house, makes also the "healthiest hospital; the same fastidious and universal cleanli-"ness, the same never-ceasing vigilance against the thousand "forms in which dirt may disguise itself in air, and soil, and "water, in walls, and floors, and ceilings, in dress, and bedding, "and furniture, in pots, and pans, and pails, in sinks, and 'drains, and dirt-bins. It is but the same principle of manage-"ment, but with immeasurably greater vigilance and skill; for "the establishment which has to be kept in such exquisite per-"fection of cleanliness, is an establishment which never rests "from fouling itself; nor are there any products of its foulness "—not even the least odorous of such products—which ought "not to be regarded as poisonous."

The removal of soiled garments, bed-linen, and dressings is therefore a subject preëminently entitled to attention. I shall never forget the expression of a Ward Sister in a London Hospital, whose ward presented a pattern of purity, who in reply to the question how often changes were made, answered with a

smile of astonishment at the simplicity of the questioner, "as often as they are required."

How shall the soiled garments be disposed of? No place should be allowed in the construction of a ward in which they can be deposited even for a moment. They become "a stercoraceous heap," as offensive and pernicious as that collected at the outlet of a sewer. In connection with that water-closet of each ward nearest to the laundry, and most removed from the lift by which food is supplied, there should be a shaft, the walls of which should be glazed with the most solid and impermeable plaster coat and painted, in which a lift shall descend from the ward to the basement. Each ward should be furnished with a box lined with copper, and provided with a closely-fitting lid, mounted on wheels or castors shod with vulcanized or rubber tires, which can be run to the foot of each bed at the time changes are made, in which soiled articles shall be deposited and drawn at once to the opening of the shaft, and the box with closed lid sent to the basement, and thence immediately to the laundry. They should not be allowed to tarry a minute by the way. The metal-lined box can be scoured and exposed to the air and sun for purification, as is done with dairy vessels, where similar causes demand similar attention to the absolute removal of every particle which can produce contamination. The usual mode of gathering the soiled garments in baskets or in the arms, and carrying them through the wards and down the stairways, diffuses the foulness and disseminates the seeds of disease. But even this, disgusting and improper as it is, is preferable to the sluttishness of throwing them loosely down a shaft, contaminating the walls by their contact in descent, and then lying at the bottom to undergo at least the incipient stages of putrefactive change, and send the poisonous influence through the shaft back to the ward.

The same shaft and lift will afford conveyance also for coal and ashes to and from the ward, thus separating all crude and refuse as well as all foul material as far as possible from the ward kitchen and the lift to the ward refectory, and saving the stairways from soil and the atmosphere from pollution.

BASEMENT AND ITS USES.

A lofty, enclosed, well-lighted and well-ventilated basement should underlie every part of a hospital. Where the necessity of keeping the proper level requires that any portion of it should be sunk below the surface, it should there be surrounded by a wide area, bounded, not by a perpendicular wall, but by a sloped embankment; and the drainage from this area to the sewer should be such that no pools of water could be collected during rains, and that the foundations and walls of the building shall be kept perfectly dry. No wooden floor should be allowed in any part of the basement. Good flags, or artificial stone made not with asphalt but Portland cement, that which is imported, well laid on a good foundation bed of furnace clinker or other dry material, should be used; and the walls should be plastered with hard polish, and finished with as much care as those of the wards.

Though the basement, however elevated and dry and well-lighted, and even when provided with vaults beneath it, is unsuited for use for general disease, there is one class of cases, continually presenting themselves in hospitals, which can be treated with more safety to themselves, as well as with less disturbance to others in rooms placed there. Mania à potu, a disease frequently developed in those of inebriate habits by the shock of injury, requires some arrangement for seclusion, not only for the sake of the other patients in a ward who are disturbed by such cases, but for the protection of the poor victim himself. Under the influence of the wild apprehensions of the delirium they not infrequently throw themselves from windows; a terrible catastrophe which is averted by placing such patients in a basement room. A general hospital must have such provisions for security, or render itself liable to the penalty due to neglect of proper care.

Rooms are also necessary for vapor and other forms of medicated baths, which cannot be administered either in the wards or bath-rooms without annoyance to the other patients. The basement affords the proper place for these also.

Store-rooms for the preservation of splints, and implements of various kinds for the use of the sick, when not in actual service,

are necessary, and will be more conveniently placed in the basement than in any other part of the buildings; and closets for the reception of the clothing of patients, which must not be allowed to accumulate in the wards, provided with receptacles in which those of each, properly marked, can be kept separate, will demand much room which cannot be given elsewhere. Store rooms of various other kinds are necessary, and offices in which many duties may be performed.

The kitchen and its appendages, though not placed under any part of the buildings, should be on the level of the basement, which should extend from it as from a central point beneath every pavilion, in order to allow the most prompt and convenient distribution of food to each, without the deteriorating influences of delay or exposure. The requisite stores of various kinds find their most appropriate receptacles and channel of distribution here. The basement should also communicate by an outlet separate from that through the kitchen, with the laundry and ash-pit, thus allowing the removal of soiled clothing or bedding to the one, and of offal of every kind to the other without being transported through wards filled with sick, or corridors communicating with them, or across grounds designed for recreation, and exposed to general observation from without.

Another sad necessity is met by the provision thus made for the removal of the bodies of the dead to the place provided for their deposit, in the same building with the laundry, till claimed by friends. They should be carried to it by the same passage as the soiled linen, bedding, etc. The grounds around the wards are thus kept free from every cause of offence to the eye or imagination of the patients, for whose use they should be made and kept as attractive as possible, while by the same arrangement everything which should prove unpleasant to the eyes of neighbors is kept out of sight.

All these advantages are sacrificed, and with no compensating benefit, where wards are raised on arches open at either side. If properly supplied with windows and doors such basements may be kept as perfectly ventilated as though the winds blew through them unchecked, while the floors of the wards are not unnecessarily chilled by the cold blasts of winter; and banks of snow driven by them, will accumulate there during the continuance of storms at least. The same attention to neatness

which is required to keep the open spaces under the wards pure and unincumbered with odds and ends of lumber, will keep the enclosed basement equally so; and in an institution superintended by a faithful warden and inspected by an active board of trustees, no accumulation of refuse material would be allowed there more than in the offices, corridors, or wards themselves. While the basement itself thus constructed communicates directly with the kitchen, a well-built, well-lighted tunnel should be constructed from the southern end of that under each pavilion, through which communication shall be maintained with the laundry and heating arrangements, and through which shall be carried all the steam-pipes, water-pipes, and gas-pipes. All these should be so laid in trunks beneath the floor of the basement that they shall be readily accessible at every point for repair or renewal; yet none of these or of the drainage-pipes, conducting to the sewer, should be laid in such a manner as will make it necessary ever to break the flagging for any possible repair. This should be guarded against in the original construction by openings at suitable places.

These basements are of the greatest value in the heating arrangements. In them should be placed the air-duct and air-chambers in which the air is heated by the radiators or coils of pipe, though this air should not be drawn from them. These chambers must be outside the wards, and nowhere but in an enclosed basement can they be properly placed.

In our climate a basement is an absolute necessity for this, if for no other reason. Practical experience will soon demonstrate its necessity for every civil hospital at least.

DRAINAGE.

Startling experiences have aroused attention to the importance of the arrangements to effect this.

A building provided with everything money can supply for elegance and general comfort, may be rendered uninhabitable by defective drainage, or an unsuspected communication with a foul sewer or cess-pool; and the purposes to which a hospital is devoted, renders this service in connection with it, one which should be provided with the most judicious and thoughtful pru-

dence, and maintained and watched with the most jealous care. If the excremental discharges of healthy action are capable of producing poisonous influences when not properly removed, how much more deleterious must be the morbid products of such various diseased organs and functions as are collected in a large hospital.

Every water-closet should be separately trapped. All drains and sewers should be laid outside the walls; and connecting-pipes, while they need the protection of walls to guard them against freezing in the cold season, should be carried to the outside drain at the nearest point.

Every pipe should be properly furnished with traps to secure absolute exemption from liability to the return of the air of the drain or sewer; and these should be so placed that access to them may be had without difficulty in case injury or obstruction of any kind should render repair necessary.

The first step toward the erection of the buildings of the Johns Hopkins Hospital should be the construction of a sewer, not within the grounds, but in the street to the south of the lot. In order to secure absolutely exemption from danger from any reflux of gases from this sewer into the drains, and to ventilate it thoroughly, a connection should be made between it and the furnace of the steam boiler in the heating apparatus, which it is proposed to place in the centre of the southern line of the lot in immediate proximity to the sewer, by which arrangement a strong draught from any point through the sewer to the furnace would be established, so that nothing could escape in any other direction. To this main sewer smaller tributaries should be laid directly from each pavilion and from the kitchen and laundry, each well-trapped. These should all be well constructed with hard brick well cemented, or good terra-cotta pipe, so that there shall be no leakage into the soil; and with such a grade as shall secure a rapid current to what flows through them.

Every possible precaution should be taken to prevent any reflux of the air from the sewer or drains into any part of the building. This is not always sufficiently attended to, and unhealthy dwellings are often caused by such neglect.

The spouts which collect the water from the roofs should discharge into the sewers. These being open at the top allow the escape of gases there at all times, except when the flow of

rain through them obstructs it. Other drain-pipes should be so connected with flues, opening above the roof as to supply similar means of escape when the falling rain interrupts it through the spouts. No part of the construction is more important, and none should secure more watchful care. The whole system of drainage should be fully planned and laid out before any further progress is made in the arrangement of the buildings. The smallest negligence or oversight may render useless the utmost cost and care elsewhere. We are told that in one of the best constructed and best managed hospitals in London, it was found that every successive occupant of two beds in one of the wards, was attacked by erysipelas. The beds, etc., were changed, but still the same result continued. On close investigation a dust-bin was found beneath these windows outside. The removal of this remedied the difficulty. After some time the disease recurred in the same location, and it was found that the dust-bin was again in use. Its permanent closure restored the salubrity of those beds—erysipelas no longer infested that spot in the ward. If the *dry dust-bin* outside thus contaminated the air, how much more active would be the pestiferous influence from a damp drain opening within the ward.

From neglect and oversight of such influences colleges have seen their most hopeful students consigned to the grave when just prepared to diffuse the blessings of the culture received in their halls; outbreaks of mortal illness among the children of schools have been found to arise from the contamination of the air due to imperfect drainage; and palaces have been converted into pest-houses.

In order to cut off all possible reflux of air from the general city sewers into which the main sewer of the hospital conducts, it should be *doubly trapped* at the point of connection.

Each pipe and drain being thus protected by a special trap, the principal sewer being ventilated by a connection with the furnace, and having also an opening to the outer air, there can be no introduction from the drains of any foul air to any part of the buildings.

HEATING AND VENTILATION.

The most important of all arrangements remains still to be considered. The proper size, shape, and capacity of a ward

admits of little debate; so that variations, and discussions about hospital plans turn more on the combination and connection of any given number of such wards, than on any modifications of the wards themselves. The temperature must be kept at the proper point, and the atmosphere must be kept pure. Miss Nightingale has expressed in terse terms, and most appropriate words, this most important truth:

"The very first canon of nursing: the first and last thing upon "which a nurse's attention must be fixed; the first essential for "the patient, without which all the rest you can do for him is "nothing; with which I had almost said you may let the rest "alone, is this, *to keep the air he breathes as pure as is the ex-"ternal air, without chilling* him." Heating and ventilation are thus inseparably connected; and every arrangement for the one must be made in due proportion and adjustment to the other. In those regions where the climate is mild and temperate, where there are no vicissitudes, and open windows and doors allow access to genial breezes which waft off exhalations, these questions have no importance. In cold regions and seasons if temperature could be maintained at the proper point without change of air, it might be done without difficulty. But the mere congregation of *healthy* persons in a closed apartment renders the atmosphere impure and incapable of sustaining life. It is not necessary in order to prove this to refer to experiments on lower animals confined in vessels from which air is excluded, nor to the fearful histories of the Black Hole of Calcutta, or the between-decks of slave and coolie ships; results due not to the mere removal of the oxygen absorbed by the vital processes connected with respiration, and the substitution for it of the carbonic acid gas thrown out in return, but still more to the accumulation of the various emanations, exhalations, and secretions which are being thrown off unceasingly from every part of the surface, internal and external, loaded with the excremental results of vital changes in the tissues. No one need seek for illustrations beyond the range of one's personal observation. If one enter an apartment of the best regulated family with all the neatness and attention to purity belonging to the highest refinement, in which several persons have slept with closed windows and doors, the air is found to be stifling and oppressive from the accumulation of these exhalations. Their retention within the system is

even more fatal than the exclusion of air from the lungs. Animals coated with an impermeable varnish perish, though there is no interruption to the respiration; a burn or scald, however slight, destroying the functions of the skin of two-thirds the surface is fatal; and we are told that a child gilded to take part in a pageant, perished from this cause before the metallic coating could be removed.

Greatly as these normal discharges vitiate the air, and terrible as are the poisonous influence they exert, when concentrated resulting speedily in fatal issues, and when less concentrated causing entire destruction of the health of those long exposed to them, as is seen in the cases of persons employed in crowded, badly ventilated apartments in various manufactures, not in themselves unhealthy; they are harmless when compared with those from the diseased organs of the sick, and the foul and putrescent sloughs and discharges from the unhealthy wounds and ulcers of the patients in a hospital ward. The prompt removal of air so contaminated, and the introduction of that which is pure is, therefore, the first consideration in its construction.

The escape of heat from any apartment, where the temperature without is lower than that within, must be the necessary consequence of the change of air; which, to maintain its purity where the contaminating influence is unceasing, must be without interruption; and as the supply of heat must be in proportion to its withdrawal, it must therefore be continuous also. The two are inseparably connected by mutual reaction. In our own climate during the warm season, there is comparatively little difficulty about ventilation. When the outer air can be freely admitted there is none. Currents created by natural forces generally supply a sufficient motive power through windows and doors, which can be thrown widely open. But there are times when the temperature without, or the inclemency of the weather even when the temperature is genial, demands the closure of all openings. During the summer and autumn months, especially the latter, we suffer from an oft-recurring condition of atmosphere in which the opening of windows and doors produces no relief; when there "is not a breath of wind" to carry off exhalations, and the air is saturated with moisture, and refuses to imbibe it from the skin, producing a sense of stifling, distressing even to those in full health, almost fatally oppressive to the sick

and feeble. Open windows and doors do not of necessity put air in motion; and without this movement of the air, the exhalations and emanations unceasingly produced by the vital processes in animal bodies, as are the odors of plants and flowers, accumulate around them and vitiate the air. The various states of the weather, and the vicissitudes of temperature necessarily associated with our varying climatic influences, require different methods of relief. When the temperature permits windows and doors to be kept open, and natural agents produce currents, these passing through the ward maintain its purity. When heat is required, or when fires can be tolerated, the most effective agency for the purification of the air and consequent motion can be put into operation. But the conditions vary greatly, and the methods of promoting change of air must be adapted to the varying circumstances. We cannot rely on any one exclusively. A well constructed hospital must be prepared to meet all changes by the various appliances adapted to each. Air, air in motion, air constantly renewed, air moderately heated, pure air, is the one central life-giving influence around which all hospital arrangements cluster themselves, and to which all are subservient.

The condition which should first claim attention is that which occurs when the temperature requires the closing of windows and outside doors. How shall the circulation of the air and its removal from the ward be then accomplished most effectually, and with least disturbance to the sensations of the patient?

One simple expedient, that earliest resorted to, and longest tried, supplying both heat and ventilation, is at the same time most effectual, and most easily applied; and when its proportions have been properly adjusted to the area to be kept pure, has always proved satisfactory.

Combustion in open fire-places connected with ascending shafts, creates a demand by the consumption of the air which is necessary for its support, which must be supplied, and causes an upward draught in the flue by the ascending force of the heat, which passes off so largely in that direction, carrying with it in addition a large volume of air. This irresistibly sets in motion that of the apartment, and causes an afflux toward the point at which it is going on of currents converging from every direction on its own plane toward the focus. The circulation of

air in an apartment thus heated has been established by actual observation conducted in a chamber the atmosphere of which was filled with floating particles which were visible so that their course could be distinctly traced.

The air is drawn along the floor toward the point of combustion. It is there warmed by radiation from the incandescent mass in the grate, and whilst one part is consumed in supporting the combustion, a very large volume is carried up the chimney under the influence of the strong draught created by it, and another portion is carried upward by the rarefaction produced by the heat, along the breast of the chimney toward the ceiling, before entering the fire. It there diffuses itself, and as it passes toward the walls, both lateral and opposite, loses some of the heat, and by the time it reaches the outer walls is chilled, and descends to the floor to be again subjected to the draught by which it is carried toward the fireplace. The observation on which this statement is founded was made in the closed chamber of a manufactory of lampblack. Now this is just what is needed, provided it can be adjusted to the area of the apartment, the air of which is to be purified; and provided a supply of fresh air equal to that which is thus consumed and carried away, can be furnished. This constitutes true ventilation, which should not be confounded with "draughts," which are not essential to it. While there is no stagnation anywhere to afford a *nidus* for the propagation of the germs of disease, there is no sensible current, unless it be at a point so near the throat of the chimney as to be harmless. In a very able paper on hospital construction presented to the British Medical Association at its meeting at Leeds, in 1869, by Capt. Douglas Galton, of the British Army, he says "the most powerful engine for ventilation for drawing out the air is the open fireplace." * * * * "Nearly seven-eighths of the heat generated by the coal in an ordinary fireplace passes with the smoke up the chimney, and carries with it out of the room a large quantity of air, amounting in even moderate-sized rooms, when the chimney is heated, to as much as from 14,000 cubic feet to 20,000 cubic feet in an hour." No statement could prove more satisfactorily the value of the open fireplace in the hospital ward. It is the removal of this amount of contaminated air to be replaced by that which is fresh and pure.

Any apartment without an open fireplace is unprovided with

the most important arrangement for the health of its occupants. A hospital ward without it, is radically and essentially imperfect. Other agencies for the preservation of the purity of the air may properly be brought into associated action, but this is the one without which all others fail. It only requires sufficient afflux to be secured from a healthy and pure source of supply through channels in which it is not vitiated in its course, and the object aimed at is satisfactorily accomplished. If the temperature permitted this constant maintenance of fire, and the size and position of the fireplaces and chimneys were properly adapted to the area of the ward of a hospital, no other agency would be needed. It possesses this most important advantage, and one peculiar to itself, that while it keeps currents in motion through every part of the air space of the ward, the final course of the air is to the point of combustion and extraction in the grate, sweeping in its progress along the floor, and about and beneath the bodies of the patients, and the beds on which they lie. The air thus carried up the chimney, must be replaced; and the supply will be drawn from corridors as well as through flues, and thus currents setting into the several wards and finding their outlet by the fireplaces will prevent the escape from the wards into the corridors of the poisoned atmosphere.

In order to secure the certainty of a sufficient draught into the ward to prevent any flow from it into the corridors, chimneys with open fireplaces should be placed in each corner of the long ward, and also a central stack in the middle of the floor of each, having a grate near the floor on the north and south faces of the central stack, and fires should be kept burning in the grates whenever the temperature permits. But the air from the corridors or other source must not be cold, or the heat diffused by direct radiation from the open fires will not be sufficient to keep the temperature of the ward at such a point as is congenial to the feelings or conducive to health. It must be warmed moderately before admission to the wards, and must be drawn from an uncontaminated source. The best mode of doing this will claim notice hereafter, attention at present being limited, as closely as the necessary connection of the topics will admit, to ventilation only.

But powerful as is the agency of the open fireplaces, we are not necessarily limited to this alone.

Other flues may well be introduced rising perpendicularly through the outer walls, and in the east and west faces of the central stacks of chimneys, having openings at the floor and near the ceiling, and each entering separately into a horizontal duct in the attic, and through it communicating with a shaft discharging through a ventilator in the roof around the central chimneys. These flues will be necessary in addition to the chimneys at those times when fires cannot be kept burning in the open fireplaces. Those near the ceilings must be closed when they are, and those near the floor should be constructed on the admirable plan introduced by Mr. Barker, of Germantown, Pa., in immediate connection with the flues for the supply of supplemental heat. Coils of pipe to be supplied with steam when there are no fires in the central chimneys, may be so placed, in connection with both the chimneys and the flues for ventilation beside them, as to secure upward currents through them at all times, and guard against descending currents. These flues in the central stack will also have the advantage of being exempt from the influence of the temperature of the out-door air, as those in the outer walls confessedly are, sometimes to the extent of producing draughts downward into the ward. To guard against this each should be furnished with a register.

But while the action of open fires thus secures entire freedom of ventilation during those periods of the year in which fires can be kept burning without inconvenience to the feelings of the patients, and the necessary additional heat can be added by warmed air admitted through chambers heated by steam coils or radiators, and ventilating flues communicating with heated chimneys lend their assistance in the maintenance of the purity of the air, other expedients are necessary to do this when fires are intolerable.

Open windows and doors, and gas jets lighted in chimneys to ensure upward draughts through them, are sufficient when the natural forces without keep the air in motion, and create currents between opposite windows or through open doors. But there are many days during the warm season when the air is perfectly still and scarcely an aspen leaf trembles in the breeze ; and others, in the autumn especially, when loaded with moisture and heated to a degree that is almost insupportable, it appears stagnated, with no motion to carry off the excremental exhalations and secre-

tions, and too much moisture to absorb them, and they hang around the person producing them with a stifling tenacity. Such days are hard to bear for the healthy and strong; to the sick and feeble they are terribly distressing.

Some method of relief for this condition must certainly be provided in every well-organized hospital.

Various expedients for producing forced ventilation have been tried—some dependent on suction, drawing the air out; and others on pressure, forcing it into the apartment in which it is to be breathed, and driving out before it what has been used.

Experience has proved them all to be unsatisfactory, with the single exception of the fan for propulsion of air through a duct communicating with the several air chambers in which the air thus propelled is warmed by the steam-coils or radiators, when heat is required, while flues in the walls and central chimneys provide a draft on the air already in the ward; such a fan should be provided in the basement. Its use would probably be unnecessary, except in the condition just described; but if it will afford relief at such times it is a most valuable apparatus. It will be readily conceded that the preservation of the purity of the air in an asylum for the insane is a most difficult undertaking. Yet by this agency Dr. Kirkbride has secured it in that department of the Pennsylvania Hospital with such unquestionable success that it is proposed to add it to the other arrangements in the general wards of that institution. It is true that there are instances in which such fans, provided when the hospitals were constructed, have never been used. They stand idle, but there is the apparatus ready for service if it should be needed. If needed and not provided the loss is a serious one. There are times when the fan will be of the utmost value.

We may now pass to the consideration of the methods of heating, which will involve of necessity some repetition.

Introduced into the wards primarily for their influence in consuming the air, and by thus creating a demand for a fresh supply promoting ventilation, open fireplaces are not less valuable also as themselves sources of heat, communicated by direct radiation so far as that reaches.

This is the most natural and acceptable mode of heating. Every one instinctively draws toward the source of heat that one may experience the gratification of feeling its direct impres-

sion, and even a low general temperature may be born with pleasure when direct heat falls upon some part of the sensitive surface. As the fires can be approached by those patients who are able to leave their beds who gather in clusters around the hearths for the sake of the enjoyment of the sensation of direct heat; and as those who are unable to leave their beds can be kept comfortable by blankets, or if necessary by warm appliances under them, the general temperature as supplied from other sources of the ward in which there are open fires may be kept at a lower degree than that which is demanded when there is no direct source of radiation accessible, and no cheering influence of the blazing hearth.

This is not an unimportant consideration. Miss Nightingale most justly condemns what she describes as a process of "under-cooking" to which too many persons are subjected by modern arrangements for heating houses without open fires, and still more frequently without any channels for the escape of heated and impure air. Bad enough for those in health and in common dwellings, it is especially injurious to the sick and feeble inmates of a hospital ward. The maintenance of an unbroken, uniform high temperature, is exhaustive of the vital force. Some fluctuations are not only congenial to the feelings, but productive of a healthy stimulus to the nerve force when kept within reasonable limits and not too prolonged or too often repeated, and regulated with discretion. These variations are most easily secured by an open fire, to which one may approach or from which one may withdraw.

Miss Nightingale says: "Nature affords air to both sick and healthy of varying temperature at different hours of the day and night and season; always apportioning the quantity of moisture to the temperature and providing continuous and free movement (of the air) everywhere. We all know how necessary the variations of weather, temperature, season, are for maintaining health in healthy people. Have we any right to assume that the natural law is different in sickness? In looking solely at combined warming and ventilation to ensure to the sick a certain amount of air at 60° F.,* paid for by contract, are we acting in accordance with physiological law? Is it a likely way to

* This point, always assumed as her standard by Miss N., is much too low.

enable the constitution to rally under serious disease, to undercook all the patients day and night during all the time they are in hospital at one fixed temperature? I believe not. On the contrary, I am strongly of the opinion—I would go further, and say I am certain—that the atmospheric hygiene of the sick-room ought not to be very different from the atmospheric hygiene of a healthy house."

There is great wisdom in these views, which should be borne in mind not only in the construction of wards and the arrangements for heating and ventilation, but should be kept unceasingly before the attention of those engaged in the administration of the wards while in use. An occasional reduction of temperature by the judicious admission of a body of fresh *unheated* air is not only agreeable to the sensations, but when not too violent or too long continued, and guarded by proper protection of those exposed to it, gives tone and vigor to the skin—relaxed by too long exposure to a high temperature—and promotes the healthy action of that most important organ and thus invigorates the entire system.

Such changes cannot be provided for by permanent arrangement, but must be controlled by the medical adviser of the sick, and effected by the discretion and under the watchful care of a prudent nurse. They are not to be confounded with draughts or imprudent exposure without proper protection. Open fires, under direct observation, facilitate the control of such changes.

But direct radiation from open fires is not sufficient to afford the warmth necessary for a large hospital ward. There must be other sources of supplemental supply, which must next claim attention.

Captain Douglas Galton, in the appendix to the essay previously referred to, describes what he calls "ventilating fireplaces, constructed on the principle of those used in military hospitals and barracks. These fireplaces are constructed in such a manner as to utilize a portion of the heat generated by the fire, and which would otherwise pass away by the chimney, in warming fresh air which is admitted into the ward; and they are, besides aiding ventilation in a remarkable degree, very economical of fuel." This fireplace consists simply of an ordinary low-down grate fixed near the hearth with the common protection of fire bricks at the back and sides. Behind this is an air chamber,

into which pure fresh air is admitted from without through a duct under the floor. An iron back above the point to which the coals are heaped, and an iron pipe passing through the air-chamber to convey away the products of combustion and the smoke, use the heat which would be carried up the chimney in warming the air in the chamber, which is then discharged into the ward through an opening in the breastwork of the chimney about halfway between the top of the grate and the ceiling. The air cannot be scorched and over-heated, as is done in hot-air furnaces and by stoves, which parch the air and not only rob it of the necessary moisture, but deprive it of its vitalizing properties. "The limit to which the heat from the fire can be so utilized will be the point at which it cools down the chimney so as to check the draught in combustion of the fuel." It is self-regulating; too large a supply of air into the air-chamber will cool down the flue and check combustion, while on the other hand, the more active the combustion the greater the amount of air thrown out through the opening into the ward, and the more active the ventilation. The warm air thus thrown out into the ward, mingles with that which ascends in front of the breast of the chimney, under the rarefying influence of direct radiation from the fire, and with it sweeps around the upper stratum of the air of the ward, is cooled as it approaches the ceiling and walls, descends by these to the floor and is again drawn toward the open fire, thus sweeping along the floor and carrying with it the exhalations and other contaminating matters held in suspension gathered around the beds, to be consumed in the fire, or carried with the products of combustion and other unconsumed matters with the smoke from the chimney-top.

But there must be still other channels through which air must be admitted to meet the demands created by the draught through the fires and up the flues; and when the outer temperature is low, it cannot be allowed to enter the ward unwarmed. It must be supplied through air chambers heated by steam coils, and these should discharge themselves into the ward near the floor, about midway between the central fireplaces and those in the corners of the wards, and also in the middle of the projection thrown out laterally opposite the central stack of chimneys. The currents thus created do not mingle, but maintain an uninterrupted circulation.

The mode of supplying the heat to the radiators or coils of pipe in these chambers, whether by hot water or steam, and, if by steam, whether by high or low pressure, is now being vigorously discussed. Hot water may be dismissed at once as not adapted to hospital use. The circulation cannot be maintained at sufficient distances from the point at which the heat is generated, and too much time is necessary in effecting changes, whether of reduction or elevation of temperature. The character of the heat supplied by steam, whether by high or low pressure, and the facility for transmission and for change are the same. The discussion therefore turns chiefly on economical points, and falls rather within the province of engineers and machinists.

The high pressure, it is believed, will furnish the requisite amount at the most distant points with the most certainty and speed, and can be regulated and altered with greater promptitude. The advocates of the low pressure claim that it consumes less fuel in the production of a given result; a most important consideration, since one of the largest items in the enormous expenditure in hospital management in our own climate is that for coals. It is well suited to private houses, where the area to be warmed is small. Placed immediately beneath the area to be warmed, and the heat which is supplied through air chambers and generally diffused supplemented by direct radiation from coils of pipe or other radiating arrangements fixed in the room to be heated, it supplies all that is required, and is admirably adapted to the service of banking houses, railroad depots, and other offices for similar purposes, where the doors are being opened continually, and persons coming and going may retain extra clothing if they require it. Ventilation is there maintained through the opening of the doors, and such apartments in modern structures contain so large an air space in proportion to the number of persons at any one time in them, that it does not become contaminated, and there is not the necessity for the circulation created by direct combustion in open fires, which has been demonstrated in hospital wards. But direct radiation, whether from coils collected in different positions or radiators of other construction, or from tubes carried around the walls, is *wholly unsuited* to ward service; especially the latter mode. Heat is diffused, but irregularly, and without

the corresponding consumption of foul air. Ventilating flues do not furnish sufficient certainty of draught, and whatever other escape may be provided, whether by ridge openings in one-story wards, or elsewhere, sufficiently capacious to carry off the vitiated air, creates too great a dispersion of the heat, and reduces the general temperature to an uncomfortable degree. To meet this, the local temperature in the immediate vicinity of the radiator must be proportionately elevated, thus giving rise not only to great inequality in the temperature of different parts of the same ward, peculiarly uncomfortable to patients confined to their beds, but occasioning also strong draughts through every opening whether of inlet or outlet. To check these, and equalize the temperature, the outlets will be closed under any other than the most rigid military discipline, and the foul air will be retained, loaded with all the poisonous effluvia. The ward will be converted into the closed air chamber of the heating apparatus. These are not mere theoretic speculations, but the results of actual observation. The "problems, to solve which you invoke the aid of experience and thoughtful judgment," are important. The solution of them is "difficult" indeed. The combination of open fires in the wards with heated air diffused through air chambers warmed by coils of steam pipes or radiators, and carried off by chimneys and ventilating flues, provides all that is required where fires can be borne. Through a large portion of the year, natural ventilation through open doors and windows is all that is required. There are periods of longer or shorter duration when a fan is necessary. One should therefore be provided. While direct radiation from steam pipes in the *wards* is thus positively condemned, it may be used with great advantage, and perhaps with economy, in corridors, basements, and offices not frequented by the sick.

FOOD; ITS PREPARATION AND DISTRIBUTION.

Diet is as important as drugs, and the proper form and mode of preparation should be as entirely under the control of the medical adviser. Both are therapeuta, and in both it should be required that the best material should be provided, the most skilful agents employed in the preparation and concoction (to

which the most convenient arrangements are essential), and that they should be presented to the patients in the most attractive guise.

Those who have visited the well arranged and well conducted kitchens of some of the oldest hospitals in the world will not soon forget the attractiveness of their bright array of culinary implements, nor the delicate and appetizing appearance of the various articles of diet prepared by careful hands specially devoted to this good work ; the truth being there fully admitted that in many cases more depends on the proper presentation of suitable nourishment to the exhausted frame than on the *farragos* of medicaments which, during the dark ages of medical science were so persistently thrust upon the debilitated organs and deranged functions of digestion. There should be no possible connection or facility of communication between the offices for the preparation and distribution of food and medicine, yet both should be central, and furnished with easy access to all the wards.

The necessity for this central position of the kitchen is universally conceded ; while the apprehension of difficulty in preventing the dissemination of the vapors and odors generated in the processes of preparation of various articles of food, not only to the discomfort of the sick, but vitiating the atmosphere of the wards, has led to the suggestion of the impropriety of placing it in the basement of even the administration buildings, and that it should be transferred to the upper story. There are many and grave objections to this change of location. An apartment adapted to such purpose for such an institution must be large, and it should be fire-proof. The prime cost of the erection of such a system of arches and masses of wall as would be necessary to render it safe would be great, and should not be needlessly incurred. But in the daily service also the labor and cost would be much increased. The consumption of fuel is great, and some mechanical contrivance for hoisting this and lowering the ashes would be requisite. All crude articles of food must be carried up and the refuse matter brought down, and the food itself when prepared must first be taken down and then distributed ; and if there be wards on the second floor, raised again to these ; thus increasing the labor and time occupied in its distribution after the preparation, and deteriorating its quality in the most objectionable manner, and to a

great degree; and rendering it less attractive to the appetite made fastidious by weakness or disease.

The basement position should therefore be retained, while careful arrangements for carrying off vapors and odors should be skilfully made by hoods over the ranges, collecting the fumes and vapors, and discharging them into the chimney.

In the plan proposed this is done by placing the kitchen beyond the south end of the central pavilion, where it has ready access to the store of fuel, and to the sewer for drainage; and from which point food can be distributed through the basements by lifts to the refectory of each ward. To facilitate this, a railway should be laid; on which a car provided with compartments surrounded by hot water, in order to retain the heat of the food should be run to each lift, and a bell in each ward refectory should be connected by a wire with the lower end of the lift, by pulling which the servant in the refectory should be apprized that the meal is ready for that ward. The vessels in which the food is placed should have covers; be made of a size and shape to correspond to that of the compartments in the car; each ward having its own, to be returned to the central kitchen for washing and scouring so soon as emptied, and should be kept scrupulously clean and bright.

Attention to food and cooking is regarded by too many as a servile office, and any interest taken in it as derogatory to human dignity. This is a most unwarrantable judgment. The healthy performance of the functions, whether moral or bodily, depends on the proper nourishment of the organs; and this upon the supply of food. If this be deficient in quantity, bad in quality, or improperly prepared, both must suffer. To attach more importance to the taste than to the nutritive properties of food is contemptible and destructive to health. Yet *taste* is an important function in the process of digestion, and may not be disregarded with impunity; and nothing can be more disgusting and repulsive to the appetite, and therefore injurious, than the sodden, badly prepared messes too often provided for sick and well, taken, if at all, with disgust: and when swallowed under the demand of the system for supply of its waste, disturbing its power by the violence done to the central organ of digestion and its numerous dependents. The care of the *cooking* of a hospital should ever be regarded as an *honorable* position, which should

secure the services of one well skilled in the art of cookery, with a sufficient number of suitable assistants, to secure the faithful and efficient performance of its duties.

ADMINISTRATION.

This resolves itself into three departments, each of essential importance, each to be conducted by independent chiefs, and yet all to be harmonized not only by consent of action, but by some recognized union as well as limitation of power.

These departments are the professional, executive, and nursing.

It will at once be conceded that no individual man can be found competent as house resident to the proper professional care of the large number of patients for whom the charity is provided, and the great variety of forms of disease which will be collected there.

If such a man existed, his talents would honestly earn, and certainly receive, a pecuniary reward far beyond any salary even the munificent foundation to be inaugurated could afford.

Whether wisely or not this is not the place for discussion, the usage has assumed the sanction of established law, that surgical and medical advice and service shall be rendered to hospitals without such compensation; and the honor of such posts is earnestly coveted, and sought after by the best qualified and most ambitious and distinguished members of the medical profession. This is surely highly creditable, since the time, thought, labor, and sense of responsibility thus devoted to the service of humanity, are taken from other fields of labor which would yield quite as large a harvest of honor with the addition of great pecuniary emolument. There is no abatement in the ranks of the profession of this disinterested desire to serve the sick and suffering; or of ambition for the renown and eminence which are the reward of well-directed hospital service. There will undoubtedly be a large force of physicians and surgeons ready to volunteer their co-operation in carrying into effect the benevolent purposes of the founder. Such service cannot be overestimated, and should not be brought into a position in which it is measured by a money standard. In a hospital of the size proposed, the duties are too onerous and demand too

great a sacrifice of time and power, to commit their performance to a smaller number than that which experience has proved practically the best proportioned; *four* of each branch. They are thus able to divide the service as is most agreeable to themselves. Some prefer a longer period of service with a smaller number of cases; and two together take service for six months and divide the wards: while others prefer the shorter term of three months and the undivided charge of all the cases presenting during that period. There are valid reasons in favor of each arrangement; but it is a matter of detail which may properly be left to the wishes and judgments of the officers themselves. However it may be arranged, the entire control and responsibility for professional treatment must rest on the surgeon or physician having charge at the time, subject only to such rules regulating consultations as shall be established in concert with the professional officers by the board of trustees.

The appointments should be made annually, with the implied understanding that changes are not to be made except by resignation, unless for some neglect of duty or other cause which should be ample to justify the attaching so grave a stigma to character as would result from such change. The occurrence of the annual elections affords opportunity for change if any good reason require it, but should never be allowed to furnish occasion to exhibit either personal favor or disfavor on any other ground than professional merit.

While the entire responsibility for the treatment of the patient must rest upon the shoulders of the attendants-in-chief, there must be subordinates to execute orders, and have charge of the medical and surgical treatment during the intervals between the visits of the physician or surgeon-in-chief, and to superintend the nursing. There is no part of the hospital service more important than this, since the efficiency of any treatment depends wholly on the faithfulness and accuracy with which it is applied. The charge of the whole could not be committed safely to one salaried officer. The duties are too arduous and conflicting; and the difficulty of accommodating himself, and distributing his service among the many cases, and under the direction of different chiefs, is too great. It would be impossible so to arrange the hours of service that one resident only should be able to attend on each physician and surgeon-in-chief in his daily visits to the

wards, nor could any one be found with the advantages of personal experience added to natural endowment of mental power and energy of character, sufficient to qualify him for such a post of duty, willing to assume a merely subordinate position, or able to keep his own opinions and usages entirely subject to those of others, some, perhaps, his juniors. Intelligent young men are better suited for such positions.

Two resident physicians to each pavilion embracing a pair of wards, one medical and the other surgical, will probably be found a judicious arrangement. If the duties to the patients are properly performed, they will require as much time and attention as can be given to them consistently with the proper study of the cases and the cultivation of medical science, the opportunity for which should be the inducement to seek the appointment. Much time would be occupied in the application of bandages, and splints, and dressings, which should be required to be done by the resident, for his own advantage as well as that of the patient. Such positions are generally in request among earnest junior members of the profession, and the selection of suitable incumbents is a matter of grave responsibility. The relations between the physician and surgeon-in-chief and the resident assistants are so intimate, and involve such responsibility, that it is proper there should be some connection of the senior officer with the selection of suitable incumbents of the junior office from among the candidates who present themselves.

The ultimate election should be in the hands of the board of trustees, but should be made from a select body of candidates, chosen from all applicants who may present themselves seeking the appointment after examination of their qualifications and merits by the medical and surgical board.

This division of the responsibility of appointment is desirable. The medical officers, sitting as a board of examiners and voting on each candidate, are preserved by the necessary reference of the ultimate decision to the board of trustees, from the perfectly natural influence of partiality each for his own pupil, while the board of trustees is only called to elect from those who have proved themselves qualified to the satisfaction of those under whom they must serve. The influences of friendship and favoritism are thus, as far as may be done, neutralized.

The resident physicians should be elected to serve at least

one year, and should be required to give some pledge to continue the full term. The time at which the service of each should expire, should be so arranged that there should always be two in office who have had six months service; and never less than two should be in the house at any moment, as patients may be brought at all hours requiring the service of more than one.

Telegraphic connection with the central police station, or a district telegraph office, should be established to facilitate the instantaneous summoning of the surgeon or physician-in-chief in case of emergency.

An honorable certificate of the fact suitably engrossed and signed by the president and secretary, should be the meed of those residents who serve faithfully the entire term for which they were appointed.

NURSES.

In this connection as subservient to the same interests the arrangements for nursing may properly claim attention. No proficiency in science, nor skill in its application by the possessor, can dispense with faithful, intelligent nursing. This faithfulness and intelligence is to be brought to bear on the case, not by proficiency in medical knowledge, but simply by that peculiar qualification which is known as "tact;" which gives superiority to those who possess it in whatever sphere of life they move. A nurse possessed of common sense and faithfulness in the performance of duty, with this tact, is greatly to be preferred to one instructed in the principles of medicine, never so thoroughly, without these.

The establishment of a "school for training female nurses" is one of the objects provided for by Mr. Hopkins. It is an important adjunct to the hospital; and if properly conducted will furnish invaluable assistance for the proper cure of the patients, and it should certainly be in the building. There is much need for practical training in the art of nursing, even in the case of those possessing a natural adaptation for the service. Gentleness and tenderness of manner may be cultivated; the proper mode of exercising control and manifesting firmness may be taught; the mode of administering medicines, of making application of dressings of various forms and kinds, of attending to the wants; of relieving the suffering produced by weariness, by

uncomfortable postures, or other causes; of changing postures and removing clothing, without exertion on the part of the patient; of simply turning or adjusting a pillow (no one who has not known by experience can conceive how much depends on the slightest properly effected change); even the bestowal of a look of sympathy or word of encouragement, are all subjects of education. Habits of personal cleanliness may be cultivated, and the best modes for preventing the necessity for too frequent changes of bedding, often attended by great suffering, or even peril to the patient, may be acquired. The more intelligent the person who is to perform the arduous and responsible duty of nursing the better. Some possess a natural intuitive "knack" for nursing; even such are not beyond improvement by instruction. They only make the best subjects for it. The worst are those who are self-opinionated, self-sufficient, and presumptuous.

To every ward there should be one good, intelligent, efficient head nurse who alone should be held responsible for the administration of remedies and the general neatness of the ward, and for the care of everything in it. She should be supplied with such assistants as are necessary; and the necessity should be determined not by the number, but by the character of the patients. It is impossible to say that one nurse is sufficient for any given number of cases, so greatly do they vary in the amount of attention each may absolutely require. The necessity is not always to be estimated by the gravity of the symptoms or the peril of life. The varieties of temper, and of susceptibility to suffering, create as much variety in the need for attendance, and cannot be disregarded. The querulous tempers of the sick are often the result and expression of the diseased condition as much as the vitiated secretions, and require not toleration only but ministrations for their cure.

The head nurse should not be required or even permitted to perform any of the rougher work. This should be done by those in training, and in some of the more offensive details by those not capable of cultivation, but possessed of physical strength. Even these should always be sober, good-tempered, and quiet.

The supervision of the nursing of all the wards should be committed to one superior, responsible to no one but the board of trustees. She should also be the principal of the training school

for female nurses directed by the letter of Mr. Hopkins. This should be in the hospital building, where its pupils will receive practical training as well as theoretical instruction, and will form a body, subject to the orders of the principal, from which assistants to the head nurses of the several wards can be detailed as need demands.

The selection at an early period of a suitable person to fill the important position of principal of the training school for female nurses and head of the nursery department, thus affording her an opportunity for receiving personal training in the performance of the duties she is to superintend in others, in the schools connected with St. Thomas's Hospital in London and Bellevue Hospital, New York, and other kindred institutions, would be a very important step toward securing efficiency in action at the first opening of the Johns Hopkins' Hospital. It is exceedingly difficult to effect changes in long continued usages. Such changes are always met by obstructions in the prejudices or habits of incumbents in possession. The need of thorough radical change in the nursing department of hospitals is generally acknowledged, and the difficulty in effecting it loudly lamented.

The chief nurse of each ward should be required to wait upon the visiting physician or surgeon, attended by the resident, in their daily visits to the bedside of every patient; there to receive and note in a tabulated book, provided with proper distribution of spaces ruled and headed for the purpose, the directions for diet and for the administration of remedies, or applications of such dressings as are delegated to the nurse's care. But in all these matters she should be subject to the authority of the resident physician in charge of the ward during the intervals between the visits of the physician or surgeon-in-chief. She should communicate with the attending physician or surgeon *only* through the resident in charge of the ward; and all directions to her should pass through this officer. The fact that the nurse has been present at the time they were given to him, and heard the directions thus given, should not be considered sufficient for her, nor be presumed to render either unnecessary or inopportune the directions of the resident to the nurse personally.

Blank forms should be furnished to the nurse for each patient, and every day, in all cases of acute disease requiring regular and

frequent administrations of doses of medicine or food. At the time of the visit of the attending physician or surgeon, the resident should be required to inscribe on this schedule, opposite to each hour, the direction for that hour, and, at the subsequent visit, the nurse should be obliged to exhibit it with a check placed at each dose given, or sign of omission if not given. Spaces should be provided in which the nurse shall record any changes in condition or symptoms which occur. These schedules, thus filled up, should be placed on file, to furnish materials for the history of the case should any development in its progress render it important to consult them. It is an important point, and if properly attended to would be productive of good results.

Night nursing is as important as that during the day, and should never be intrusted, as is too often done, to an undisciplined attendant. The number of cases requiring attention at night may be small, but they are those of gravest character, attended by the greatest risk, involving the greater responsibility, and demanding the better care. But it should be committed to other hands than those exhausted by service during the day. The health and comfort of the nurses should be as much an object of consideration as that of the patients. No labor of mind or body, or exhaustion of feeling, should be demanded which shall impair their own health. A good and faithful nurse is too valuable to be sacrificed even to her own impulse of good. The interests of the patients, too, demand this care of the nurse on the part of the managers. Weariness and consequent weakness develop nervous excitability, the influence of which is especially injurious to the sick. A cheerful, happy temper is one of the highest qualifications for nursing, and this cannot be maintained where the physical strength is overtasked and exhausted.

THE SUPERINTENDENT.

The executive department of such an institution requires a head of no ordinary endowment and culture, and the efficiency with which it is conducted will depend more upon him and his mode of carrying into action the rules they may frame, than upon the wisdom of the trustees, or the perfection of the rules themselves. Minuteness of perception and accuracy of observation must be combined with readiness to recognize the obstacles to be

encountered in the preservation of the purity of air, and of neatness and cleanliness in all the surroundings, which must be maintained at whatever cost of labor, though all the tendency of the normal action of every part of a hospital is to the production and accumulation of foulness. He must above all things possess the power of self-control, without which he will never be able to exert the command over those employed which is necessary to subordinate them to his authority. He should have such a degree of mental culture as shall render him an acceptable companion to the cultivated officers associated with him in the application to its purpose of the great design of the endowment; and yet he must be so familiar with the detail of domestic service, that he can enter with a full comprehension of what is necessary into the provision of the requisite supplies. He should have delicate sympathy with those engaged in different departments of service in the difficulties they must encounter, and yet with it firmness and decision to demand and require the faithful discharge of the respective duties of each in his several department. With *no* control over the treatment of the patients, he must be so far familiar with it, and appreciate its importance, as to provide intelligently whatever is required to carry out the practical application of the means necessary to accomplish the purposes of those who do have charge of the ministration of the remedies, and see that nursing is faithfully performed; he must have sufficient sympathy with the sufferings of the sick to listen to their complaints, and provide for the relief of any remediable inconveniences; and yet have coolness and firmness of feeling enough to resist unreasonable demands and turn a deaf ear to querulous complaints, the natural offspring of unhealthy functions, and to discriminate between those which are the result of natural imperfection of temper, and those which are the consequence of disease.

To equalize conflicting claims, to harmonize conflicting feelings, to control and bring into properly adjusted coöperation conflicting duties, to overcome difficulties as they arise unexpectedly, to suggest modes of accomplishing objects, and yet be the cheerful agent in carrying out the suggestion of others whether coincident with his own or opposed to them, requires a character combining opposite qualities in no ordinary degree.

If in union with these qualities he should have received a

medical education, he would possess an unquestionable advantage. But in that case he must lay aside all aspirations after professional honors, strictly speaking, and have no disposition himself to enter on practical duties, or criticise the manner in which those duties are performed by those to whom they are confided. The duties belonging inherently to the office of warden or superintendent would absorb all the capacity of one most perfectly qualified. It would not be in the power of any one mind to discharge them faithfully and take any part in the medical and surgical service of the house. That would be a vain attempt to serve two masters, each fairly entitled to undivided devotion of all the faculties, and like all such efforts, would result to the satisfaction of neither.

A matron or chief female officer will be necessary in addition, who should have no connection with the nursing nor responsibility for that service. She will find full occupation in the supervision of the stores of bedding, the proper performance of laundry service and repair, and the maintenance of perfect cleanliness and order in those parts of the establishment not embraced in the wards properly speaking, which should all be under the control of the head of the nursing department. There need be no conflict, the duties are distinct, and each department would tax fully the capacity of one person without combining with it those of another. The care of the kitchen and the attention to the economical provision of varieties in diet, and the proper preparation and distribution, would fall in the province of the matron; and, if well performed, would demand much skill, time, and labor. It is an important and honorable service, on the proper discharge of which very much depends, and might well be coveted by a lady, in the strictest sense of the term, possessed of culture and refinement, but with an aptitude for household duties.

ARRANGEMENTS FOR TEACHING.

It is not necessary that hospitals as such, should be used for purposes of medical instruction. They may be founded and endowed, or supported by voluntary contributions, with the proviso that they shall not be so used. That such a protection

is an advantage to the sick, no one can deny; nor that the disturbance of the tranquillity of the patient caused by making one the subject of remark of the teacher, and object of investigation by the student, is in many instances injurious, even when conducted with the most delicate address on the part of the teacher, and responded to on the part of the class by a similar regard to the feelings of the individual. On the other hand, the mode of investigating disease, the manner of making the necessary inquiries, the relations of symptoms to causes, the various details of the relations between the medical adviser and patient, can never be so well taught as by practical illustration at the bedside; and are best acquired under the guidance of an experienced practitioner. Indeed, no one, however well instructed in the theory of medicine by books and study and oral teaching, is qualified to put the principles thus acquired to practical use, without some such instruction in the art of investigating the nature of disease, and detecting its diagnostic marks, and tracing the influence of remedies applied. Very few medical students are favored with opportunities for acquiring such knowledge and cultivating the necessary tact, except as they are afforded by clinical instruction in hospitals. It is necessary that they should have it; and this necessity is recognized by the judicious founder of the hospital, who, including a medical school in the plan of his university, directs that the hospital he endows shall be thus made subsidiary to the advancement of medical science. He thus requires that, in return for the benefits he confers on the sick, and the blessings he provides for them, they shall contribute somewhat to the good of the common humanity. This he was certainly entitled to stipulate; and every patient who accepts his munificent provision for his own personal advantage is bound, by the very act, to return the service required for the benefit of others. It is but a small tribute in acknowledgment of a great boon.

The relations thus established should be guarded on the one side from offensive and oppressive intrusion, and on the other from unnecessary and selfish withholding of an opportunity for doing a great good, not to the mere student only, but through him to fellow-sufferers without limit. The teacher who would disregard the proper delicacy, or ignore the feelings of a patient, in presenting a case to a class, or subject one to fatigue and

injurious exposure in order to exhibit the symptoms or progress of disease, or the advantage derived from treatment, is not worthy to be called an instructor, and would not receive an appointment by any body of men right-minded themselves on such subjects. He could not teach nor exhibit what he did not himself possess or practise, the proper mode of treatment of the sick. It is not for a moment to be supposed that such an one would ever hold a post on the staff of the Johns Hopkins' Hospital.

It is not to be denied, however, that there are grave difficulties in the way, recognized by every properly qualified teacher, and from which he would himself desire to be protected. A class of students of medicine must embrace men of every grade of intelligence and of every variety of character. Most if not all of them are unused to consideration of the feelings which belong to sickness, and, if earnest in the pursuit of their object in life, are bent only on using every opportunity for the acquisition of the knowledge which is essential to success. Many, with the reckless indifference of the period of life at which such studies are pursued, think only of the present gratification of curiosity. To allow such motley companies to throng the wards filled with patients in every stage of disease; cluster around the beds of those whose extreme illness renders them especial objects of interest; hustle each other for places; chaff each other in sport; or weary the sick by repetition of questions to satisfy their own desire for information at the expense of the suffering of the sick, were a mortal wrong. Such invasions are also destructive of the police of the hospital. It is impossible under such circumstances to maintain order or cleanliness.

Some mode must be devised to meet the emergency; to guard the sick from improper intrusion; to afford the students the advantages which are so essential to themselves, and so important to the interests of humanity; and to save the hospital from a disturbance which is so objectionable.

The plan here proposed embraces a lecture room and operating theatre, the access to which by the medical class is entirely without the hospital, and yet so placed with regard to the general wards, that patients can be taken to it without injury to themselves; with small waiting wards attached in which they can rest till needed for illustration, or where they can remain for a time

after an operation. To the general wards only the more advanced class of students should be admitted; and those only in small bodies, properly adjusted by the attending physician or surgeon whose service they are following, so as to give them opportunities for observation without injury to the patients. The details of this arrangement should be committed to the medical and surgical staff of the house, and lie under their control, subject to such modification as they shall find expedient.

The question as to the location of the medical department of the university does not belong to the consideration of hospital arrangements, and cannot be properly discussed in connection with it.

DISPENSARY.

In considering the question of dispensary service it must first be determined whether it is to include visits at the homes of the sick, or only giving advice and furnishing medicine to those who are able to leave their homes in quest of it. It is in this latter form that it is generally connected with hospitals, leaving the other to district or general associations specially instituted, and by which it can be more properly conducted. It is in this view that it will claim attention.

It is an associated agency rather than an integral part of the hospital itself, and it would be imposing too great a tax on the time and labor of the regular staff to expect them, in addition to their ward services, to devote the necessary time and thought to the number who are drawn by the reputation of the institution to seek relief at its doors.

The abuse of charity by the resort to public institutions for gratuitous advice and assistance on the part of many who are able to make moderate compensation for the service they receive, and who by doing so lose their own sense of self-respect and become accustomed to dependence and learn to rely on it, is a subject which has demanded and received much attention in Great Britain as well as in our own country, both from the members of the medical profession and the managers of hospitals. A ready and partially justifiable apology is presented in favor of those who thus place themselves needlessly in the position of beneficiaries, in the confidence inspired in the superiority of the advice of gentlemen who have established for

themselves a reputation which has led to their receiving hospital appointments.

This ought not, however, to be accepted without careful limitation, since such parties can receive the same advice at the private offices of the same skilful practitioners, who are entitled to compensation for the toil and anxiety by which they have qualified themselves and acquired the reputation which they thus transmit to the institution they serve. Nor should the claims be disregarded of the large number of aspirants for fame and the just pecuniary reward of their exertions, who crowd the ranks of the junior members of the profession, and are entitled to a fair field in which to cultivate and exhibit their powers. The general interests of humanity are promoted by the recognition of diverse claims and due regulation of their relations to each other. There are rights to be maintained on both sides, and evils to be avoided which will attach themselves to every course of human action.

The out-door dispensary should therefore be under the charge of an entirely distinct staff of medical and surgical officers, and the access to it should be by a separate entrance; and while medicine may be drawn from the same stock, and manufactured in the same laboratory, the compounding the prescriptions of the physicians and surgeons should be the duty of a separate apothecary. The duties of the laboratory and the compounding and dispensing to the wards, will furnish full employment to the apothecary of that part of the institution, and where there is a large number of patients in the out-door dispensary, the attention to them interferes with hospital duties.

It is proposed to devote the basements of the two southern pavilions on the plan herewith submitted, to this dispensary service, with access across paved yards on the level of the street bounding the hospital on the south, entirely distinct from that to the hospital.

These basements will be elevated above the level of the ground, and will contain ample area to be subdivided into waiting-rooms for patients and dispensing-rooms, and allow a separate examination-room for each specialty into which the general service may divide itself.

It would be impossible to enter upon the discussion of the question of "specialties" in practice or in teaching. Such divi-

sions are pushed by some to an extreme which is not only absurd, but very injurious to the interests of medical science as well as those of patients. When once the medical man is thoroughly instructed in the general principles of the science of medicine, he may, and probably will, acquire greater proficiency in the application of these to one form of disease than another, and therefore, in public service or in private practice, acquire distinction in the treatment of some special form of disease. He will naturally under such circumstances turn his attention especially to that class of diseases, and this fact will in turn bring a larger number of such cases to his consulting-room. Out of this grows eminence in a peculiar line. Men who have thus acquired proficiency and reputation in the treatment of special disease, will desire appointments which will afford them a wider field of observation and a larger harvest of renown. Appointment of such men on the dispensary staff will secure proper attention to the patients seeking advice, and add largely to the efficiency of the institution. But it should not be allowed to degenerate into a position in which aspiring ambition shall seek reputation in a special plan of treatment, a mere stepping-stone to personal notoriety; to which it is quite possible to pervert it. The character for ability in the treatment of some special form of disease should have grown out of previous study and consequent aptitude.

The surgery of the eye, and of the ear, may each well be made a specialty; and so may the peculiar diseases of women, and those of children; but the great body of cases should be treated on general principles by general practitioners. Four physicians, and the same number of surgeons, should have care of these general groups of cases, one of each rendering service at stated hours daily, while one to each of the special subjects enumerated should also give daily attendance at some other hour, not only to avoid confusion among the applicants themselves, but to enable them to receive such as shall have been referred to the specialist by the general physician or surgeon. Opportunity should also be afforded to the officers on the dispensary staff, of making their cases the subject of clinical instruction to the medical class, in the amphitheatre of the hospital, on such days and at such hours as will not interfere with the lectures of the hospital staff proper.

TRANSPORTATION OF THE SICK AND WOUNDED.

This is one of the important subjects on which you solicit suggestions.

One or more vehicles, properly shaped to receive a mattress or stretcher, hung on springs adjusted to the varying weight it may be required to carry, and provided with all the appliances to limit motion, and prevent its transmission to the sick or wounded occupant, should be held in readiness; with the horses required to draw them. These should be used only when the distances are great or the weather inclement. For moderate or short distances stretchers, carried by men, may be substituted not only on account of economy of expenditure, but, what is much more important, to the great diminution of the suffering of the patient. The rude extemporized resort to the unhinged window-shutter, or door, or hard settee, properly guarded by a small mattress or folded quilts, is often to be preferred to the wheeled carriage, however carefully driven over illy paved streets, swayed from side to side in the unavoidable jostle of a crowded thoroughfare. Bearers can generally be secured with but little difficulty.

The modern application of telegraphy has provided conveniences for summoning assistance, which cannot be too highly appreciated, and of which hospitals have not been slow to avail themselves.

The hospital office should be put into immediate connection with the central police station; with the understanding that messages should be promptly transmitted through it from every part of the city, whenever an accident has resulted in injury requiring the subjects to be sent to the hospital. One of the resident surgeons should be detailed for duty in taking charge of the case, and superintending the transportation to the hospital. The well-intentioned but ignorant officiousness of benevolent spectators often suggests remedies or actions not only inappropriate, but positively injurious; and the meddlesome interference of some who claim the privilege of doctors without the qualification, is often more pernicious still. When we think of the evil effects too often resulting from such ignorant or presumptuous interference, we cannot estimate too highly the value of the timely and authoritative interposition of one who comes

prepared to take prompt measures suggested by knowledge and experience.

All the instruments required for stanching hemorrhage, or supporting an injured limb, should be despatched with the ambulance in charge of the surgeon. Limbs or lives which would be sacrificed by delay in the transportation to the hospital, or through injudicious treatment, would thus be saved.

RELIGIOUS SERVICES.

The importance of this branch of hospital arrangement cannot be over-estimated.

Considered from the lowest point of view it is evident that man's spiritual nature is as much a part of his being as his corporeal, and its appetites and disordered conditions require as decidedly supplies and remedies. Temples to the god of healing were probably the hospitals of the civilized nations unenlightened by Christian revelation. They were certainly the tokens of a sense of dependence on a higher power than human art for the relief of sickness and pain: and among all Christian people hospitals for the relief of disease have been an outgrowth of religious philanthropy. It were irrational, to say the least, to pass without consideration the intimate relation between the body and the soul, and to overlook the influence which the one exerts upon the other, and while providing for the cure or relief of the morbid states of the body to neglect the claims upon our sympathy of feelings which disturb the bodily health, and upon that ground alone, if on no higher, are entitled to demand consideration.

Religious instruction and consolation can be neither rejected nor neglected with impunity, however much the injudicious obtrusion of it may be condemned. The proper adjustment of this influence is a delicate affair, and is entitled to much thought.

Even those who under the exciting and all-absorbing influence of active pursuit of temporal business and pleasure have been most successful in banishing from their minds the thoughts of another state of existence, find that in hours of weakness and sickness, with their enforced exclusion of customary pursuits and excitements, the soul naturally realizes and dwells upon the shortness and uncertainty of the present life, and that the thought

of another state of existence will intrude, however much it may be repelled. The judicious direction of such thoughts, and the supply of the consolations of revealed religious truth, are therefore as much a humane duty as the provision of proper remedies for bodily disease, and support for bodily weakness; and the proper control over action designed to meet this state of the mind and heart of the patients is as legitimate an exercise of judgment, as that which provides and regulates the application of remedial agencies to bodily diseases. It would be as unwise to leave this without provision as it would be to open the wards for the reception of cases of disease without control over the mode or character of the treatment to be employed for cure or relief.

The importance of the subject was properly appreciated by the founder, who in his letter of instructions to the Trustees says: "It is my especial request that the influences of religion "should be felt in, and impressed upon, the whole management "of the hospital; but I desire, nevertheless, that the administra- "tion of the charity should be undisturbed by sectarian influence, "discipline, or control."

The religion of Jesus Christ, in whose divinity and offices he himself professed his faith, is beyond doubt that which he desired should permeate with its healing influence the institution he endowed; committing the control of the means by which that influence should be disseminated to the board, excluding sectarian teaching and attempts at proselytism, at the same time that he provides for the extension of the benefits of the charity to all without regard to creeds or the want of them.

The character and known views of the members of the board of trustees selected by Mr. Hopkins himself, and to whom he entrusted the carrying into application his "especial request," —men with whom he had been intimately associated for years before the selection of them for this duty,—may be looked upon as the expression of his purposes in this respect.

Some rules for the regulation of this important matter must be adopted.

That which is simplest of all, requiring no argument for its support, is, that every patient in the hospital shall enjoy, as an unquestioned right, the privilege of receiving the visits and religious services of any one he or she may select, whether a regu-

larly ordained or appointed minister of any Christian church or not; subject, however, to the consent of the medical or surgical attendant, who alone can determine how far the state of the bodily health of the patient may render such visits improper or injurious; and provided also that such visits shall not be made at times which would interfere with the discipline of the hospital.

The second rule is equally incontestable, and of universal aplication.

No service thus rendered to or performed for any one or more patients shall be conducted in such a manner as shall interfere with the comfort, or disturb the quiet of, or in any way incommode other sick persons in the ward.

The propriety of these rules will not be questioned.

The next step is on more debatable ground, and must be taken with due caution.

The interruption to the usual current of thought and employment of mind occasioned by bodily injury or sickness, presents an opportunity which should not be neglected, for the presentation to the attention of subjects of eternal interest to the soul. How shall this be done, and by whom?

The supply of Bibles, and of books of devotion, and of instruction in those points of religious belief held in common by the great body of professed Christians as represented in the board created by the founder, should be encouraged in conformity with his "especial request."

But this silent and unobtrusive influence does not meet fully the requirements of the case, and as no one authorized teacher is appointed, other agencies must be invoked for vocal instruction and ministry, and some restraint established, or irregular and antagonistic teaching will lead to improper excitement, or even give occasion to injudicious and reprehensible controversy.

In a hospital conducted on the principles of that founded and endowed by Mr. Hopkins, there can be no *written law* on this subject. It must be left to the discretion of the board of trustees, which should be represented in this relation by a committee appointed to superintend and direct this special subject. This committee should, either directly or by delegation of authority to the superintendent, regulate and control the time at which and the persons by whom visits for this purpose, may be made.

This authority to be final and without appeal, unless to the board in session.

The same committee, or its deputy, should make arrangements to secure for the benefit of the inmates, the performance of some form of public service and instruction on the day appropriated to Divine worship; such services to be held in a chapel in some part of the buildings easily accessible, and at such hours as will not interrupt the necessary routine of daily service; due notice being given to all able to attend, without the exercise of any control or improper influence, the character and duration of the service to be subject to the control of the committee, who shall have power to exclude any ministrations they may believe disturbing or injurious to the sick or convalescent.

The rules for the government of the institution relating to this subject should be well considered, and adopted before the opening of the institution, and once decided should not be allowed to become subjects of discussion.

HOME FOR CONVALESCENTS.

To a superficial observation the addition of such an appendage to the arrangements for the relief and cure of the sick appears a simple matter indeed. The more careful thought is given to the subject the more formidable becomes the array of difficulties which present themselves.

The location of such an institution is itself of vital importance. It must be on some route of public travel which shall furnish conveniences for easy access to the feeble and those in delicate health, or just emerging from the perils of acute disease. Water, with steamboats running frequently, presents the most available channel of communication, and the influence of the breezes and currents of air which follow water-courses is desirable, if a suitable and healthy site can be found on the shore.

It should be high, and there should be no marshes in the neighborhood to poison the air by the exhalations.

The distance, even by water, should not be so great as to involve fatigue in transportation, and it must be at a point with which communication is open during the cold season as well as during the summer, and must not be so remote as to render inconvenient occasional visits from the physician or surgeon who

has had charge of the case in its acute stages. The miasmatic influence which prevails on the shores of the Chesapeake and its tide-water tributaries, precludes the resort to them. Next to water, railroad communication is to be chosen. But this must be by a route affording frequent trains and stoppages, and the site selected on this must be near a station.

If a common road affords the only avenue of approach, the distance from the hospital for the treatment of acute disease must be so limited, that the probability of procuring a suitable site is proportionally diminished.

The site itself is as important as the location, and the selection of it is surrounded by as many and as great difficulties. It must not only be in a salubrious district, free from the contaminating influences of imperfect drainage and neighboring swamps, but must not be in the vicinage of any of the numerous establishments inimical to health which cluster around the suburbs of every great city. It should have a good elevation and perfect drainage, an ample supply of water, sufficient area to furnish space for outdoor exercise and amusement, with unobstructed air, and ready access to market for supplies.

The site determined, a second question at once presents itself scarcely less perplexing. Will it be proper to collect convalescent invalids without regard to age, sex, or color in one building? All are certainly included in the provision made by the founder.

During acute sickness the collection of all in one common institution is unattended by any difficulty. Is there not, however, a change in circumstances connected with returning health and vigor, which renders indiscriminate and unrestricted communications in hours of constrained idleness liable to very serious objections?—objections which would not be obviated by the interposition of territorial lines of division, nor even by the obstacles interposed by separate buildings on the same grounds. This is a subject which demands careful thought and investigation, and on which there is yet no experience in this country to guide one in forming an opinion. The separation of the sexes in detached buildings would alone involve greatly increased labor in administration and supervision, and enhance largely the cost of maintenance, which would be doubled by the distribution into separate buildings. Distinct homes for the white and colored must, of course, be designed.

There is a limit to human responsibility, and if one waits till some plan for doing good is devised, which shall be free from all contingencies which may result in evil, one may abandon every effort for the relief of the suffering which abounds in the world.

Responsibility terminates with the exercise of reasonable care to provide guards against the evils inseparable from the reception of both sexes in one house; and the same intercourse which is proper in social life, in lodging-houses and other homes for the healthy population, may well be recognized as allowable in the home for the convalescent; the cost of building and expense of support being thus greatly diminished, and the benefits proportionably extended to a larger number. Still, it is a very serious difficulty, and the only effectual barrier against the evil consequences which are inseparably connected with one common home would be the establishment of two, entirely distinct in government, and remote from each other. The original cost would be double, and that of maintenance nearly so; but it is only by this that the evils resulting from association can be wholly avoided. The saue principles of construction would apply whichever course is taken.

It is difficult to determine the proportion to the general hospital which such an appendage should bear. The percentage of recoveries to admissions would not afford even an approximate estimate. Various influences will induce a large proportion of those thus restored to desire to return to their own homes so soon as they are able to leave the wards for the sick. Duties to be performed, however imperfectly, will draw heads of families; and the indescribable charm which finds its centre in the home of the lowliest, will cause a large proportion of those who possess homes to prefer to return to them even though the material comfort, to a disinterested observer, be beyond comparison less than that offered in the convalescent home. There is in the mental and moral association a charm which may be more powerful in its attraction, if not in its health-restoring influence, than sunshine and pure air and good diet without its aid.

Then again there may be many patients discharged cured from the wards, to whom for various reasons it would not be desirable to extend further benefits. At the moment of an accident, or in the hour of sickness, all are welcomed; the profligate, the profane, and the unworthy and ungrateful.

Bad and good, incorrigibly evil, and those unwilling to submit to control, as well as those who respond cheerfully and gratefully to that which is necessary for proper order, are all collected in a hospital provided for the sick poor. To some of these it may not be proper to extend any aid, beyond that which humanity and Christian love teaches us should be extended to the unthankful and the evil as well as to the good.

Designed only for the reception of "convalescent patients," it should not be filled with chronic invalids and incurably sick, whose presence would materially interfere with the comfort and diminish the advantages of those for whose special benefit the provision is designed. Great care will be necessary to guard against this.

When these several classes of cases are eliminated, but a small percentage remains to claim the privilege of the home for convalescents. All these are considerations which claim attention, and the decision upon the questions they present must rest with the board of trustees. It is sufficient to indicate them and invite attention to their essential importance.

Perhaps twenty per cent. of the cases of admission would be a liberal estimate of the proportion for which it would be necessary to make provision in the home for convalescents, unless it be thought within the scope of the purpose of Mr. Hopkins to extend its benefits to others than those who have passed through the wards of the hospitals so generously endowed.

The requisite capacity, the location, and site having been determined, the character of the buildings next claims attention.

The same principles which govern the construction of the hospital proper are equally applicable here. Sunlight and air are the great agents whose influences are to be provided; and this must be done without stint, though with as much regard to economy of original cost of construction, and expense in permanent management, as is consistent with this provision. Should the plan of one home only, be adopted, a solid parallelogram of sufficient size to furnish the required room is the most economical form of building, the sexes being provided with separate dormitories and parlors, but being thrown into association in the chapel, refectory, and the open grounds. Any disposition to improper association would overleap whatever barrier could be interposed by placing them in different wings or even detached

pavilions, with common centre building for administration offices, and the restraint afforded by mutual observation and the more minute circumstantial supervision of the officers of the institution which would naturally result from such concentration, would be the most effectual.

The detail of arrangement of such a structure should be the subject of careful thought. It is only necessary to present the general principles which should govern the selection of the plan. The kitchen, laundry, and heating apparatus should be in detached buildings, their location in relation to the main building being subject to the nature of the grounds chosen. The kitchen must be brought into as close proximity to the refectory as possible, and the laundry be as much detached.

There should be commodious and well-aired and lighted apartments for the use of the inmates in such weather as forbids out-door amusement; and every inducement should be presented to encourage some agreeable employment of strength and occupation of time. Miss Nightingale says: "A little needle-work, a little writing, a little cleaning, would be the greatest relief the sick could have if they could do it. These *are* the greatest relief to you though you do not know it. * * * * Bearing in mind that you can have all these varieties of employment which the sick cannot have, bear also in mind to obtain for them all the varieties which they can enjoy."

The dormitories should be large and airy, and heated on the same principles as those advocated for the hospital wards. They should be common, not isolated. One convalescent should not be left alone during the night, lest there should be some need for assistance which could not be summoned. Two only should not be placed in the same apartment, lest incongruity of temper or dissimilarity of habits should involve risk of disturbance. A few private apartments should be provided for special cases whose presence in the common dormitories would interfere with the comfort of others, or for such as could pay for extra accommodations. Even these should have communicating doors, so as to permit the summoning of assistance; and there should be galvanic connection with the apartments of the nurse by which she could be summoned in case of necessity.

Refectory, dormitories, and rooms for amusement and occupation in weather which does not admit of out-door pursuits, are

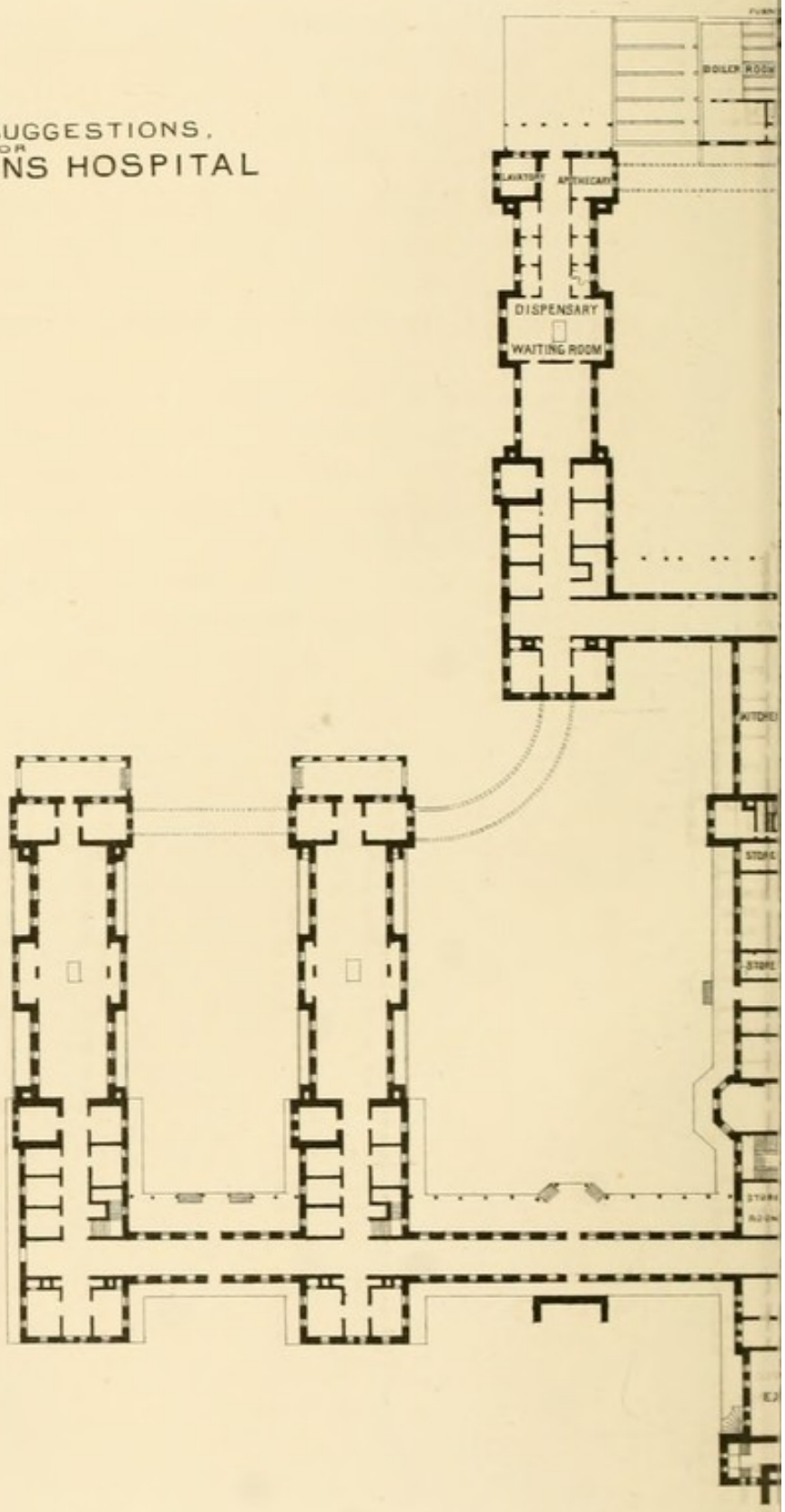
all that will be required. Food, air, and appropriate occupation are the influences which promote convalescence. No part need be set apart for the apothecary. The requisites for the comfort of a well-ordered lodging-house are all that are needed for such a home.

The objection to corridors or verandas surrounding the wards of the hospital, does not apply to such an institution, and wide piazzas or galleries should be provided, so arranged as to furnish shade during the warm season, and warmth with shelter from the wind during the cold.

No dark corners or recesses should afford opportunity for concealment; or for the accumulation of dust and dirt. Every part should be well lighted, well aired, and open to observation.

The entire charge of the administration would be most properly committed to an intelligent and experienced physician, who would be able, with the assistance of a judicious matron and proper nurses, to conduct the medical treatment, as well as the general economy of such an institution.

DR. MORRIS' SUGGESTIONS,
FOR
JOHNS HOPKINS HOSPITAL



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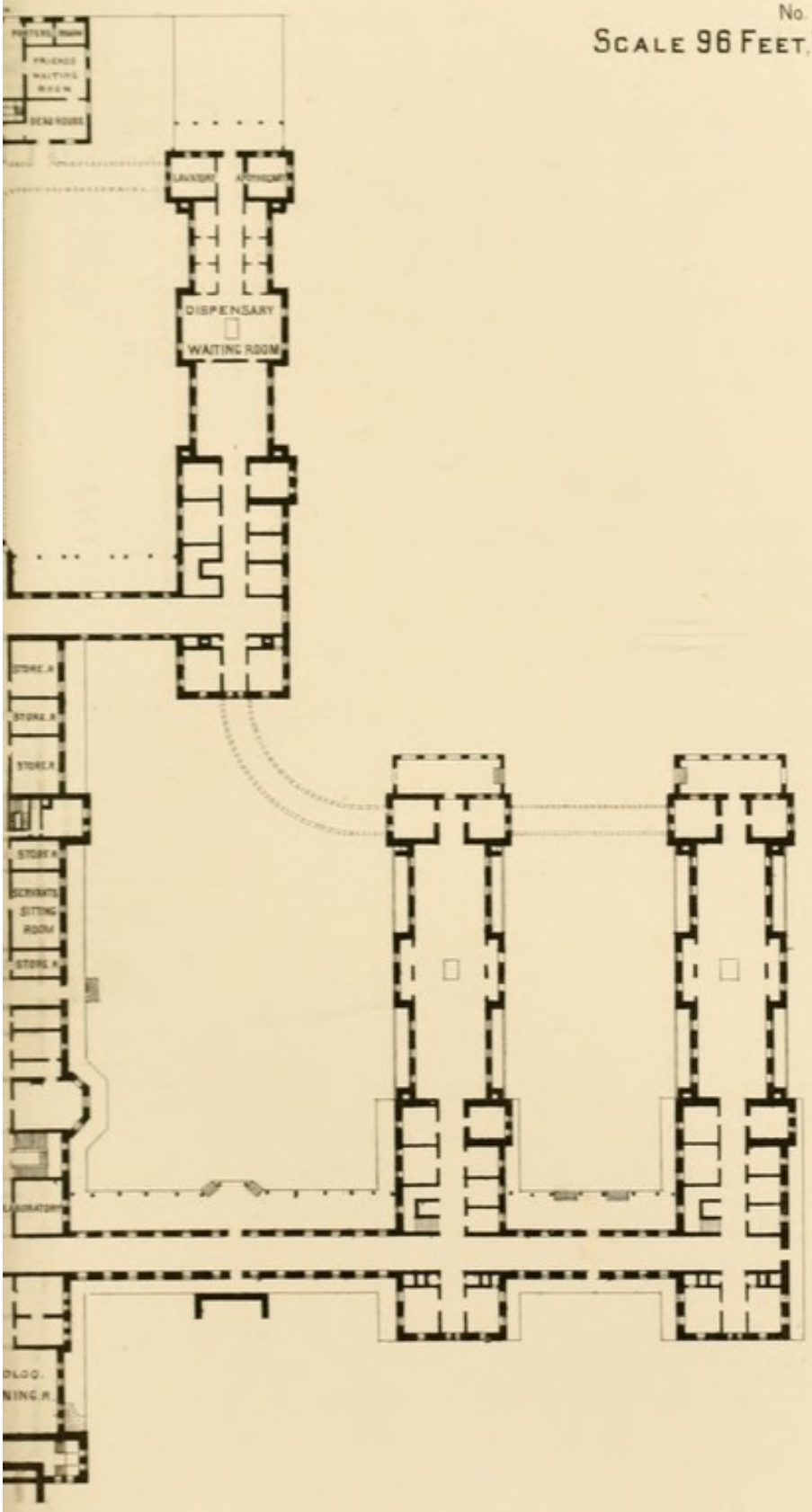

SEMENT.

DESCRIPTION OF DRAWINGS.

The entire group of buildings is composed of pavilions, the long axis of each running north and south, connected by lateral corridors running east and west, and so placed as to throw all those portions of the pavilions appropriated to sick wards to the *south* side; other adjunct apartments being projected on the north side.

They are so placed on the lot of ground, that the extreme south building (the heating house and laundry) shall be on the line of the street bounding it on the south, and at the grade of that street; and the southern end of the south range of ward pavilions shall be on the line of the north side of this building and its yard; thus providing that the north or main front of the group of buildings shall recede as *far as possible* from the north line or Monument Street, leaving space for widening said street and for ornamental grounds.

The entrance is by a gateway at the middle of the Monument Street front. At the one side of this gateway is a one-story building, containing two rooms for the gatekeeper; and at the other, two rooms of corresponding size to be used as waiting-rooms for applicants for admission; one appropriated to each sex. At either side of these buildings east and west, glass houses, fronting to the south; the one for the conservatory and the other a grape-house.

The central building is distributed to *three* services. The north end, constituting the main front of the building, is of two stories thrown into one, surmounted by a dome or other arrangement for lighting the operating apartment and lecture-room; and may be finished with flanking towers or any architectural arrangement adapted to give it character as the most prominent feature in the building. This position is important to it as the only one which affords a *north light*, which is that best adapted to an operating room.

The front entrance in this main central building is for the exclusive use of students and others attending at lectures and operations. The entrances to the hospital proper are placed in the main corridor, at either side; and should be provided with porticos or porches corresponding in style with that in the centre of the front of the main building. The front entrance,

appropriated to students, has no communication with the other parts of the hospital, in order thus to guard against any intrusion into the wards except under the restriction of rules to be adopted by the board of trustees.

The main portion of the central pavilion, immediately in the rear of the amphitheatre for lecturing, has three stories: the two lower appropriated to offices and the residences of officers; and the upper to the accommodation of the training school for female nurses, required by the plan of the founder. The rear of the central pavilion is of only two stories, corresponding with the four interior ward pavilions, and contains on the first floor two wards for children, and on the second private apartments for pay patients and for resident physicians. The main floor of the central pavilion is divided by a central passage running north and south its entire length from the north end, where it enters the lecture-room and operating apartment, on the level of the arena of the amphitheatre, to the south end, where it opens upon the corridor connecting with the two southern ward pavilions; and is crossed at right angles by the connecting corridor running east and west. It thus affords easy communication with all the wards, from which patients can be brought as illustrative cases for lectures or for operation. On either side adjoining the lecture-room are suitable apartments, lighted from the side, in which patients can wait till required to be taken in; or rest after operation till sufficiently recovered to justify removal to their respective wards; and also smaller rooms for the use of the lecturer or operator, containing cases for instruments, splints and apparatus, and conveniences for washing, etc. This central passage, running north and south, is intersected by the main corridor running east and west, upon which are strung the several ward pavilions hereafter described. To the south of this, on the main floor, on the one side is the apothecary's dispensing room, connected by magnetic wires and speaking-tubes with each ward; and on the other, the business office of the warden or superintendent. Adjoining these rises the main stairway; beyond which are parlor and dining-room for officers; and still beyond, wards for children, opening on a veranda across the south end, from which passes the gallery connecting this building with the south pavilion wards. The ward on one side being appro-

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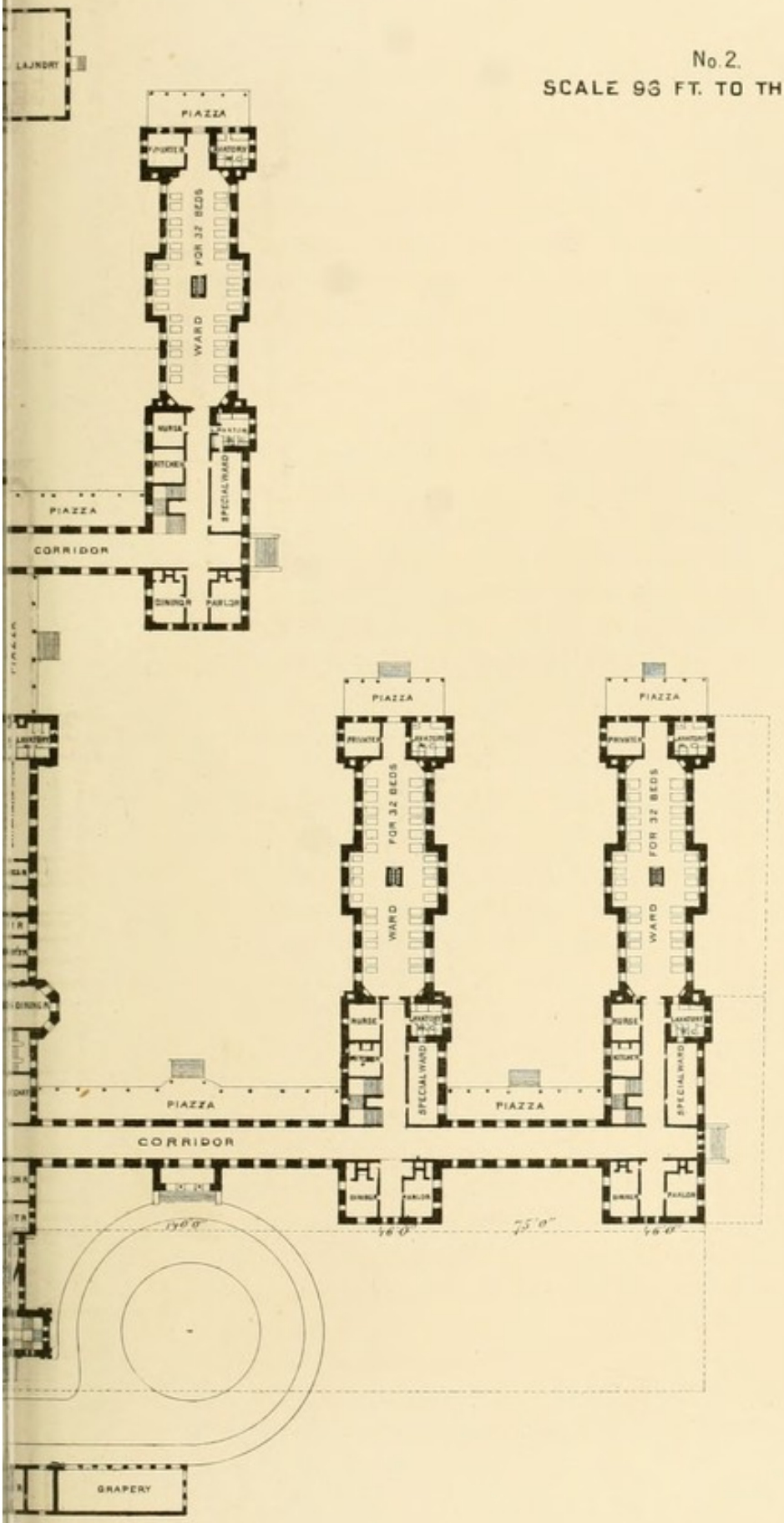

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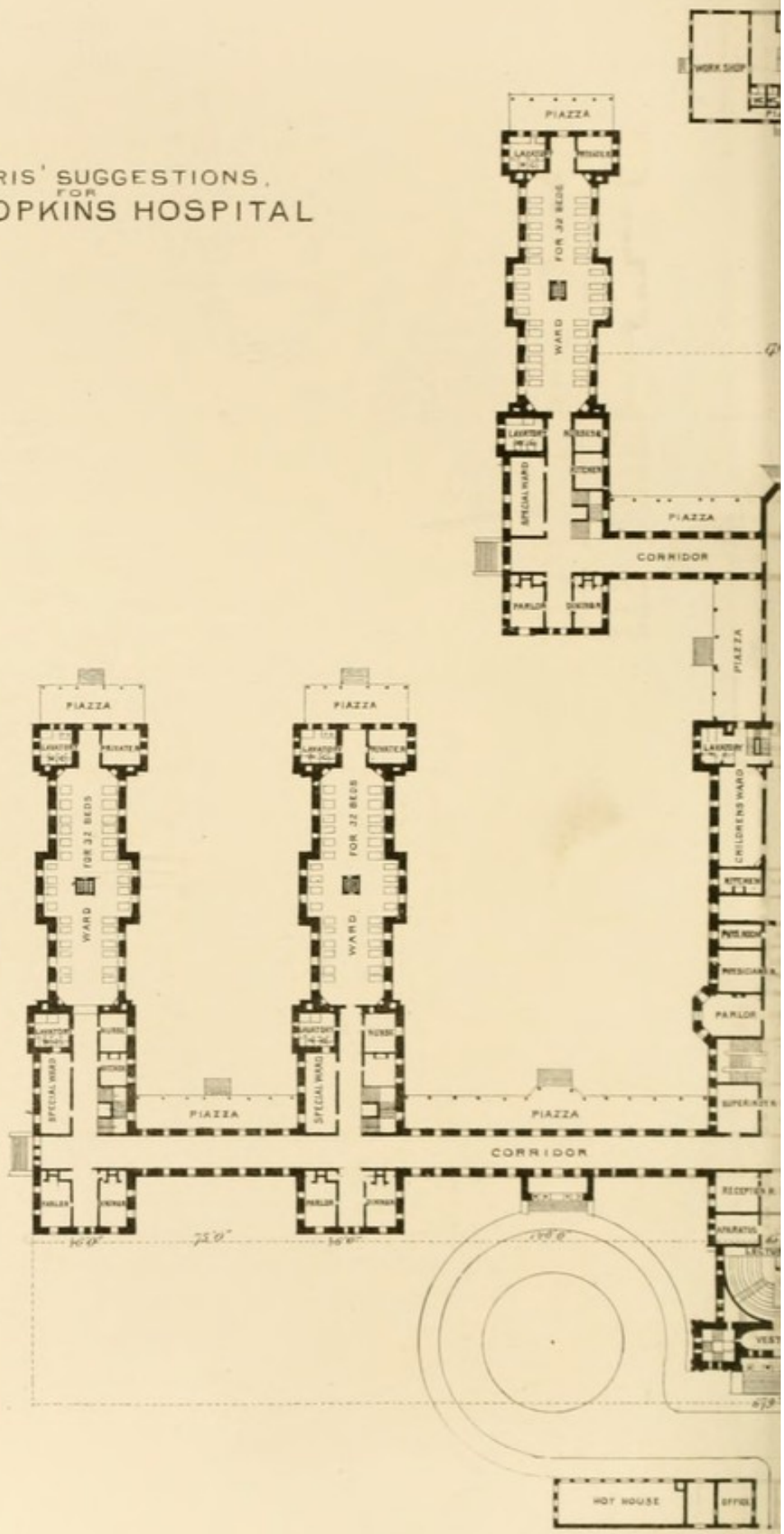
DR. MORRIS' SUGGESTIONS.
FOR
JOHNS HOPKINS HOSPITAL



PLAN OF PRIN

priated to white, and on the other to colored children. The connecting gallery passes over the roof of the central kitchen, which is thus placed at the very centre of the entire group of buildings to be supplied from it, on the level of the basement, through which it communicates with them all, without exposure of the food after preparation to the deteriorating influences of vicissitudes of weather, or delay during transportation.

In the basement, under the operating and lecture room, are well-lighted apartments of the same area as those above, communicating with them directly, which are suitable for purposes of pathological investigation; withdrawn from unnecessary observation, yet having easy communication with other parts of the building through the basement passages. The other portions of the central basement are occupied as storerooms for general purposes under the warden's apartment, while beneath that of the apothecary is a laboratory, to be made fire-proof, with a detached fire-proof storeroom for keeping ethers, alcohol, and other highly inflammable articles used in the preparation of medicines, and also wines and liquors for direct administration, which should be held as medicines and dispensed as such by physicians' prescription.

On the second floor, immediately in the rear of the upper part of the amphitheatre, the entire space occupied below by waiting-rooms and hall is thrown into one apartment, to be used as a chapel, lighted from either side, east and west, and also by windows to the north opening into the amphitheatre over the upper range of seats. It is divided from the corridor by an open screen of glass, so that this may be thrown into it if necessary.

The area on this floor south of the transverse corridor is appropriated to the various apartments for officers, and a board room and library, and to apartments for the use of pay patients and resident physicians; and the central passage terminates on a veranda running across the breadth of the pavilion. The central part of the main building has a third story in which are the accommodations for the training school for nurses.

The entrance to the hospital proper is, as before mentioned, by separate doors, protected by appropriate porticos or porches, opening into the main corridor on either side of the main central pavilion, half way between that and the two-story ward pavilions which lie parallel to it, at the distance of 140 feet on either side.

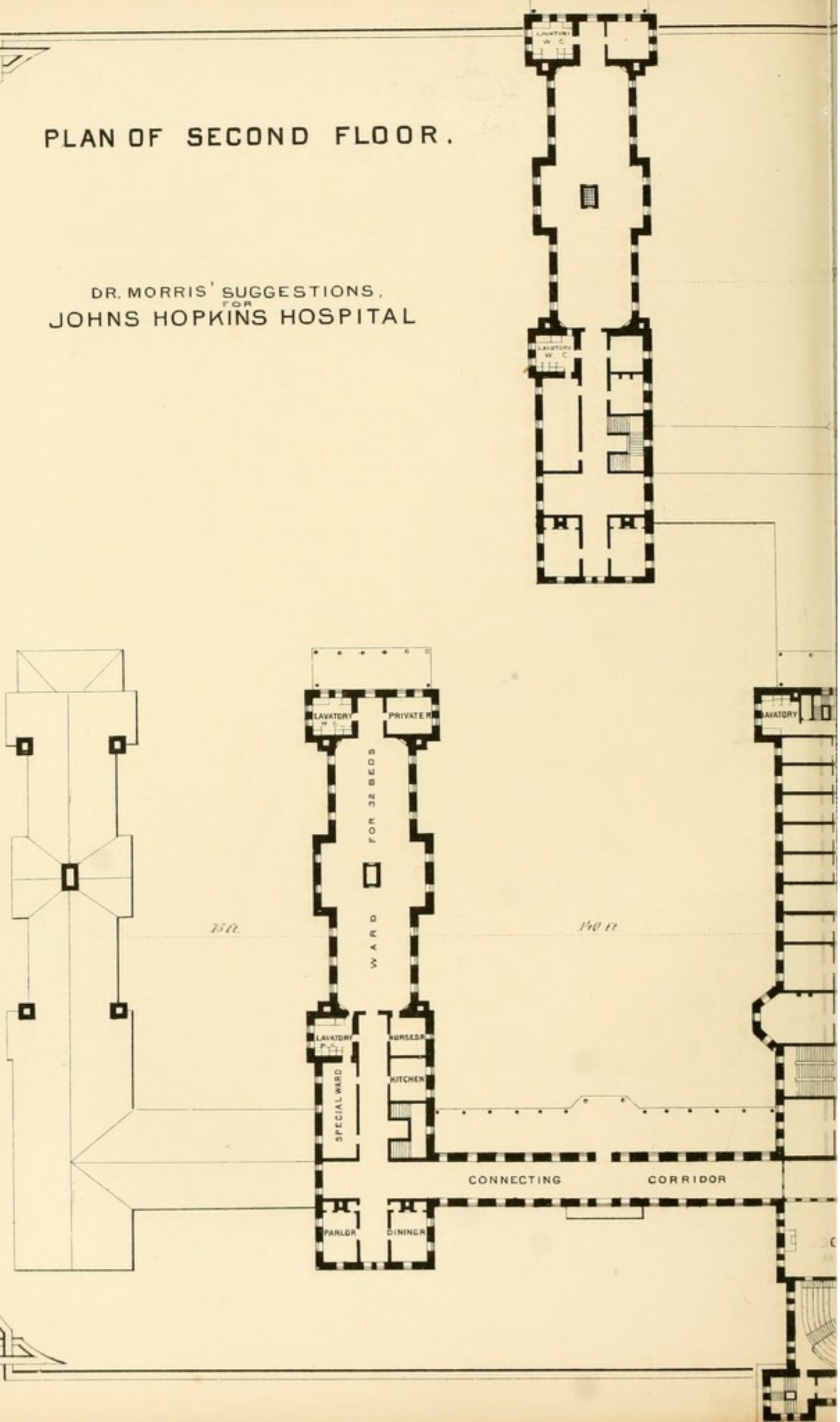
The female patients and their friends will enter at the side connected with the wards set apart for that sex, and the males and their visitors on the other, being directed to the one or the other by the gatekeeper, persons having business with the warden or superintendent being directed to that nearest his office.

Each pavilion, except the central one, is a separate and distinct hospital, perfect in itself in the accommodation furnished for the treatment of the patients. But, as all are to be brought under the administration of one common central power, it is necessary that there should be some channel of communication, which in this climate must be provided with arrangements to adapt it to use in all the vicissitudes to which we are liable of heat and cold, sunshine and storm. If the temperature were uniform and genial, there need be no covered communication, and each pavilion might stand entirely detached from all others. But some protection is required against inclement weather and extremes of temperature, whether high or low. The construction of these corridors is therefore such as to provide against both extremes. They should have the smallest breadth of wall consistent with solidity, allowing the *widest possible* space in the intervals, to furnish the freest currents of air when suitable, and be provided with glass sashes, by which the weather can be excluded when the necessity for protection requires this to be done for safety. The windows should open to the ceiling, and the doors should be large and wide, and they and the windows should be placed directly opposite to each other, that thus there may be, during the warm months, the utmost freedom of circulation of air, while, even then, protection from the sun is needed by sick and well in passing to and fro.

The pavilions next the central building on either side are two stories, those beyond but one. The corridors are, therefore, of corresponding height, those connecting the outer pavilions being only one story. On the south-side of each corridor is an open veranda of the same width. These are found by experience to be most valuable adjuncts. Sheltered from the north winds during the winter season, they receive the warm rays of the sun, and afford exercising galleries for those patients able to walk or move themselves about in wheel chairs, while morning and evening in the summer months they are shaded from the direct rays of the sun, and furnish pleasant resting-places in the open air. On the

PLAN OF SECOND FLOOR.

DR. MORRIS' SUGGESTIONS, FOR
JOHNS HOPKINS HOSPITAL



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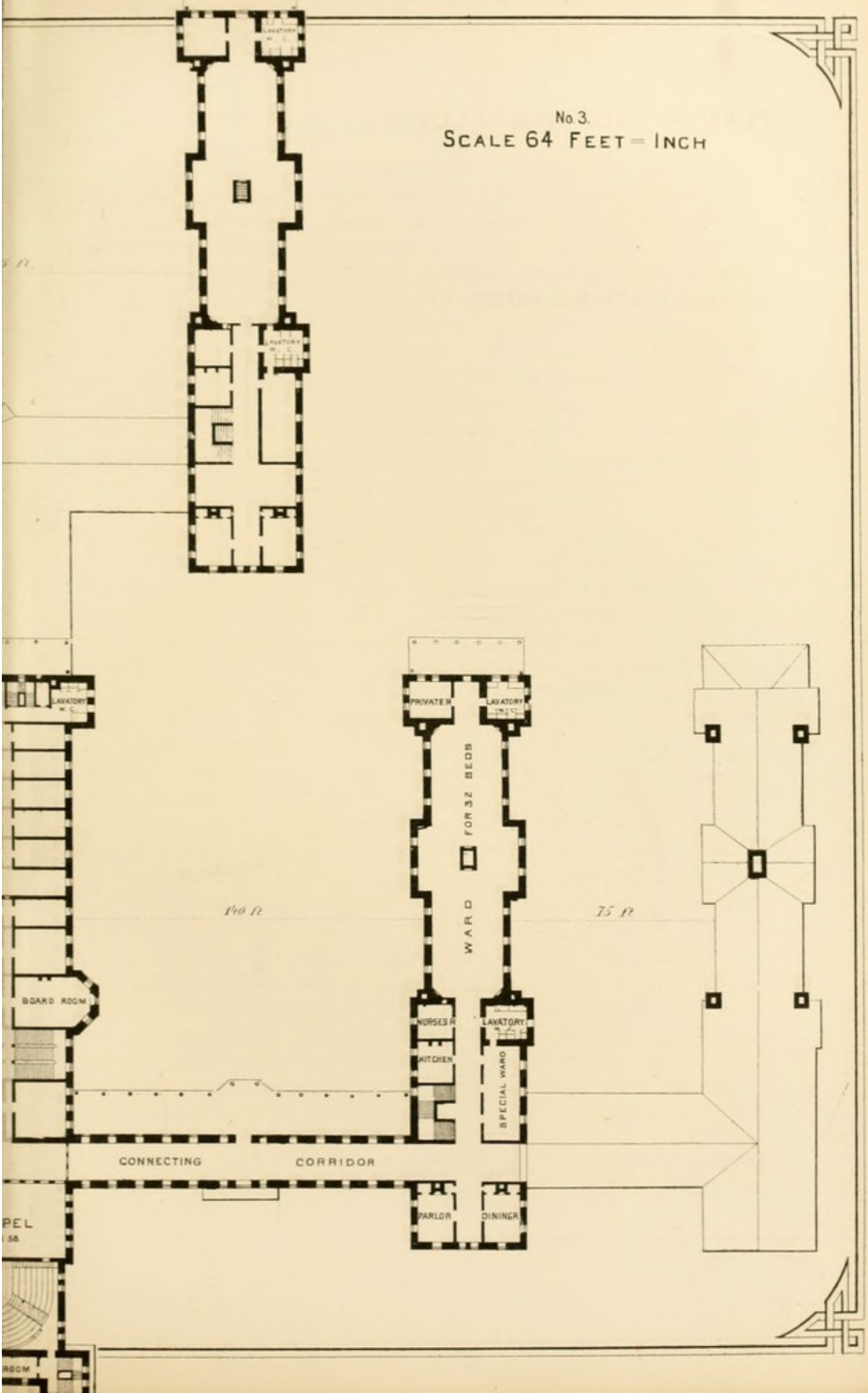

same level with the wards, they are easily accessible from them; and yet do not serve, as galleries around them would, to exclude the light and confine the air of the ward, nor are they subject to the deleterious influence of the poisoned air of the ward. Patients congregate there for pleasant chat and lively amusement, without interfering with the repose or disturbing the tranquillity of the sick in the wards to which they belong. If connecting corridors were of no other service they would be valuable as affording opportunity for this arrangement of verandas, instead of placing them parallel to the wards.

It is not necessary to repeat here the description of the detail of arrangements in the several wards, as they correspond accurately with the plan proposed in that part of the essay in which the principles of construction are explained. Each ward with its adjuncts is but a duplicate of the other. The outer pavilions are made one story only, in order that they may thus be drawn so much nearer the general centre, and not exclude light and air from the inner ones; and also because the required number of beds is provided with only one floor. A larger number of patients than is thus provided for should not be gathered in one hospital. For the same purpose of concentration the two south pavilions are placed in the position they occupy, by which they are brought near the central administration, the heating power, and the kitchen. As they can be placed on a somewhat lower level than those in front, the gallery of communication between them and the transverse corridor uniting these may have a slight inclination, and if exception should be taken to a second story of this transverse corridor as obstructing the access of air to the northern pavilions, it may be made only one story with an open veranda on the flat roof; though the distance south from these pavilions, and the wide space between them renders such an objection of little force.

The basement of these southern pavilions is appropriated to the out-door dispensary service, having separate entrance on the street bounding the hospital on the south, across paved yards, interposed between the street and the south end of the pavilions; these have no outlet at that end. The space between these pavilions is wide—176 feet.

On the level of the street, on the south line of the lot quite beyond the terminal line of the southern pavilions, is placed a

building of only one story, containing the heating apparatus, with coal-bins adjoining on the one side, and the laundry on the other, having attached to it a yard, also on the level of the street, but sunk below that of the hospital grounds, in which clothes shall be dried in the open air and sunshine whenever it can be done, thus receiving the purifying influence of light and air. The drying room only to be used when the weather forbids out-door drying.

The kitchen is placed at the most central point of the entire group of buildings, and perfectly detached from them all, on the level of the basement, by which it has communication with every part by railway and lifts. The central chimney, with its perpetual fire, will afford opportunity to connect with it flues for ventilation of various parts more accessible from this point. The isolation of the kitchen from all other buildings will prevent the diffusion of fumes and vapors arising from culinary processes, as effectually as though it were placed on the upper floor.

It will be seen also that an underground passage, well-lighted, connects the kitchen with the coal-bins and ash-pit, and affords opportunity to bring in provisions and stores without any connection with the hospital or any of its adjuncts, and that similar tunnels convey the various pipes and tubes connected with the arrangements for heating and lighting and the supply of water, to the basements under the several pavilions; and these passages also afford conveyance for soiled clothing to the laundry, and for the bodies of the dead to the apartment appropriated to receiving them and delivering them to friends.

An area of twelve feet wide at the bottom and easy slope to the surface surrounds every part, which is in the least sunken below the surface.

It will be noted that in each of the wards the lateral walls are broken midway, thus forming external projections corresponding with the end towers. This provides the same amount of floor and air space as that for which the plain parallelogram is calculated, and which is encroached upon by the central stacks of chimneys.

No representation on the drawings is made of the hut or tent rooms, which should be provided for any cases requiring absolute isolation, these not being permanent structures, and easily placed on any part of the grounds, as occasion demands.

HOSPITAL CONSTRUCTION

AND ORGANIZATION.

STEPHEN SMITH.

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HOSPITAL CONSTRUCTION

AND ORGANIZATION.

STEPHEN SMITH, M.D.,
OF NEW YORK.

INTRODUCTORY STATEMENTS.

FROM the letter of Mr. Hopkins to the trustees we learn that he contemplated the establishment, upon the grounds selected, of—

1. *A General Hospital;*

2. *A Training School for Female Nurses;*

3. *A Part of the Medical School of the University.*

It is evident from this letter that it was his desire that the general hospital should be the central feature of this great charity. The "Training School for female nurses" and the "Medical School" were to be accessories which would both promote the best interests of the hospital, and enlarge and greatly extend its usefulness. We have therefore to develop the plans in detail by which these three institutions may be so grouped together in one harmonious whole, as will best secure the highest interests and greatest success of each.

It is important to notice, also, that one of the important elements which enters into the study of hospital foundation is eliminated from the proposals of the Trustees of "The Johns

Hopkins' Hospital." The site for the hospital is already selected, and the necessary land obtained.

The questions to be determined are, therefore, limited to the preparation of the site, and the arrangement and construction of the several buildings required to fulfil the objects and purposes of the donor.

In the discussion of the several questions raised, the author has aimed to establish general principles, without entering into the consideration of details. The plans submitted are, therefore, rather in outline, the duty being left to the architect and engineer to complete the design according as their judgments may dictate. This course has been pursued in compliance with the instructions of the trustees, and in deference to the experience of those officers who are immediately responsible for the success of this great charity. The proper construction of a general hospital of the dimensions contemplated, involves a knowledge of the special wants of a large community of people, sick of a great variety of diseases, and the proper methods of care in each case. Such knowledge can be gained only by long experience in the care of the sick, combined with a practical acquaintance with hospital construction and management. The architecture of a hospital differs, also, from all other structures in almost every particular, and these peculiarities can be thoroughly appreciated only by those who have given to this branch long and patient study. It is necessary, therefore, in order to the proper development of hospital plans that the physician and architect should combine their knowledge and experience, the former in establishing general principles, the latter in reducing those principles to form and practice. And it may not be improper to add that whatever general plans are adopted, their success will depend upon the perfection of details.

I.

SITE OF THE HOSPITAL.

"I have given you in your capacity of trustees thirteen acres of land, situated in the city of Baltimore, and bounded by Wolfe, Monument, Broadway and Jefferson Streets, upon which I desire you to erect a hospital."—*Mr. Hopkins' Letter to the Trustees.*

. . . "It consists of an eligible piece of ground, situated in the eastern part of the city, . . . fourteen acres in extent, in the form of a parallelogram, 709 by 856 feet; . . . very elevated above the general level of the city, and commands an extensive view in all directions; . . . is healthy, with complete surface drainage, while underground drainage may be accomplished to tide-water; . . . it is easily accessible by street railway, and by paved streets which bound the four sides of it."—*Letter of Instruction of Trustees.*

PREPARATION OF THE GROUNDS.

Whatever may be the nature or condition of the soil of the site selected, two important objects are sought to be attained in its preparation for permanent occupation by a hospital. These are: 1. *Immunity from the evils of ground air and ground water.* 2. *Surface grading and cultivation.*

Both objects involve the necessity of sanitary works of the highest importance to the future healthfulness of the hospital, and demand the most careful and painstaking execution.

1*st. Immunity from the evils of ground air and ground water.*—Every soil contains in greater or less quantity air and water. The proportion of these elements in different soils varies very much, depending for the most part upon the density of the individual soil. But in some proportion they always exist in soils, and may become active factors in the causation of un-

healthfulness to dwellings, unless adequate preventive measures are adopted. It is the combination of these elements which renders a soil damp.

1. *Ground air.*—It is found by actual experiment that gravel contains 35 per cent. of air. It has been well stated: "This is certainly a great quantity of air; but for all that, this ground, as far as it is dry, consists to the extent of one-third of air. In building on gravel, we build as well on air, just as we build on water when we build on piles driven into a swampy soil, and cut off under water." * What is true of gravel is also true of other soils, as sand, clay and even of stony and rocky soils. Sandstone is nearly as porous as loose sand. The rock of Malta was found by experiment to take up one-third of its volume of water, which shows that when dry it must contain air to the same extent.† This ground air is generally very impure. It is found to contain a large amount of carbonic acid, and other impurities derived from the soil, the amount and kinds varying with the composition of the earth. Pettenkofer found, in sterile lime-rubble, a few feet under the surface, as much carbonic acid as in the worst ventilated human dwelling-places. The amount of gas increases in proportion to the depth to which we penetrate, within given limits, and to the proximity of the ground water, except in the months of June and July, when the upper stratum contains the greater proportion. But the ground air may contain other impurities than carbonic acid. It may be charged with the emanations of any organic matters in the soil undergoing changes. The air in burying-grounds is thus heavily loaded with the gases arising from the decomposition of bodies buried deeply in the earth. Another feature of this soil air is, that it moves from point to point under the influence of the same laws which govern the movement and diffusion of gases. Difference of temperature of the free and ground air leads to "exchange and motion." These fluctuations occur constantly. Again the rise of temperature of the ground in a given locality is followed by a movement of the surrounding ground air towards this point, thus establishing currents through the earth. It is evident, therefore, that the ground air is a most important ele-

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* PETTENKOFER. *Air in Relation to Clothing, Dwelling, and Soil.* London, 1873.
† PETTENKOFER, *op. cit.*

ment to be considered in the soil of the site of dwellings. If the soil near or more remote from buildings contains organic matters which are emitting deleterious gases, these emanations are readily carried by underground currents and discharged into any receptacle to which the air is drawn by difference of temperature.* These receptacles may be the heated basements of dwellings, and thus the dwelling may become a foul air shaft for the discharge of the ground air, loaded with carbonic acid gas and other dangerous impurities.†

The effects of these emanations from the soil upon the health of residents is most disastrous. The malarial poisons may be of a kind which insidiously impair the constitution, and cause permanent ill-health, and premature decay and death, without even a suspicion of their source. Persons thus chronically poisoned fall an easy prey to other exciting causes of disease, intensified by these existing agents of ill-health, or convalesce with great difficulty.‡

Or again, the ground air may convey into dwellings the active germs of diseases which, in due time, produce their legitimate fruits. There is reason to believe that typhoid fever, cholera, and diarrhœal diseases may be introduced from the soils to the interior of dwellings, and their local origin escape detection.§ It is evident, therefore, that too much importance cannot be attached to those measures which protect dwellings from the evil effects of ground air.

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* "Remarkable testimony as to the permeability of the ground, and of the foundation of our houses, has been given by gas emanations into houses which had no gas laid on. I know cases where persons were poisoned and killed by gas, which had to travel for twenty feet under the street, and then through the foundations, cellar-vaults, and flooring of the ground-floor rooms."—PETTENKOFER, *op. cit.*

† "[Thus our heated houses ventilate themselves not only through the walls but also through the ground on which the house stands. If there is any gas or other smelling substance in the surrounding ground air, they will enter the current of this ventilation. I have witnessed a case in Munich, where not the least smell of gas could be detected in the street, but a great quantity of gas found its way into the ground-floor room of a house where no gas was laid on."]—PETTENKOFER, *op. cit.*

‡ ". . . They may (lodgers brought in by ground air), without betraying their presence in any way, become enemies, or associate themselves with other injurious elements, and increase their activity."—PETTENKOFER, *op. cit.*

§ "In another case the gas (from pipes in the neighboring ground) penetrated into the best heated room, and produced an illness of its inmates, which was taken for typhoid fever."—PETTENKOFER, *op. cit.*

2. *Ground water.*—Pettenkofer, who first called attention to the sanitary aspects of ground water, thus explains the meaning of the term: "The stratum, or surface of the stratum of saturation of porous ground, accessible and observed in wells in the upper water-bearing stratum of the ground in any locality." * He regards this saturation surface of ground water as due to underground lakes, ponds, or streams filled in with drifted soil; such water surface being covered to a greater or less height, and on which covering or soil people live and cultivate the ground. This stratum of ground water varies very much in different seasons, depending upon the amount of rain-fall, evaporation, and other conditions affecting soil saturation. With its rise the soil becomes more and more saturated, and dampness ensues; with its recession the soil becomes more dry. And as this water-line fluctuates, so the amount of ground air varies, penetrating and filling all the interstices of the soil as the water recedes, and again escaping into the open air as the water rises to the surface. The ground air is liable to become charged with deleterious gases emanating from the soil, and to discharge them into the open air, to the detriment of the people living in the vicinity.†

But a more serious danger from the fluctuations of ground water results from the liability of the conveyance of the germs of disease from one point to another. It is now well established that cholera, typhoid fever, and similar diseases, spread widely through the agency of the ground water, the infectious discharges of the sick being thrown upon the ground. The ground water acts not only as a carrier of these so-called "ferments," but is itself fermentable under certain conditions, and thus becomes capable, at times, of enormously increasing the amount of infectious materials.

It is apparent, therefore, that no hospital site can be regarded

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* *Report on Epidemic Cholera to the Bavarian Government, etc.*

† "In a porous soil which easily allows the rise and fall of the water-line, an amount of air finds entrance and exit equal in volume to the quantity of water which occupies the interstices of the earth. If the soil is impure from cesspool soakage and other sewage abominations, the air drawn into those interstices, as the water-line falls, becomes naturally loaded with the results of sewage decomposition. As the water-line rises, this air is expelled, and adulterates the pure atmosphere above. If the area is inhabited, much of this finds its way into the basement of the houses built upon such a foundation (it gets out more easily there), and the inhabitants naturally suffer from the effects of foul air."—DR. CARPENTER, *Public Health*, March, 1875.

as properly adapted to the construction of residences for the sick, which is not thoroughly protected against the evils which arise from a soil having a high saturation level. At no season of the year is such a site healthy. Every fluctuation of the ground-water has its attendant sanitary evils. With its rise bowel affections increase, and with its fall malarial poisons are developed.*

Remedial Measures.—Obviously the first effort should be to secure purity of soil. All sites may contain, mixed with the soil or collected in deposits of variable extent, animal and vegetable matters of a putrescible nature, which may give off very deleterious gases. If the grounds have previously been used for yarding stock, for slaughtering, or for any offensive trades discharging liquid refuse, the soil is liable to be saturated with putrescible matters which will render the ground air foul and deleterious to the occupant of the dwelling located thereupon. There may also be unseen deposits of organic matters which will, if allowed to remain, impair the healthfulness of the site.

Great care should therefore be exercised in securing purity of the soil of the entire area under control. All local collections of filth should be scrupulously removed, and the places supplied with earth, free from organic impurities, and largely composed of sand.

There should also be a thorough examination as to the existence and depth of the stratum of water-bearing soil, and the fluctuations of the ground water. And when these facts are determined, a system of deep drainage should be perfected, which should effectually prevent ground water from approaching within at least six feet of the surface.

But our efforts to protect the site from the evils of ground air and ground water should not be limited to the measures suggested. However pure the subsoil may be, the ground air may bring from great distances and from great depths noxious gases and discharge them into heated basements, or into the open air of the grounds. Nor will the subsoil drains always prove adequate to convey from the site the impurities which they may contain. The drain and sewer pipes are also liable to

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* "The rise of the water-line is attended by certain evils. Typhoid and its allied diseases become prevalent, but as the water-line falls again another set of diseases become prevalent also; the intermittent class—ague, neuralgia, rheumatic disorders—are rife."—DR. CARPENTER, *Public Health*, March, 1875.

allow the escape of their contents into the soil, or to become so closed that the sewer gases penetrate them, and thus reach the basements of the buildings, or the open air.*

The most effective method of protecting the hospital against these dangers is by a system of ground ventilation which will withdraw constantly from the soil all foul air and all gases, and discharge them at such a distance from the ground as to prevent their return. This can be done by means of a heated shaft which communicates by its base with drain pipes and conduits leading to all parts of the grounds at various depths. This shaft may be the chimney of the boiler and other heating apparatus of the administration buildings. It should have an altitude of 150 feet or more, and being the most conspicuous figure on the grounds, it should be monumental in its design and appearance. The superficial soil conduits should be very porous to enable the air to enter them readily, while the deeper drains should be especially laid for drainage. If these soil drains are properly laid and connected with the heated shaft, the air and gases in the ground will be forcibly drawn into the shaft, and discharged into the free air far above the buildings. The result would be that instead of the constant escape of the ground air into the free air of the grounds and into the basements of the buildings, the free air would be drawn into the ground and thence escape through the heated shaft. The process would prove to be one of constant purification of the soil.

2. Surface Grading and Cultivation.

"I wish the large grounds surrounding the hospital buildings to be properly enclosed by iron railings, and to be so laid out and planted with trees and flowers as to afford solace to the sick, and be an ornament to the section of the city in which the grounds are located."—*Mr. Hopkins' Letter to the Trustees.*

In grading and cultivating the grounds, our aim should be to

* "If the subsoil is drained by sewer pipes, and the latter are not ventilated in the most efficient manner, another evil also arises. The sewers which were pervious and allowed leakage into the subsoil of both air and water, which passed downwards, are now sealed to some extent (by the rise of ground water), and all sewer gases find their way into the houses direct."—Dr. Carpenter, *Public Health*, March, 1875.

add to their beauty and healthfulness. Far too often hospital grounds show no taste in their cultivation or care, and the impression which we receive at first sight is repulsive. But a plot of ground of fourteen acres on which a large number of buildings of approved architectural finish are grouped, ought to be so laid out and cultivated as to prove inviting and attractive to the most ordinary visitor.

In selecting the site of a hospital we give preference to an exposure or inclination of the grounds towards the sun at mid-day, and towards that point of the compass from which the prevailing winds arise. We thus secure the influence of two important elements of healthfulness to the hospital—sunlight and heat, and currents of wind. When the natural inclination of the ground selected is not in the required direction, much may be accomplished in improving the surface inclination by judicious grading. The site of the Johns Hopkins' Hospital affords an opportunity of overcoming by grading natural defects in the inclination of the surface. With but little effort and small expense the surface may be inclined towards the south, south-east, and west, so as to expose every building on all its sides to the sun and winds.

In the cultivation of the plot the ultimate purpose should be to secure a large supply of vegetation, and especially of trees; for trees, judiciously selected and arranged, are not more essential to the beauty of the landscape than to the purity of the air. Man and vegetation are the complements of each other in their effects upon the surrounding atmosphere. "Plants," says Schacht, "imbibe from the air carbonic acid and other gaseous or volatile products exhaled by animals, developed by the natural phenomena of decomposition. On the other hand, the vegetable pours into the atmosphere oxygen, which is taken up by animals and appropriated by them. The tree, by means of its leaves and its young herbaceous twigs, presents a considerable surface for absorption and evaporation; it abstracts the carbon of carbonic acid, and solidifies it in wood fecula, and a multitude of other compounds. The result is that a forest withdraws from the air, by its great absorbent surface, much more gas than meadows or cultivated fields, and exhales proportionally a considerably greater quantity of oxygen." *

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* *Les Arbres.*

Again, the foliage of trees has the power of absorbing and rendering innocuous poisonous emanations from the earth. The most dangerous marsh miasms are rendered harmless if a grove intervenes between the resident and the marsh.

Finally, trees greatly modify the temperature and humidity of the surrounding air. This effect is produced by the absorption of the moisture of the air and earth, and its exhalation from the leaves. Hales states that a sunflower with a surface of 5.616 square inches, throws off 20 to 24 ounces avoirdupois every twelve hours, and a vine with twelve square feet of foliage exhales at the rate of 5 to 6 ounces daily. Bishop Watson, in his experiments on grasses, estimated that an acre of grass emits into the atmosphere 6.400 quarts of water in twenty-four hours. As this exhalation of vapor is a cooling process, and as it proceeds more rapidly as the temperature rises, it is evident that vegetation, and especially shade trees, tend powerfully to equalize the temperature. They absorb the excessive moisture of the air, and again give off clouds of vapor under the stimulus of light and heat. Marsh says: "The evaporation that cools the air, diffuses through it at the same time a medium which powerfully resists the escape of heat from the earth by radiation." The value of a single tree for these purposes may be gathered from the estimate made of the amount of foliage on the Washington Elm, at Cambridge, Mass., viz.: 7,000,000 leaves exposing a surface of 200,000 square feet, or about five acres of foliage.

As conservators of pure air over the grounds on which a permanent hospital is located, shade trees are, therefore, invaluable, and should be assiduously cultivated. In their selection care should be taken to secure a large variety, including evergreens. They should be so planted as most effectually to serve the purpose of intercepting foul air, of supplying needed shade, and of modifying temperature. Around the entire margin of the grounds they should be so selected and planted as to effectually screen the air which enters the grounds of all impurities. In the large area between the groups of pavilions on the northern and southern portions of the grounds they should be so planted as to furnish a grove which would thoroughly purify the air passing from the pavilions on the south to those on the north side. Between the pavilions there should be continuous rows of

shrubs, sufficiently high to intercept the possible lateral currents of air.

In thus advocating a large supply of trees we do not propose to create a shade so dense as to render the grounds damp. It should be a fixed purpose of the architect that no part of the grounds uncovered by buildings shall be unsunned and unaired.

The cultivation of flowers should be an important feature in the management of the grounds. These gardens or plots may occupy the open spaces between the pavilions. They add greatly to the beauty of the scenery, and afford great pleasure to the sick.

Fountains, with one or many jets, add much to the scenery, and, if numerous enough, tend also to purify the air by washing out the floating impurities.

II.

THE GENERAL HOSPITAL.

1. Capacity of Hospital and Distribution of the Sick over the Surface Area.

"It is my wish that the plan thus chosen shall be one which will permit symmetrical additions to the buildings which will be first constructed, in order that you may ultimately be able to receive four hundred patients."—*Mr. Hopkins' Letter to the Trustees.*

In this statement we have the capacity of the proposed hospital given, when fully completed.

The first question which we have to consider is the proper distribution of the sick over the allotted area, so as by symmetrical additions to accommodate, finally, the requisite number.

Distribution of Sick over Surface Area.—Two important principles in hospital construction are at variance in the consideration of this question.

1st. On the aggregation of the sick depends economy of construction and facility of administration. The more compactly the sick are arranged the less house space is required; the nursing is more readily supervised, the food supplied and all the details of management are simplified and reduced to a minimum of expense. Thus a hospital having large wards, or several adjoining wards, requires far less *personnel* and machinery than wards of the same size divided or in separate buildings. It follows that the crowding of patients in wards and the aggregation of wards is favorable to economy and efficiency of administration.

2d. But this aggregation of the sick tends to unhealthfulness, and thus to defeat the purpose for which a hospital should be constructed.

It is a well settled principle in sanitary science, that beyond a certain given number of square feet of surface or ground area,

people cannot be healthfully aggregated together. French authorities limit the number to 80 persons per acre, while English writers allow 100 persons per acre. And especially is this true of the sick. The morbid products constantly excreted from their bodies, as from the skin and lungs, poison the surrounding air, and render the immediate neighborhood of the sick unfit for the residence of other persons. Not only is the surface area immediately around the sick rendered unwholesome, but from the tendency of such emanations to ascend, the area above it is contaminated to a much greater extent.

Again there are many varying conditions among the sick which still further modify the rules of surface distribution. Those suffering from acute diseases require in general more separation than convalescents, or those affected with chronic complaints; surgical cases require larger areas than medical cases; specific fevers than inflammations. Thus we may multiply the conditions which would modify any fixed rules of surface population of the sick. In a general hospital all these varying conditions are found, and due consideration must be given to them in the final distribution of individual diseases. Finally, it is evident that the limits of healthful occupation of surface area will depend upon the constancy and certainty of the renewal of the air about the sick. It is possible to renew the air surrounding an individual sick person so constantly and perfectly, that neither he nor his immediate neighbor can respire the contaminated air. But the conditions by which such results could be attained would be expensive and complicated, and would require the most watchful supervision. We must, therefore, attain the same results by means which are largely self-operating and inexpensive.

To reconcile these conflicting principles and secure that degree of isolation essential to the protection of the individual patient, whatever may be his malady, with such aggregation as will render administration effective, we must combine isolation with ventilation.

The distribution of the sick to surface area was very thoroughly studied by the *Chirurgical Society* of Paris, and the conclusion reached was, that every hospital should have a space of clear ground of not less than 540 feet to each patient. This would give to each building containing 80 patients one acre; or in other words,

a hospital accommodating that number of patients should stand in the centre of an acre of ground. The proportional area was to be greater as the number of patients increased. There can be no doubt, however, that for permanent healthfulness a smaller number of persons to the acre is desirable, for we thus more effectually secure isolation. Where the grounds are ample, as in the present case, there is no other reason why the number should exceed 40 persons to the acre as a general average, than that which grows out of administration. And we believe it possible, in the combination and construction of the ward and administrative buildings, to fix upon 40 patients to the acre as the basis of distribution of the sick to surface area.

2. The Classes of Sick to be received.

"The indigent sick of this city and its environs, without regard to sex, age, or color, who may require surgical or medical treatment, and who can be received into the hospital without peril to the other inmates; and the poor of this city and State, of all races, who are stricken down by any casualty, shall be received into the hospital, without charge, for such periods of time and under such regulations as you may prescribe. It will be your duty to make such division of the sexes and patients among the several wards of the hospital as will best promote the actual usefulness of the charity.

"You will also provide for the reception of a limited number of patients who are able to make compensation for the room and attention they may require."—*Mr. Hopkins' Letter to the Trustees.*

"In the same general category of things to be provided, would be included suitable appliances for promptly and efficiently caring for accident cases, so numerous in a large city; and a dispensary for out-of-door relief, both by the dispensing of medicines and the giving of medical advice."—*Letter of Instruction of Trustees.*

From these instructions it appears that all classes of persons, and all forms of disease, are to be admitted to this hospital, excepting such as would be perilous to the inmates. This latter

qualification obviously excludes known contagious diseases, as small-pox, scarlet fever, etc. There is also no exception to the social condition of the sick. The poor and the rich of both sexes and of all ages are alike to be received, and suitable provision must be made for them.

The questions which arise under this head for our consideration relate to the special requirements of the sick: *first*, as regards their diseases; and, *second*, as regards their social condition.

1. What provision shall be made for the care and treatment of the great variety of diseases admissible to a general hospital? Shall they all be provided with the same conditions, or do they require to be classified and grouped according to their peculiarities in buildings arranged for their special necessities? Heretofore this question would have been decided in favor of entire uniformity in the provision for the care of the sick. Diseases would have been indiscriminately intermingled in the same wards (excluding known contagious affections), even to the extent of mixing medical with surgical cases, typhus and typhoid fevers with chronic diseases. But the recent advances in our knowledge of the intimate nature of contagion, and of the infectious nature of many diseases hitherto believed to be simply inflammatory, inevitably leads to the conclusion that general hospitals must hereafter be general only in the sense of admitting all diseases, but must be special in their methods of providing for individual groups.

There can be no doubt that that hospital will soon be regarded as best arranged and managed which adapts its wards to the cure of special diseases, and so classifies its patients that each malady has its appropriate and designated wards. The policy of mixing patients suffering from different acute diseases, in the same ward, is wrong in theory and pernicious in practice. There are certain conditions of temperature, isolation, food, medicines, nursing, etc., which are peculiar to individual diseases, and which cannot be suitably provided in the aggregate.

Nor can we overlook the lesson as to the necessity of isolation of many classes of diseases which recent studies of the methods of propagation of acute affections by germs is teaching. Though the germ theory is still *sub judice*, yet so many important facts

have recently been placed on record, that it will be but an act of prudence, if not wisdom, to give them due weight in hospital management. By the *germ theory* we understand that a particle of an infective nature may be emitted from the sick, and give rise in another person who receives it to a disease, if not altogether like that in the former, quite as dangerous. Such transference may take place through the medium of the air, food, water, or substances used about the sick, as sponges, linen, etc. Formerly, the number of diseases known to be propagated by a specific contagious principle was limited; small-pox, scarlet-fever, measles, etc., being types.* But this list has been considerably extended lately, and at the present time there are such evidences that a much larger number of acute diseases must be included, that we cannot be too cautious in our hospital provisions for their care. There is now no doubt that the blood of persons sick of various acute diseases contains microscopical organisms which do not exist in the blood of those in health, or of those suffering from chronic maladies; and those organisms increase and diminish as such diseases increase or diminish in severity. If these so-called germs produce their like, as do ordinary seeds, it is evident that all diseases which propagate themselves by means of germs should be classified and assigned to special wards, with as much care as we should small-pox and scarlet-fever. Again, we have to consider that it is a well-established fact, that infective emanations from persons suffering from many acute diseases not only injuriously affect other patients, but that they infect ward furniture and the materials of which the ward is constructed. We would not presume to place persons sick of pneumonia in an uncleaned ward recently occupied by persons sick of small-pox, for we know that the

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* "Under the name infectious diseases we group together those affections which we know, or at least believe, must originate through the infection of the system with certain peculiar poisonous matters, and which are mainly distinguished from the ordinary poisons by the fact that they can reproduce themselves under favoring conditions to an endless degree. The classification of this group of diseases will, of course, be modified from time to time, according to whatever theory of their etiology is maintained; and yet it is easy to foresee that when investigations have been prosecuted further in this direction, infectious diseases will be found to occupy a far wider field than now is commonly given them."—LIEBERMEISTER, *Introduction to the Infectious Diseases, in Cyclop. Prac. Med.*

germs of small-pox are stored in the walls and furniture of that ward, and that they may escape again into the air and infect any susceptible person. The same remark is true of erysipelas, gangrene, pyæmia, septicæmia, typhus, relapsing fever, and we know not how many other acute diseases. It follows, therefore, that in making permanent provision for the great variety of diseases which will from time to time enter a general hospital, we must be able to group them so as to prevent one class from damaging another.

It may be stated, therefore, as a "general principle of hospital hygiene," that in the care and treatment of the sick in a general hospital many and diverse conditions will be required. As we select remedies with reference to the special requirements of individual diseases, so, in a measure, we must adapt the external conditions of the sick to their special needs. And one of the special needs of the sick is that the ward shall be adapted to their necessities. One disease is best treated in the open air, another in a tent, and a third in a dwelling. One recovers more readily in the light, another in darkness; one requires large superficial and cubical area, another requires less. To group these widely different diseases in the same ward and subject them to the same conditions, would be as absurd as to give them all the same remedies.

Adopting the principle, that, in order to make suitable provision for the sick admitted to a general hospital, diseases must be classified according to their special peculiarities, and isolated, we have next to inquire as to the proper classification of diseases for this purpose. The principle of classification should, as already noticed, be the same as that which governs in the classification of the diseases of special hospitals for contagious maladies, viz., *the contagious and infective nature of the several diseases.** It is true that we cannot classify all diseases with absolute pre-

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* . . . the conviction is growing stronger that, in the investigation of diseases, . . . the idea of causality represents the last point to be reached, and accordingly the most scientific rule of classification must refer to causes, *i.e.*, must be *etiological*.

"The most advanced position reached thus far is the one now held with regard to the etiology of infectious diseases. This group rests upon an etiological basis, and there is scarcely any difference of opinion respecting its value, as the best ultimate foundation for classification in these diseases."—LIEBERMEISTER, *Introduction to Infectious Diseases, op. cit.*

cision on this basis as we can small-pox, scarlet-fever, measles; yet enough is now known of the infectious properties of large numbers of the diseases, both medical and surgical, of a general hospital to prove that the time has arrived when such classification must be recognized as the guiding principle in the distribution of the sick in wards.

In the *first* place, the sick must be grouped according to the conditions of sex, age, color, etc.

Sex.—There should be two groups of wards for the purpose of completely isolating the sexes, viz., northern and southern.

Age.—One or more wards in each group must be set apart for children.

Color.—Separate wards can be assigned to persons of color in each group, if it is found necessary.

Pay Patients.—One or two wards in each group may be arranged for those who pay, and who, on that account, expect and are entitled to more care and attention than ordinary charity patients. Such persons require isolation, and many of the comforts and conveniences of home. The interior arrangements of pavilions devoted to this class should make it convenient for family friends to remain with and take care of the sick, and enjoy the privacy of home life.

It would at first appear that diseases might be grouped in accordance with the present classification in mortality returns, which, to some extent, recognize etiology as the basis of classification, but practically such division would not accomplish the purpose. The following scheme would be more nearly in accordance with our present knowledge of the requirements of each group.

1*st Group.*—Gangrene and sloughing, erysipelas, pyæmia, septicæmia. These diseases are intensely infective, and require isolation, with large areas of superficial and cubical space.

2*d Group.*—Diseases attended with much suppuration, fevers, etc., but not complicated with the preceding conditions. These affections are less infective, but require isolation.

3*d Group.*—Acute medical and surgical diseases, having but slight if any infective properties.

4*th Group.*—Chronic non-infective diseases, convalescents, etc.

Out-door Department.—The department devoted to out-door

relief and practice should be connected with, and be provided in, the buildings devoted to the instruction of medical classes. The "Pathological Building" or laboratory (so called on the plan) should have its northern, basement portion provided with rooms to accommodate the out-door poor service. Access would be directly from the street.

III.

BUILDINGS ADAPTED FOR THE CARE AND TREATMENT OF THE SICK OF A GENERAL HOSPITAL.

"It is my wish that the plan thus chosen . . . shall provide for a hospital which shall, in construction and arrangement, compare favorably with any other institution of like character in this country or in Europe."—*Mr. Hopkins' Letter to Trustees.*

"It will readily occur to you that the subject most prominent at this day in the professional consideration of the Hospital question as applicable to cities, is the choice between the pavilion system, which admits buildings of two or more stories in height, permanently constructed, of which the Herbert Hospital in England and several in this country may be considered good modern types; and the barrack system of one-story structures, destructible in whole or in part, which were so successfully used in the late war, but of which no extensive and prominent example is now in operation. In determining the claims of these systems respectively, as applicable to us, careful regard should be had to the character of the patients intended to be the subjects of our nursing, so as to avoid the error of building an institution which shall prove to not meet the requirements demanded in the care and cure of women and children, and the generally enfeebled inhabitants of the sheltered lanes and alleys of a city, however much such a structure may have been a success when applied to the uses of hardy men in the field. We presume there must be some general principles of hospital hygiene and of hospital treatment fixed and immutable in their character, the discovery and proof of which are the result of close careful recorded observation and judgment. If these principles can be best applied through the agency of the pavilion system, we wish to adopt that; if by the barrack system, then we will avail ourselves of that form of construction; and if the true rule for our guidance shall be found in the good features of each, and the combining of them

all into a harmonious middle course, then we desire to make that selection and combination."—*Letter of Instruction of Trustees.*

In providing a residence for a sick person with a view to his prompt restoration to health, our first and chief concern would be to secure him an unfailing supply of pure and properly-tempered air. Whatever other provision be made for his care and treatment, to the wholesomeness of the air he breathed we should attach chief importance. For pure air is the best restorative in all forms of disease which human agency can provide, while impure air will destroy health and life in spite of every means which we may devise and provide.* Simple and self-evident as is the proposition that the sick must have pure air in order to prompt recovery, we are strangely liable to allow it to lose much of its force when applied to the aggregations of sick persons forming a hospital. With infinite care and patience we select the residence of a single invalid, with a view to secure pure air, sunlight, isolation from other sick persons, and every condition essential to health; yet when we make provision for large numbers of sick in one residence, we are not sufficiently alive to the fact that we have increased the ratio of the importance of these conditions by the number of sick to be cared for.

Impressed with these facts as perhaps no other person ever has been, Miss Nightingale, in the following concise and emphatic language, thus defines what she understands by a hospital pavilion:

"By a hospital pavilion is meant a detached block of buildings, 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 the hospital may consist, or with the general administrative offices, except by light airy passages or corridors. The 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

* "In modern hygiene nothing is more conclusively established than the fact that vitiated atmospheres in our dwellings and their surroundings are the most fruitful of all sources of disease."—RIGHT HON. LYON PLAYFAIR.

establishment miles away. The essential features of the pavilion construction is that of breaking up hospitals of any size into a number of separate detached parts, having a common administration, but nothing else in common. And the object sought is that the atmosphere of no one pavilion or ward should diffuse itself to any other pavilion or ward, but should escape into the open air as speedily as possible, while its place is supplied by the purest obtainable air from the outside." *

If there be "some general principles of hospital hygiene and of hospital treatment, fixed and immutable in their character, the discovery and proof of which are the result of close careful recorded observation and judgment," those principles are embodied in the preceding statement. In this definition of a pavilion we have set forth the true principles of hospital construction. Every hospital building devoted to the sick, whatever maladies they may suffer from, should secure the conditions and the results set forth in this description. It will be noticed, however, that no particular form of structure is here described. The pavilion may therefore be a tent, or a barrack; it may have one or many stories. Adopting the principles so concisely stated in this definition, there is great latitude for the exercise of judgment in their application to the buildings of a general hospital, as is illustrated by the variety of plans adopted by modern hospital architects. It would be unprofitable to discuss the merits and demerits of these plans in this connection, and we proceed to consider the special application of the principles of a hospital pavilion to the proposed general hospital.

In the preceding sections we have arrived at two conclusions, which have an important bearing upon the provisions to be made for the sick. The first is, that in the distribution of patients there shall be a minimum number per acre; and the second is, that the sick shall be classified, not only according to sex, age, and their social condition, but also according to their diseases. It is evident that in applying these principles we are limited on the one hand to a given population per acre, and on the other that we require the largest possible number of wards, and the largest amount of ward space. Both of these conditions may be fully secured, however, by adopting a system

* Notes on Hospitals.

of pavilions which, while it answers every requirement, will admit of such contraction or expansion as the exigencies of the service may demand. The system contemplates a series of temporary and of permanent pavilions, of such number and capacity, and so constructed, arranged and distributed, as to fully meet all the conditions, and secure all the results proposed. To the consideration of these two classes of structures we now proceed.

Temporary Pavilions.—Temporary pavilions are buildings of cheap construction, designed for temporary purposes and frequent renewal. They are adapted for those diseases which are most liable to infect the materials of the ward, and thus render it unfit for occupation. Hence the necessity of the frequent renewal of these structures.

The simplest and least expensive structure yet devised for the care of the sick is the tent. And humble as is such a ward the results which follow the treatment of the most dangerous accidents within them are far more favorable than those which are given by the more pretentious permanent hospitals. The tent is susceptible of being converted into a mere shade for protection from the direct rays of the sun,* and of being inclosed so as to be adapted to the most rigorous winter. The tent admits also of the most thorough ventilation, both in summer and winter.†

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* It is this open air condition of a tent that renders it so valuable in the treatment of diseases attended by blood-poisoning. An eminent surgeon has said that the most successful treatment of pyæmia was in the open air, under the shade of a tree.

† "If most satisfactory results have followed the treatment of the wounded and sick in tent hospitals, it has been principally because they are more completely capable than any other hospitals of a constant and natural ventilation. Formed of a tissue permeable to air and gases, the vitiated air within them is constantly passing out, and is constantly being renewed by fresh air which enters, not only through certain openings, but passes freely through the network of the covering itself. During a considerable portion of the year the doors may be opened, and the walls of the tent so raised as to enable the patients to pass many hours of each day in the open air. In the colder season, when it may be necessary to warm the tents, the air within them may be maintained even more constantly pure; since, whenever the temperature of the air within a tent is raised to a degree above that of the air without, the air within the tent begins to escape, or rather is forced into the surrounding atmosphere, from which, in turn, it is necessarily renewed; and the rapidity of the outgoing and incoming currents of air will increase with the difference existing between the temperature within the tent and the temperature of the atmosphere at large. In my opinion, where the difference between the interior and the exterior temperature is from 30° to 60° Fah., most of the vitiated

The tent may be a pavilion erected upon permanent foundations with a permanent roof, and thus yield the advantages of a temporary structure as far as the health of the inmates is concerned, and of a permanent structure so far as affects the administration.* The class of cases to be admitted to the tent are included in the first group. These diseases, being highly infectious and frequently extremely offensive, require large areas of superficial space and the most ample supply of pure air. The superficial area per bed should be three or four times that devoted to ordinary patients.

Wooden pavilions, or "barracks," are, next to tents, the least expensive structures. Though designed for temporary purposes, they have all the essential features of permanent buildings except in material. In construction they should have the dimensions and general internal arrangements of the permanent pavilions.

Permanent Pavilions.—There are two general plans of constructing the permanent pavilions of a general hospital, to which allusion should be made. The first plan is that of aggregation of wards in buildings of several stories; the second is that of

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air passes out through the tissue of the tent. However this may be, it is certain that at our ambulance, where we maintained a constant temperature of about 60° Fah. night and day—when we had fuel—the atmosphere within the tents seemed to grow purer as the weather became severe. Never at any time was a persistent odor to be perceived in the tents, except that of tobacco smoke; and it may be interesting to observe, that while this odor clung to the tents during the mild days of the winter, it rapidly escaped whenever the weather was frosty. I believe the greatest advantage, from a sanitary point of view, to be derived from the general use of tents in the hospitalization of the sick and wounded, depends upon the facility with which the atmosphere within them may be kept pure and wholesome, and the common results of overcrowding avoided. Another very probable cause of the excellent results obtained in tents, may be attributed to the circumstance of their occupants being constantly more or less exposed to the influences of direct light. When the sick are treated in the open air, the influence of light upon them must be very considerable. How important a factor this agent may be, among the several known to be indispensable in order to have the best sanitary condition, it is difficult to say. We know, however, that without light the maintenance of health for any considerable time is impossible, and that its invigorating effects upon organic life in general bear a constant relation to the directness or indirectness with which the light may reach it. If it be true that the light within a tent is not at any time, strictly speaking, direct sunlight, the light within a white cotton tent not only is in great part direct light, but the light is stronger—the tent being in the sunshine—than it generally is in any room receiving its light indirectly, and by reflection, as nearly all rooms do.—DR. CRANE, *History of the American Ambulance.*

* For details, see *History of the American Ambulance*, etc., by THOMAS W. EVANS, M.D., London, 1873; also *Tent Hospitals*, by J. FOSTER JENKINS, M.D., 1874.

segregation, or the entire separation of wards; each ward being a hospital pavilion of one story, with all the accessories detailed by Miss Nightingale. The objects sought to be attained by the first method are economy of construction, and facility of administration. But such aggregation of wards always implies many things in common, as stair- and hall-ways, dining-rooms, day rooms, and even attendants, and these conditions must result in a community of atmosphere among wards and rooms under the same roof. The second plan is designed to render the isolation of the sick from all sources of foul air complete and effective. It sacrifices economy if there is economy in the construction and management of two or more stories of wards to the highest interests of the patient.* He is not only to be separated from the air of the administrative buildings, but as far as possible, also, from the air which has been contaminated by other sick persons.

While we do not doubt that the wards of pavilions of more than one story may, by their construction and management, be preserved in a fair state of healthfulness, especially if the stairways are external to the building, yet we are persuaded that the liabilities incurred by increasing the population to surface area are so manifold as to render it very unwise to construct two or more stories of wards for a permanent hospital. Nor do we believe that pavilions of more than one story of wards are more economical in construction and management. The imposing style of architecture which they are supposed to require renders the buildings extremely expensive, while the labor of ascending stairways is most exhausting. But even if they were less expensive in every respect than one-story pavilions, but in any degree less healthful for the sick, the latter should be preferred.† The only plausible reason urged in favor of multiple stories of wards is the want of adequate ground space, as in the location of hospitals in the built-up portions of cities. But it is question-

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* "The mode of construction in hospitals is, it is presumed, to be determined by that which is best for the recovery of the sick. If any other consideration is taken, such or such a percentage of mortality is to be sacrificed to that other consideration."—MISS NIGHTINGALE, *op. cit.*

† "The objection usually urged is that hospitals in two floors cost more than in three or more floors. But I submit that this is not the question before us, which is how to construct a hospital with the requisite facilities for ventilation, administration, nursing, and health."—MISS NIGHTINGALE, *op. cit.*

able whether even that excuse will much longer avail; all modern scientific inquiries into the conditions under which the sick recover, tends to prove that hospital sites should be selected where there is ample area, and hence in suburban rather than in urban districts.

In the present instance, from every point of view, we can but regard the question as settled in favor of permanent pavilions of one story of wards.* On this plan diseases may be classified and isolated to the greatest advantage, and those symmetrical additions can economically be made to the buildings which will eventually give the hospital the required capacity. If, however, buildings containing more than one story of wards are erected, they should be occupied by those sick of non-infective chronic diseases, and by convalescents.

Adopting the plan of one-story pavilions we proceed to consider the details of their arrangement and construction. The general features of the best constructed pavilions are now so well established that it will be necessary to enter into details only so far as to render the special features of these individual structures apparent. They may all be constructed on the same plan, with such internal modifications as will adapt them to particular or specific purposes.

Architectural Features.—As permanent pavilions are erected with a view to no other renewal than perhaps the interior wall, it is important that they should be so constructed as to allow of as little accumulation of filth as possible, and to admit of the most thorough cleansing. The architectural designs of the exterior of the pavilion must be largely left to the good taste and judgment of the architect. To what extent it is wise to lavish money in mere ornamentation of the exterior of the wards, those charged with the responsibility of the expenditure of funds must determine. We can only advise that nothing in the arrangements of the exterior should be allowed to interfere with the

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* "The most healthy hospitals have been those on one floor only."—MISS NIGHTINGALE, *op. cit.*

" . . . It may be accepted as a rule that, so far as the sick are concerned, they would be better placed in wards all on one floor, opening out of a common corridor; and if land is cheap, and the site fairly level, it is probable that such an arrangement might be more economical than building two-story buildings."—CAPT. DOUGLAS GALTON, *Construction of Hospitals.* London.

largest possible exposure of the wards to the sun and air.* But we must assert in the strongest terms that the interior of the ward shall be finished without ornamentation. There should be no jutting cornices, no projecting casings; in a word no surface which, by its position and construction, naturally collects and retains filth. To this general statement we may add, that whatever materials are selected it should be borne in mind that the interior surfaces whether of the wall, the floor, the ceiling, or the furniture, will require frequent cleansing by *rubbing* to secure freedom from accumulating organic matters. No substance should, therefore, be employed which is not susceptible of cleansing by thorough rubbing.†

Dimensions.—The form of the pavilion should be that of a parallelogram, its width not exceeding 30 feet, and its length varying with the number of patients to be accommodated. We should adopt as a standard for the distribution of the sick 20 patients to the ward. There should be two rows of beds, and each bed should have 8 feet of wall space. This would give 120 feet of superficial space to each patient, including one window, 4 feet in width. Each patient should have about 2,000 cubic feet of air space. The dimensions of the ward proper based on these figures would be as follows: Length, 80 feet; width, 30 feet; height, 16 feet. Each bed would stand in a space 8 feet in width and 15 feet in length—removed 2 or 3 feet from the wall, and separated from the foot of the nearest bed on the opposite side by at least 12 feet.

These details can be modified to meet every contingency. In

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* "Hitherto we have studied too exclusively architectural effect, and in our zeal to vie with other public buildings have lost sight of the humble, but sacred purpose to which a hospital is dedicated. If richly carved work, fanciful windows, imposing towers, etc., were essential elements in the successful treatment of the sick, the former style of hospital architecture would ordinarily fulfil the purposes of life saving. But when we recall the fact that the largest success in the treatment of the most dangerous and fatal forms of disease is in the simple tent on the open field, we fully realize how vain, indeed how criminal, is the expenditure of money in efforts at mere architectural extravagance."—*Principles of Hospital Construction*, by the AUTHOR.

† "To purify rooms the air must blow long into them, or every part must have the organic matter rubbed off by the hand. This is a sufficient rule for both hospitals and private houses. Good rubbing will purify furniture, and this our housewives know; long-continued currents of air are also known to be good, but better as a supplement to rubbing."—ANGUS SMITH, *op. cit.*

a temporary ward of the dimensions given, as a tent or barrack, it may be advisable to diminish the number of patients to 3 or 4, and arrange but one row of beds. In wards with chronic, non-suppurating diseases a larger number than 20 may be safely distributed.

Walls.—The walls of permanent pavilions should be constructed of porous brick. The walls should be hollow, and should be plastered on lath, with a good hard-finish surface. Such walls are porous, but they admit of thorough cleansing and disinfection. Impervious walls are not of easy construction, and it is questionable if the amount of ventilation secured through porous walls is not a material advantage to the sick, provided such walls are properly cleansed. Hollow walls are much warmer, and less liable to dampness, than solid walls; and there may be suitable arrangements made to disinfect the entire walls by forcing powerful gases, as chlorine and sulphurous acid, into these hollow spaces, thence through the bricks and plaster.

The interior wall surface constructed as proposed may be washed down with disinfectants, or be treated by disinfecting gases, or, finally, it may be entirely removed, and a new surface applied with comparatively little expense.

The Basement.—The pavilions should have well-constructed foundations, so arranged as to meet the conditions necessary to render the ward above healthy, and make the management successful. The materials of the foundation or basement story may be brick or stone. They should be laid on a base so constructed as to give a permanently dry foundation, not only of the walls, but of the entire area which the foundations cover. The best surface is that made of asphalt laid on concrete, the soil being properly underdrained. The basement should be six feet in height above the surface of the ground, and the arrangements of the different portions should adapt them for their special purposes. These purposes are as follows:—

1. *An Air-Chamber.*—All that portion of the basement directly under the ward should be constructed into an air-chamber. It should have double walls, and be perfectly secured against dampness and against the entrance of air except through properly constructed openings like double windows for summer ventilation, or with the air-shaft connected with the fan for winter ventila-

tion, if the fan is used. The coils of steam-pipe may be so arranged in this chamber as to distribute the heat to all parts of the chamber. The ceiling should be the floor of the ward above. If this basement is used as a hot-air chamber, suitable openings should be made in the ward floor like registers, and so arranged as to properly distribute the heated air uniformly over the ward. There may be valvular openings in the air-chamber communicating with the hollow space between the double walls, through which hot or cold air, or disinfecting gases, may be so forced as to heat, or cool, or disinfect the entire materials of the walls. The floor of this chamber should be on a level with the surface of the ground, and should consist of asphalt laid on concrete. The dimensions would be 80 ft. length, 30 ft. width, 6 ft. height; total cubical capacity, 13,440 ft.

2. *Water-Closets.*—One of the most difficult questions to settle in ward arrangement is the location of these filth-accumulating appendages, so as at once to make them conveniently accessible, and yet harmless in their effect upon the ward atmosphere. To make them accessible, they are generally grouped upon the same floor as the ward, at the extreme end, and direct communication with the air of the ward is intercepted by hallways, doors, and counter and cross currents. These precautions have proved more or less ineffectual. The air of the ward has too frequently been contaminated by the emanations from these adjacent rooms, and no ward can be healthy the air of which is polluted by the effluvia from a permanent water-closet in constant use. The danger does not so much follow from the recent dejecta of the sick, as from those accumulations which undergo putrefactive changes, and during that process evolve new and more dangerous infective materials. It is of the first importance, therefore, that these permanent receptacles of the excreta of the bowels and kidneys should be so placed and so managed, that their atmosphere can never by any possibility reach that of the ward.

There is apparently but one method of entirely overcoming this evil, and that is by the removal of the closet from the floor of the ward, and locating it where it will be so separated from all direct connection, that the air within it cannot penetrate the ward. This plan would require that it should be located in the basement, or upon the grounds of pavilions devoted to a class of the sick who are capable of walking up and down

stairs. This number is always large in general hospitals, amounting to at least one half of the inmates.* In the wards in which some patients were unable to ascend stairs, it would be practicable to provide for them a small room on the ward floor, with dry earth-closets, a urinal, and a lavatory. These conveniences would be adapted to the wants of the comparatively few who could not go down and up a flight of stairs, and if properly located and thoroughly attended to, would not be a source of foul air to the ward.

If this plan were adopted there should be a staircase of easy ascent, relieved by a landing, and leading from a room adjoining the hall on the ward floor to the basement, on the extremity of the pavilion next to the corridor. The water-closets should adjoin the basement on one side, and the corridor on the other; the entire height being that of the basement at this extremity, or twelve feet. These rooms would thus be placed entirely outside of the pavilion, and could be provided with ample means of ventilation independent of the ward. The part of the basement inclosing the staircase should be separated from the other part by a permanent brick wall.

3. *Service Rooms.*—The remaining portion of the basement next to the corridor should be devoted to the room or rooms necessary for the service of the ward. There should be a stairway to the ward floor, and an elevator to convey all articles to and from the ward, except dirty linen, which should have a shoot separated from all other communication.

The Ward.—The special features of the ward which require notice, are the windows, the floors, the ceilings, the free extremity, and the service rooms.

1. *The Windows.*—We have proposed to make the ward eighty feet long, with ten beds on each side, having eight feet of wall space to each bed, which includes a window four feet in width. This plan would give ten windows upon each side, of four feet

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* "The following census of the patients in Bellevue Hospital, New York, with reference to their ability to traverse a flight of stairs, was recently taken:—

Number able to traverse a flight of stairs	242
Number able to walk only about ward	101
Number unable to leave their beds	99
Total	442"

each in width. The location of the windows of wards upon the opposite sides is generally opposite to each other, for the purpose of favoring currents of winds across the ward. This result undoubtedly follows, but at the same time the beds are not very thoroughly flushed by the air which passes directly across the ward from window to window. There is also a tendency to the conveyance of the emanations from the patient of one side to his fellow opposite. We propose, therefore, to so place the windows that they shall alternate on either side, thus producing cross-currents. The windows should have double sash for warmth in the winter, and as a means of ventilation without currents, and should extend to the floor. The plan on which the windows are located necessitates the arrangement of the beds alternately along the wall. The space which we have given to each bed, viz., ten feet, with a window four feet in width, provides six feet of wall space to each bed. It is evident that this plan gives two advantages which have not been secured as yet in hospital construction, viz., 1st. The cross currents most effectually flush the beds with fresh air, and 2d. The air of one bed is not conveyed to that of the bed opposite. The diagram illustrates this plan.

2. *The Floor.*—The floors of the permanent pavilions should be of hard wood, as oak, or ash, or of wood properly treated with beeswax so as to admit of polish. The boards should be tongued and grooved, and put together with white lead, or other plastic material capable of solidifying, so as to prevent crevices for the lodgment of filth. But a better floor is made of hard wood, as ash and oak, arranged and laid in parquetry. Such floors are extremely durable, admit of the most thorough cleaning, and present the least facilities for the collection or retention of filth.

3. *The Ceiling.*—The ceiling serves the purpose of forming an air-chamber above the ward which protects it from the extremes of heat and cold, especially the former. It is contended that high ceilings, by which is meant a height greater than sixteen feet, are injurious, as they permit a larger stratum of foul air to accumulate in the upper part of the ward, and diffuse itself again over the ward. This undoubtedly is true, except when there is free outward ventilation in the ceiling, as in the ridge ventilation of the common barrack. If the outflow is large and uninterrupted, as it should be in pavilions of one story, the

height of ceiling above seventeen feet is a matter of little importance. With this provision supplied, the ceiling may be laid upon the inside of wide rafters, giving an air-chamber of a foot or more in depth, and a greatly increased capacity to the cubical contents of the ward. An air-chamber of this size, with a modified ridge ventilation, would amply protect the temperature of the ward from the direct rays of the sun upon the roof, and from extreme cold. A roof for a pavilion has been suggested constructed of iron arches and glass coverings, like a conservatory, or the New York Grand Central Depot, the glass being double, with an interspace to prevent the condensation of moisture. Such a roof, with suitable ridge and roof ventilation, would give a very pleasant effect to the interior if the glass were suitably colored. Still we believe the common ceiling, constructed as above proposed, would be preferable as a permanent arrangement.

The Extremities of the Pavilion.—An important feature of a pavilion of one story is the arrangement of the extremities. The plan usually adopted is to locate the bath-room and water-closets in one extremity, and the ordinary service rooms in the other. In order to give sufficient space for these accessory rooms, it has been deemed necessary to increase the width of the extremities by adding projecting towers or sections. These additions have a tendency to obstruct the free access of both air and sunlight to the external wall surfaces of the ward, and hence ought to be avoided. It would be much wiser to go to the other extreme and make the extremities narrower than the ward, so that the ward walls should be constantly flushed with air and sunlight. This can be effected by removing as many of the service rooms to the basement as practicable. If the bath-rooms, ward-closets, scullery, etc., are located, as now proposed, in the basement, there will be no practical difficulty in constructing the extremities of the pavilion on a scale of width sufficiently less than that of the ward to fully expose the entire ward walls to the sun and winds.

The plan we propose, however, is as follows: The extremity of the pavilion connected with the administration, should be connected with the ward by a hall diminished in width so as to render the angles of the ward free, to the extent of 3 or 4 feet, in which windows can be placed. Large windows, or doors

with steps leading to the grounds, should be placed at each end of this hall. The other, or free extremity of the pavilion, may be diminished much more in width, viz., 10 feet; and as there are no service rooms required, the narrowed portion may be completed as a bay window for flowers, with such architectural finish as may be deemed suitable; or it might be arranged for a ward operating room.

Service Rooms.—The extremity of the pavilion devoted to administration should have provision for a hall way, clothes-room, stairways, water-closets, store-room and a ward dining-room.

Hallway.—The hallway may be narrow, not exceeding 4 to 6 feet, and may terminate in the stairways to the basement. It should be closed at both extremities by doors.

1. *Nurse's Room.*—The nurse should have no separate room in the pavilion. She will have her sleeping and private apartments, with her clothes, in the building devoted to nurses. By this means she requires no room, nor bed and other necessaries which tend to make the ward foul. Her retiring room, where she can rest and yet overlook the entire ward, should be the recess at the free extremity of the ward. When relieved of duty, which should be frequent, the nurse should retire then to the Home.

2. *Clothes Room.*—A small clothes room for ward linen should have an exposure to the external air and to the sun. It is too much the custom to have the ward linen shut up in a close, dark, and unventilated room. The linen is often damp when it is packed on the shelves, and if placed on the beds in that condition, as it sometimes is, the effect is injurious to the patients.

3. *Water-Closet and Lavatory.*—If these necessaries are located on the ward floor, they should be as effectually separated from the ward as possible. A convenient and very suitable place is that given in the plan (see illustration), the ventilation being provided for entirely separate from the hall way which leads to the ward. The closet room has ample window space and opens into the stair way, which naturally is a ventilating shaft.

4. *Store-Rooms.*—Store-rooms should be set apart, one for the medicines, instruments, and other appliances, and another for the clothes of patients.

5. *Ward Dining-Room.*—Every pavilion should have a dining-room so entirely separated from the ward that it is impossible to contaminate the ward atmosphere with the emanations from the food. It should be sufficiently isolated from all other apartments to prevent the air ever penetrating to them. It should communicate with the service-room of the basement by a lift.

Bath-Room.—We would exclude the bath-room altogether as an appendage of the ward, and substitute a portable bath for the ward, and a general bath-house for the hospital. The ordinary bath of the ward is generally a receptacle of filthy linen, and is rarely used for remedial purposes; even when it is so used it is of no other value than what follows cleansing with hot or cold water. This can be effectually done in the common portable bath. A general bath-house should be erected and provided with every facility for hot and cold, shower and swimming, sulphur and electrical, and other medicated baths. This establishment might be satisfactorily located in immediate contact with the laundry.

Day-Room.—In order to give proper effect to the external appearances of the administrative portion of the pavilion, a second story should be added, and in this we would arrange the day-room of the ward, in addition to any similar provision made at the free extremity of the ward. This room would be large, well lighted and aired, and would afford facilities for a reading-room or gymnasium.

The preceding plan of a proposed permanent pavilion is, as already stated, adapted to all the pavilions to be erected. Even the tent would best serve its purpose if its foundations and roof were permanently constructed in the form of the basement and roof prescribed for a permanent pavilion. If it is necessary to adapt any pavilion to special diseases or cases, the interior admits of any necessary changes.

We have to notice next the medium of communication between the wards.

Corridor and Sub-way of Administration.—The medium of communication between the pavilions, and between pavilions and the administrative buildings, is a part of the general plan. These passages are corridors, or perrons, and generally consist of enclosed walks variously arranged. The ordinary elevated and enclosed corridor is seriously obstructive of the free circulation of air over the grounds. In many instances it is so elevated as

to present a permanent barrier to the passage of currents of air. In order to obviate these objections, and yet secure all the advantages of the corridor, it is better to construct the passage-way partly under ground, and convert the top or roof into an open walk. This construction can be easily effected in the light soil of the site selected. This sub-way should be so arranged as to accommodate the gas pipes, the hot-air pipes, and the water mains at the bottom, so that they may be readily inspected. Above this chamber should be the floor of the sub-way for the passage of a tram, and for a walk for officers in stormy weather. The top should be an open walk for officers. It is desirable that this sub-way should have at least four feet of elevation above the surface of the ground, and that this part should be well supplied with windows for light and ventilation.

Relation of the Pavilions to each other.—A great variety of plans have been adopted of arranging the pavilions on the ground. Of all the plans proposed, that best adapted to secure isolation, exposure to sun and winds, and facility of administration will be pavilions parallel to each other. They may be arranged alternately on either side of a central corridor, or upon one side. In the former plan the administration extremities of the pavilions front alternately north and south; in the latter they may all be located on the northern extremity. The advantage of the former is compactness, and hence facility of administration; of the latter, exposure of the free extremities to the sun and winds, and freedom from contamination of the air of the service rooms. The latter plan is preferable. (See illustrations.)

Arrangement of Pavilions upon the Grounds.—It is important to separate as widely and effectually as possible the male and female portions of the general hospital. The two sexes of patients cannot safely be allowed to intermingle even on the grounds. They should not only be as widely separated as possible, but there should be an effectual bar against their approach to each other. We shall best accomplish this purpose by locating the pavilions for the different sexes on opposite portions of the grounds. The plan proposed is as follows: Locate the pavilions for the males on the southern, and the pavilions for the females on the northern section of the grounds. In order to carry out the full purpose of Mr. Hopkins, of providing ulti-

mately four hundred beds, there must be twenty pavilions or their equivalents in each section—each accommodating twenty patients. At the commencement but one or two pavilions need to be built in each section, and the remainder can be added as patients increase, or as circumstances require.

In arranging and distributing the single pavilions upon the grounds regard must be had: First. To the largest exposure of the wards to the sun and winds; Second. To the most complete isolation of one building from the other; Third. To convenience and economy of administration.

Exposure to the Sun and Winds.—In order to expose all parts of the ward most effectually to the sun, the long axis of the pavilion should run north and south, or as nearly in that direction as the grounds will permit. This position admits of complete exposure of the entire external part of the building, and of the interior of the wards, to the rays of the sun every twenty-four hours; and this direction of the long axis is most favorable to the currents of air on this site. The prevailing south wind would flush each side of the building, and the air escaping from the ward would be borne away from the adjoining pavilions.

Isolation of Pavilions.—The rule of separation of pavilions is thus given by Miss Nightingale: "The distance between the blocks should not be less than double the height of the block. * * A greater distance would be better, but this would involve a greater cost for land, and a greater distance to be traversed by the hospital staff. * * * If the wards are raised on basements, the rule as to distance should apply only to the height of the pavilion from the floor of the ground-floor ward." If separation of the pavilion is one of the most effective methods of securing isolation, it should not be prevented by so unimportant a consideration as the distance to be traversed by the hospital staff. The site of the proposed hospital favors adopting to the fullest extent every practicable method of protecting the sick from sources of danger due to their aggregation. We believe that the rule above given, and which has generally been followed, does not apply in this case, and should be discarded. We propose, therefore, to separate the pavilions on the same side of the corridor by a space of 100 feet.

Number of Pavilions of each class.—The last question which we have to determine in this connection is the number of pavil-

ions which will be required of each kind to meet the several classifications and conditions prescribed. We will take as a basis of calculation two hundred patients, such as are found in a general hospital, which admits the indigent sick of all ages, but limited to a single sex. There will be on an average twenty patients suffering from infectious diseases, as erysipelas, septicæmia, etc. For this number there should be provided two tent pavilions of the size of the permanent pavilions, each containing, not to exceed, ten patients. There will be forty patients suffering from acute medical and surgical diseases, attended with more or less suppurative inflammations of a possibly infectious character. These cases require isolation in buildings which, though well ventilated and cleansed, may require removal at long intervals. Two wooden pavilions, admitting twenty patients each, would accommodate this class. There will be 100 patients suffering from chronic affections, or who are convalescents; these cases require less area than any of the former, and could be amply classified and distributed in four pavilions. Finally, there will be forty patients represented by children, or those who pay, for whom two pavilions will be required. This system would require for one section of the hospital, for example that devoted to males, ten pavilions, as follows:—

2 tents accommodating.....	20	patients.
2 wooden pavilions or barracks accommodating	40	"
4 permanent pavilions accommodating.....	100	"
2 permanent pavilions accommodating.....	40	"
Total.....	200	

This arrangement is a number equal to one half of the proposed hospital. If the same provision is made for both sexes, which is the rule in general hospitals, we have but to duplicate the plan to meet the requirements of a general hospital having a capacity for 400 patients.

IV.

HEATING AND VENTILATION.

"Certainly not second in importance to any of the matters you are invited to instruct us upon, are those of ventilation and heating, and the kindred subjects of light and sunshine as curative agents. The various methods of heating, combined with ventilation, form professional problems about which the most experienced and best informed medical minds seem to be far from being united. Whether heating should be accomplished by steam or hot-water pipes radiating their heat directly into the room, or by the same agency imparting heat to air in chambers, to be thence sent into the apartment to be warmed; or by open fires in the angles or side walls; or by ventilating stoves in the centre of the ward; or by a combination of these methods, are subjects upon which opinions widely differ: and whether ventilation should be accomplished by what is called the natural method, through doors, windows, and unavoidable leakages, or through flues and ducts acted upon by the differing temperature of the outer and inner currents, or by enforced currents set in motion by fans, blowers, or other mechanical contrivances, are points which have equally earned advocates and opponents. To solve for ourselves these difficult problems, we invoke the aid of your experience and thoughtful judgment."—*Letter of Instruction of Trustees.*

The problems of heating and ventilation have always been difficult of solution, whether applied to hospitals or private residences. The methods which have been suggested and employed are innumerable, varying from the common fireplace to the most fanciful and expensive apparatus. And yet the objects sought, viz.: *the constant removal of foul air, and the constant supply of properly tempered fresh air, without noticeable currents,*

does not seem to present any extraordinary difficulties. But when we reflect upon the infinite varieties of apartments which are constructed, their external surroundings, and interior arrangements of rooms, we comprehend the complicated nature of the problem of their proper ventilation.

The different methods of ventilation may be reduced to three: 1. Natural ventilation, where the ordinary doors, windows, and heated fireplaces are relied on; 2. Vacuum, or exhaustion of the air of the room by heated shafts; 3. Plenum, or propulsion by a fan. These different methods have their special merits, which largely depend upon the circumstances under which they are employed. Natural ventilation is the simplest and most effective method yet devised in small and isolated buildings having proper inlets and outlets of air. It is not efficient in buildings or apartments so inclosed as to obstruct the free flow of the external air. The efficiency depends upon the degree and steadiness of the heat in the fireplace; but this will vary with the temperature of the external air, and so it will happen that at certain seasons, as in the summer, the ventilation may come to a standstill. If, however, the building has an unobstructed flow of external air around it, the ventilation will still prove efficient. The vacuum differs from the natural method simply in providing a permanently heated chimney with a constant suction power applied to the air of the ward. It is more expensive in construction, but when once completed is without further cost, as the shaft is heated by the fires necessary in the administrative buildings. It can readily be employed to supplement and make more effective the natural method. Plenum ventilation differs entirely from the other methods. Instead of attempting to draw the air through the wards by creating a vacuum, it seeks to force the air through by propulsion. Its advantages are that the air of the ward is constantly being agitated and finally driven out, owing to the large and forced accessions of fresh air. The power of the fan to create that constant pressure which insures movements of the air without sensible currents is proved by the anemometer. Without the fan this delicate instrument generally demonstrates stagnation in many parts of the ward, but when the fan is in operation, the rapidity of its movements shows the agitation of the air in every part. The value of the fan is greatest in large buildings of multiple stories inclosed

by other buildings, and in wards devoted to infectious diseases.* The great drawback to its general use is its expensiveness, and the want of means of diffusing the air properly. The machinery —a fan driven by steam—air tubes, air chambers for heating the air, etc., etc., is costly in construction and expensive in management.

There are many methods of warming the air of the wards of a hospital, but they are all more or less subservient to ventilation. The purpose of all these methods is to supply the ward with properly tempered air, free from all impurities, and with a due degree of moisture. That these objects are rarely fully attained is but too well known to every one. The air is liable to be over or under-heated, to be deprived of its moisture or of its proper proportion of oxygen, and to be saturated with irrespirable gases and other impurities. It is for this reason that all artificial methods of ventilation, which included the process of heating, have been so generally discarded, and the natural method preferred.

When we attempt to analyze the different methods of heating, we find they may be reduced to three: 1. The heating of the building itself, as the walls, floors, etc.; 2. The heating of the air of the building; and 3. The heating of air external and forcing it into the building.

1. It requires but a small amount of heat to warm the air of an inclosed room, provided the heat is properly diffused. A room is often comfortably warmed in winter by heated flues communicating with the kitchen fire, which warm large areas of the solid walls. So also a room so situated that the floor is all warmed by the heat in the room below, will be habitable in the coldest winter without other sources of heat. The explanation is very simple. The walls, floors, and other solid structures of dwellings and apartments are capable of receiving and storing up large quantities of heat, and of again imparting it to colder bodies and to the surrounding air. It is a question whether we do not overlook one of the most effective methods of warming

* . . "in the case of infectious diseases, it would seem in the abstract to be of the greatest importance that the patient should be in a current. . . Even in health we poison ourselves, and in disease we tend more rapidly in the same direction. Infectious emanations may be collecting round a patient, and if so, the still air will keep them more carefully near him."—Dr. August Smith, *op. cit.*

apartments, by neglecting so generally the simple processes of heating the walls, floors, and other solid structures of the building.* The best illustrations of this method of heating is seen in large conservatories and in the tent hospital. In the conservatory the ground is warmed by flues laid in the earth or under the floors, heated by furnaces situated outside of the building. In this manner a tropical climate is readily maintained in northern latitudes during the winter. In tent hospitals the heating apparatus is constructed on a similar plan: the stove, or fireplace, or furnace, is placed outside of the tent, and the ground, or space, if there is a cellar, under the tent floor is warmed by the flues leading from the fire to the chimney. By this arrangement the ground and the floors are maintained at a uniform temperature, and these impart their heat to the air of the ward. In some instances registers are inserted in the floor, through which the air beneath enters the ward. The records of temperature made in large tent hospitals heated in this manner, show remarkable uniformity at all times, and in all parts of the ward.† The system of ventilation in these wards is evidently natural. The egress and ingress of air is through the necessary openings, and largely through the materials of the tent itself.‡

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* "Our methods of warming are very cumbrous, and we seem to be behind ancient Rome and modern Russia. We warm the air, which changes in a moment, when a door or window is opened, and we do not warm the house itself. Builders make the walls thinner in these days, and we sit at a fire very much as savages over a blaze in the open air."—AUGUST SMITH.

† "The thermometer out of doors standing at 29° Fahr., we found the following temperatures existing within the tents, at five feet from the floor: At the entry of the first tent (over the furnace), 57°; second, 59°; third, 61°; fourth, 89°; fifth (farthest from the furnace), 55½°."—M. BREHAN, *The Am. Ambulance.*

"I have many times myself been a personal witness to the fact, that during the rigorous month of December, when the cold was ranging from 14° Fah. to 10° Fah., the temperature within the tents was maintained from 54° to 59° Fah., and that without forcing the fire."—M. JOLLY, *Ambulance Americaine.*

‡ "A canvas tent within which the air is warmed by a fire, is the best illustration which can be suggested of effective natural ventilation. Neither special inlets nor outlets for air, nor shafts, nor driving fans, are needed; the elevation of the general temperature necessary for the comfort of those within the tent in the winter season, with the free action of the wind without, is all that may be required to maintain a ventilation in every respect satisfactory; satisfactory, not only because it is sufficient, but because it is accomplished regularly and without draughts."—*The American Ambulance.*

This method of heating through hot-air chambers under the floor is capable of great extension. The pavilion may have all that portion of the basement directly beneath it converted into an air-chamber, in which are located the steam pipes. Thus, the floor of the ward would be suitably warmed. Registers could also be arranged in the floors, or the floors could be largely perforated, and thus diffuse the heated air in the ward. And again, the hollow wall space might be made to communicate with the air-chamber, and thus both walls and floor would be warmed. Finally, the air-chamber and hollow wall space could communicate with a space between the roof and the ceiling, and the entire wall surface would then be warmed. In this arrangement there would be great economy of heat, and the ventilation of the ward would be very complete.

2. The air of the ward is warmed by radiant heat from fireplaces, stoves, steam-pipes, etc. In this method of heating natural ventilation is generally adopted. The fireplace is the oldest method, and in many respects the most efficient. It provides both the means of heating and a powerfully drastic outlet for the air of the ward. Though wasteful of fuel, yet within the limits that it properly warms the air, it is the most efficient method of warming and ventilation ever employed. One of its best features is its self-regulating power. Heating by stoves, steam-pipes, etc., are well calculated to economize fuel, but they require great care in the regulation of the inlets and outlets of air, to preserve the air of the ward from being overcharged with impurities. There are many combinations of these methods, as fireplaces and stoves with air-chambers, jackets, etc., which answer a good purpose.

3. The method of heating the air externally, and forcing it into the wards, is seen in the ordinary furnace located in the base ment and in the hot-air chamber where the fan is employed. The machinery necessary to effect heating and ventilation properly by this method is somewhat complicated, and requires not only a nice adjustment of parts, but constant care in its management. Hence, while it is very efficient when properly employed, it is more readily deranged than any other method. It is more costly in its outfit, but very economical of the heat.

In appreciating these several methods of ventilation and heating, and their adaptation to the several parts of a general hospi-

tal, it may be stated that natural ventilation is best and most usefully applied in small buildings, standing quite alone, and with a free circulation of air around them. It is the only method which could be employed in a tent hospital. It can be made efficient in any temporary wooden structure. It is only slightly less efficient in permanent hospital-pavilions, which stand alone, with free circulation of air all around them. In buildings aggregated together, with inclosed courts and projecting portions, it is altogether inefficient. On the contrary, vacuum and plenum ventilation become more powerful and less expensive in proportion to the aggregation of buildings. We are, therefore, readily brought to the conclusion that natural ventilation should be relied on in all detached one-story buildings, and the vacuum and plenum ventilation should be adopted in two or more story permanent buildings, whether pavilions or administration.

Of the several methods of heating, that should be preferred which requires the least machinery and care on the part of ward attendants, and does not in itself tend to vitiate the air. In a temperate climate, where the thermometer fluctuates in winter between 40° F. and 25° F., the weekly mean being rarely below 30° F., no elaborate system of heating can be required. Either the common fireplace, or the ventilating fireplace, or some combination which embodies the familiar principle of the fireplace, should be adopted, or the ward should be warmed through the air-chamber heated by coils of steam-pipe. The latter method would prove the most economical, as the floors and walls could be so warmed as to be retentive of heat for long periods. It would require less supervision also on the part of attendants than any system which necessitated the frequent replenishing of fires.

V.

ADMINISTRATIVE BUILDINGS.

"In whatever plan may be adopted, we presume there will be no departure from the now very general method of a central administration building, with wards for the treatment of the sick as carefully separated therefrom and from each other as practicable. To the details of this building we specially invite your attention; the objects to be accommodated in it, the amount of room to be given to each, and their location in respect to each other for convenience of use.

"The location of the kitchen and its appurtenant offices is a subject of great practical importance, upon which new and, so far as we know, hitherto untried suggestions have been made. Whether it should be in a separate building from those devoted to administration or to the nursing and care of patients, or in the basement of some one of them, or in the upper story of any, are points open to discussion, and are to be carefully considered."—*Letter of Instruction of Trustees.*

The buildings required for administration should be so located as to be accessible to all branches of hospital administration, and yet not obstruct light and air over portions of the ground occupied by the pavilions. Nor should they be so situated that by any possibility the air of the pavilions can be contaminated by emanations from the works necessarily carried on within them.

Central Administrative Building.—One building must be devoted principally to offices and to the residence of officers. It should be so located as to be accessible both to the street and to the general hospital service. It should be sufficiently large to accommodate an apothecary's department and store-rooms in the basement, a reception room, superintendent's office and clerical rooms, trustees' room, dining-hall of officers on the first story,

nd living apartments of the superintendent and resident medical nd other officers, on second and third stories.

Kitchen.—The location of the kitchen is made the subject of pecial inquiry. Like the other administrative buildings, it is a ermanent structure, and too much care cannot be exercised in lacing it where it will best serve its purpose, without detriment o the sick. The air of the kitchen is necessarily more or less harged with the vaporized, gaseous, or other products of the ooking process, and although these materials may not at the nstant be injurious to the sick, yet they are liable to take on ew forms, or enter into new combinations which are very dele-erious. Three plans of locating the kitchen are mentioned, viz., in a separate building; 2. in the basement of a building; and on the upper story of the administrative building. Of these ifferent locations, the first is preferable to the others in the pre-ent case. The reasons are: First, There is ample surface area for e separate location and construction of the kitchen and its ppurtenant offices. Second, By thus giving complete isolation the kitchen, we relieve all of the other buildings of the possi-ility of contamination by its emanations. This relief cannot e obtained when the kitchen is located in the basement of nother building. In the basement of the administrative build-g, where it is more often located, it generates an atmosphere hich penetrates the entire house, and frequently renders the air f apartments on other stories highly offensive. Third, In the osition which we have selected, the kitchen is far more con-eniently located for the service of the hospital than if removed the roof of the administrative buildings. The communication ith the street, with the sub-ways of administration, and with e central administrative building is direct and convenient. As ere can be no other advantage of locating the kitchen in the asement, or in an upper story of another building, than economy f ground space, and perhaps in a limited degree of fuel, these asons do not apply in the present instance.

Laundry.—The laundry is peculiarly liable to contaminate the rrounding air. The foul linen subjected to steam heat gives f whatever products of animal excretion may be contained in eir texture. Hence this service should be isolated either in a parate and special building, or be located on the upper floor of e central administration building, as has been proposed in other

hospitals, and as is practised in certain hotels. Where the grounds are ample, there is less necessity of locating the laundry in or on the main administration building. In the present case it would be better to erect a laundry, separate from the other buildings, with an independent but thorough system of ventilation, by which the vapors and gases are drawn into the chimney and discharged at a great altitude. The most favorable situation on these grounds is on the central part of the eastern side. If located here, in connection with the boiler-rooms, the laundry will be convenient to all parts of the hospital, the ventilation can be rendered very perfect, and the prevailing western winds will remove all gaseous emanations and vapors from the grounds.

Bath-House and Gymnasium.—In connection with the laundry, a bath-house should be constructed. It should be of sufficient capacity to supply every needed facility for bathing, for cleanliness, and for medication. It should be supplied with hot and cold and swimming baths, hot air Turkish baths, and every form of medicated baths. In the same building should be a gymnasium, supplied with all the apparatus required for a general and special exercise.

Dimensions.—The dimensions of these various buildings and apartments will determine the dimensions of the main structures These are matters of detail which architects can best determine.

VI.

THE MEDICAL SCHOOL.

"You will bear constantly in mind that it is my wish and purpose that the Institution shall ultimately form a part of the Medical School of the University."—*Mr. Hopkins' Letter to the Trustees.*

* * * "As the Hospital will be used for clinical teaching to the medical classes of the University, it will be needful to consider what accommodation that subject will require, and how and where it should be provided. As closely connected therewith we should be glad to have your advice as to the most judicious location of the Medical School buildings of the University, that is, whether they should be in close proximity to the Hospital, or whether they can with equal profit and convenience be erected with the other buildings of the University a mile distant."—*Letter of Instructions of Trustees.*

Not the least interesting feature of the University scheme of education projected by Mr. Hopkins, is that which lays the foundation of a medical school in connection with a general hospital. The organized methods of medical education in this country are extremely imperfect, and practically yield little more than elementary instruction. The educating bodies are private corporations, empowered to fix their own standard of qualification, and to bestow on whom they please the doctorate of medicine. As these educating and licensing corporations are supported entirely by the fees of students, and are irresponsible to any other authority it naturally happens that in their rivalry for patronage the lowest possible standard of qualification obtains.

No school would presume to institute a preliminary examination of the students applying for admission to test their mental or educational fitness for the course of study.

In the lecture-room students of every grade of advancement are assembled to listen to the same lecture, and no oral examination is made except at the option of the student. In the final examination the student is required to answer a few technical questions, and is then advanced to the highest rank known to his profession. The consequence of this vicious system of education is that the standard of medical qualification is extremely low, the degree of Doctor of Medicine is a misnomer, and the country is overrun with titled but unqualified practitioners. In the munificence of Mr. Hopkins we have the prophecy and possibility of a reform in medical education which will be general in its character and permanent in its results. Incorporated into the University as an integral part of its system of education, the Faculty of Medicine will be required to subject their students to the same tests as are required in the other departments, to grade the course of instruction, and firmly to exclude all unqualified applicants for its degree of Doctor of Medicine. While there can be no doubt that a school thus organized and conducted would at first repel medical students who were pursuing their studies and seeking graduation through the old channels, it is equally certain that in the near future such a school would be the centre of attraction to the profession in all parts of the country, and would assume a national character and importance.

Relations of a Hospital to a Medical School.—No medical school can be regarded as properly endowed for instruction which has not the advantages afforded by a hospital. It is at the bedside only that the student can be successfully taught the practical duties of his profession. The hospital also furnishes the basis of pathological or morbid anatomy, a branch of medical education of the first importance. Facilities can also be furnished for the study of practical anatomy. In these three particulars the hospital should be required to contribute to the course of instruction pursued in the medical school.

To render the hospital available to the school, buildings should be constructed adapted for the care of the dead, for an operating room, for laboratories for the studies of practical and pathological anatomy, and for a museum.

Mortuary, Pathological Laboratories, and Museum.—One building could be arranged for the care of the dead, for anatomical laboratories, and for the museum. It should be located on

the exterior part of the grounds. In its underground portion should be constructed the vaults for the reception of the dead, a well-lighted room for post-mortem examination, and conveniences for visitors of the dead. It should communicate with the underground sub-ways for administration, through which the dead should be transported in air-tight caskets. The first story should have an entrance for students directly from the street, and be constructed for a lecture room, and laboratories for pathological investigations. The second story should contain the museum, and if practical anatomy is pursued at the hospital, its laboratories should be located on the upper story.

Operating Theatre.—The theatre for operations should be located on such portion of the grounds as will most effectually isolate it from the wards, from the kitchen and laundry, and from the buildings devoted to the care of the dead, and instruction in morbid anatomy. It should also have attached to it accident wards for both sexes, to which the recently operated may be removed, as well as accidents requiring operations.

In its arrangement care should be taken to prevent all unnecessary disturbance of the sick, before and after the operation. It is very inconvenient to convey such patients up and down stairs, and hence the ward and theatre should be on the same floor. There should be a private room in which anæsthetics are administered without exposure of the sick to the gaze and often ridicule of medical students. Private rooms for consultation with provision for instruments, and room for various surgical appliances should be provided.

VII.

CHAPEL.

"It is my especial request that the influences of religion should be felt in and impressed upon the whole management of the Hospital; but I desire, nevertheless, that the administration of the charity shall be undisturbed by sectarian influence, discipline, or control."—*Mr. Hopkins' Letter to the Trustees.*

The religious element is best impressed upon the management of a hospital by the constant and consistent exercise of all those virtues which belong to the Christian character by officers and nurses in the daily discharge of their duties. This fact is strikingly illustrated in those hospitals which are entirely under the administration of religious orders. Religious forms and exercises enter into the daily routine of management. But in a hospital, the administration of which is to be undisturbed by sectarian influence, discipline, or control, and yet the influences of religion are to be felt and impressed upon the whole management, there is need of a building or apartment set apart and dedicated to religious worship and instruction.

The chapel should stand quite apart from all other buildings, and should be devoted exclusively to worship and instruction. The practice of using the operating theatre for religious and other meetings should not be allowed, as the air is liable to become foul and poisonous to freshly made wounds. Nor should the chapel communicate directly with any of the pavilions, for in such cases it becomes a foul air chamber, which ventilates itself into the wards. It may very properly be located in one angle of the grounds, and thus stand apart from all other structures. In architectural finish it can be made a highly ornamental feature of the group of buildings, but should be in har-

mony with the structures occupying the several other angles of the grounds.

A chapel thus situated, and used for the moral and intellectual improvement of the sick, is by no means a superfluous building. It should be free to every denomination, and such special appointments should be made in construction and furniture as different religious sects might require. It would thus be in use almost daily for religious services. There should always be an organized school of instruction in the elements of an English education, for the benefit of those who need such instruction, and the number is always large in a general hospital. This school should be regularly conducted in the chapel. And, finally, there should be courses of lectures, concerts, and entertainments given for the amusement and instruction of the inmates. The importance of thus supplying the cravings of those sick of chronic diseases, or convalescents for mental recreation, can scarcely be overestimated.

VIII.

TRAINING SCHOOL FOR FEMALE NURSES.

"I desire you to establish, in connection with the hospital, a training school for female nurses. This provision will secure the services of women competent to care for the sick in the hospital wards, and will enable you to benefit the whole community by supplying it with a class of trained and experienced nurses."—*Mr. Hopkins' Letter to the Trustees.*

"Comprehended within these details will be the consideration of the accommodations for the training school for nurses, and whether they should be within the hospital buildings or separated from it."—*Letter of Instruction of Trustees.*

Every general hospital should have a well-organized training school for nurses as a part of its system of management. This is a duty which it owes alike to itself and to the community. A hospital is a school for nurses in the very nature of its service. All that is required to perfect such instruction is a well-devised plan by which it shall be rendered systematic. And nowhere else can a nurse be properly trained so as to acquire accurate knowledge and valuable experience.* Here she is under strict discipline; she sees every phase of disease, and becomes thoroughly familiar with every appliance in the care and treatment of the sick. The value of "trained and experienced nurses" in hospital practice

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* "With regard to an oft-disputed question, whether it is desirable to train probationers entirely in a *public* hospital, I should say, without hesitation, that it is there *only* that they *can* be trained."—MISS NIGHTINGALE, *Notes on Nursing.*

can not be over-stated.* However complete the hospital may be in all its details, and whatever other provision we make for the comfort and restoration of the sick, all will prove but of secondary value if those who have immediate care of the wards and of the administration are incompetent. Remedies are not more valueless administered by the ignorant than are the nicely adjusted provisions of ward details managed by unqualified and irresponsible nurses. And these facts apply with greater force to nurses in families, where the physician is not so constantly in attendance, and where the appliances are not so abundant.† Indeed, "trained and experienced" nurses, in the sense here contemplated, are unknown outside of the training school. The best nurses met with in families are totally ignorant of that elementary medical knowledge which is the basis of the intelligent care of the sick.‡ They are harmless, perhaps, in simple cases, but in emergencies they are powerless to do good. This is no fault of nurses, for hitherto there has been no opportunity offered them in the general hospitals of this country to gain a truly professional education. In making the "Training School for Female Nurses" one of the foundation stones of this charity a service will be rendered to the public of great and ever-increasing magnitude.

The organization of the school should be part of the general plan of administration, for its first object is to supply the hospital with "trained and experienced nurses." In the first place, a suitable building should be erected on a convenient part of the grounds. It should be located where the occupants would be free from noise, and from contact with the routine of administration. It should be of sufficient dimensions to accommodate the

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* "When the disease is formidable, and the result of the struggle doubtful, the success or failure of the physician will in a great measure depend upon the skill and ability with which the nurse economizes and sustains the vital powers of the patient, whose recovery or death will depend quite as much on the qualifications of the nurse as of the physician."—SIR JOHN MCNEILL.

† "I am bound to say that I think more patients are lost by want of care and ingenuity in these momentous minutiæ (attention to diet) in private nursing than in public hospitals."—MISS NIGHTINGALE.

‡ "The nurse's work is, in fact, a very important part of medical practice, and for its due exercise requires a considerable amount of knowledge, both of the laws of health and disease."—MISS NIGHTINGALE.

matron and the entire staff of nurses and assistant nurses with dining, living, and sleeping rooms. The grounds should be ample for exercise and the cultivation of flowers. In this building all the nurses should have separate apartments, in which they live and keep their clothes and all articles necessary for their use.

Dr. W. G. Wylie * thus describes the quarters of the nurses at St. Thomas's Hospital, London:—

"The building which has been erected for the accommodation of the probationers (St. Thomas's Hospital, London), called the 'Nightingale Home,' adjoins the house of the matron. . . . It is entered from the main corridor of the hospital, and contains on the ground floor a capacious dining-room, with adjoining room for the sister in charge. Above these are four floors of bed-rooms, affording a separate room for each of the thirty-five probationers, bath-rooms, and a day-room for convalescents."

The training school for nurses connected with Bellevue Hospital, New York, is organized on the plan of that at St. Thomas. The apartments of the nurses are outside of the hospital, in a building on an adjoining street. When relieved of duty the nurses retire to their "home," and are entirely free from care. This school has proved a marked success in every respect.

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* See *Letter to State Charities Aid Association*, New York.

IX.

ADMINISTRATION.

"It will be your especial duty to secure for the hospital surgeons and physicians of the highest character and greatest skill."—*Mr. Hopkins' Letter to Trustees.*

"Upon the subject of management, with its numerous details of medical attendance, residental and occasional, nursing, domestic service, police regulations, etc., etc., we should be glad of any advice, and, indeed, with reference to the whole matter, our wish is to put you in our place, so far as to learn from you how you would execute the trust we are now seeking to be instructed about, if it were confided to you."—*Letter of Instruction of Trustees.*

Successful administration of the affairs of a general hospital requires the most complete subordination of all departments to the governing board or its representative, and the most perfect harmony between these several departments. Governing boards may not act judiciously, but as their will is supreme, their rules must be implicitly obeyed. Every act of insubordination must be promptly met and adequately punished. However arbitrary such regulations may seem to be, all experience proves that civil hospitals cannot be successfully managed without giving to the administration something approaching military discipline. The duties of administration of a general hospital may be divided as follows:—

1. *The Executive Duties;*
2. *The Medical and Surgical Care of the Sick;*
3. *The Nursing;*
4. *The Duties of Warden.*

1. *The Executive Duties.*—There must be but one executive head in a general hospital, and he must be held rigidly responsible to the governing board. He should be selected for his intimate familiarity with all the details of hospital administration, and for his known executive ability. Experience has also amply proved that he should be a medical man who has been thoroughly trained in hospital practice. His title should be that of "*Superintendent*," or "*Medical Superintendent*," and he should have general charge of the entire establishment. It should be his duty to enforce all rules and regulations, and all officers and employees should be subject to his control under the rules. He should have no direction whatever of the medical and surgical treatment of patients except in cases of emergency.

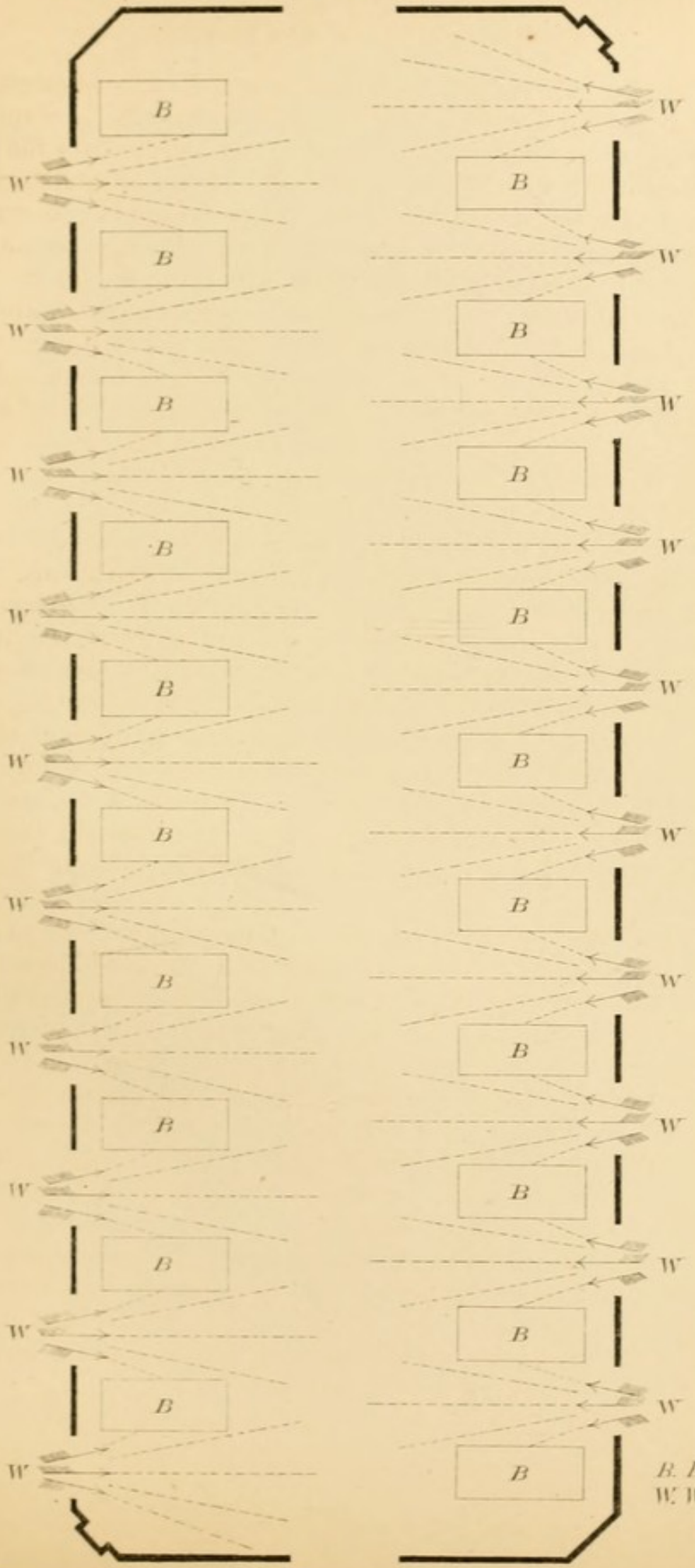
2. *The Medical and Surgical Care of the Sick.*—The care and treatment of the sick should be under the exclusive control of the visiting and resident staff of physicians and surgeons. The visiting staff should constitute a medical board. They should prepare rules governing the resident medical staff and the nurses in their duties in the wards, to be approved by the trustees. The resident medical staff should consist of three grades, viz.: house physician or surgeon, senior assistant, and junior assistant. They should have their living apartments in the administrative building, and should serve in each grade six months, or at the longest, one year. The medical board should have no other disciplinary power than that of suspension from duty of an offender.

3. *The Duties of Nursing.*—The entire charge of the nursing should be under the matron, who should be the lady superintendent of the training school. She should be held responsible for the rigid enforcement of the rules governing the corps of nurses. The grades of nurses should be nearly as follows:—1. Two division nurses, who are the chief nurses of the male and female divisions; 2. Ward nurses, two for each ward, and designed to relieve each other both day and night; 3. Ward maids, two for each ward, who are to do cleaning and render needed assistance about the care of the patients.

In a hospital that has a well-organized training school as a part of its management, there should be the most perfect system of nursing. The candidates for nurses should be carefully selected, and the training should insure that intelligent subordina-

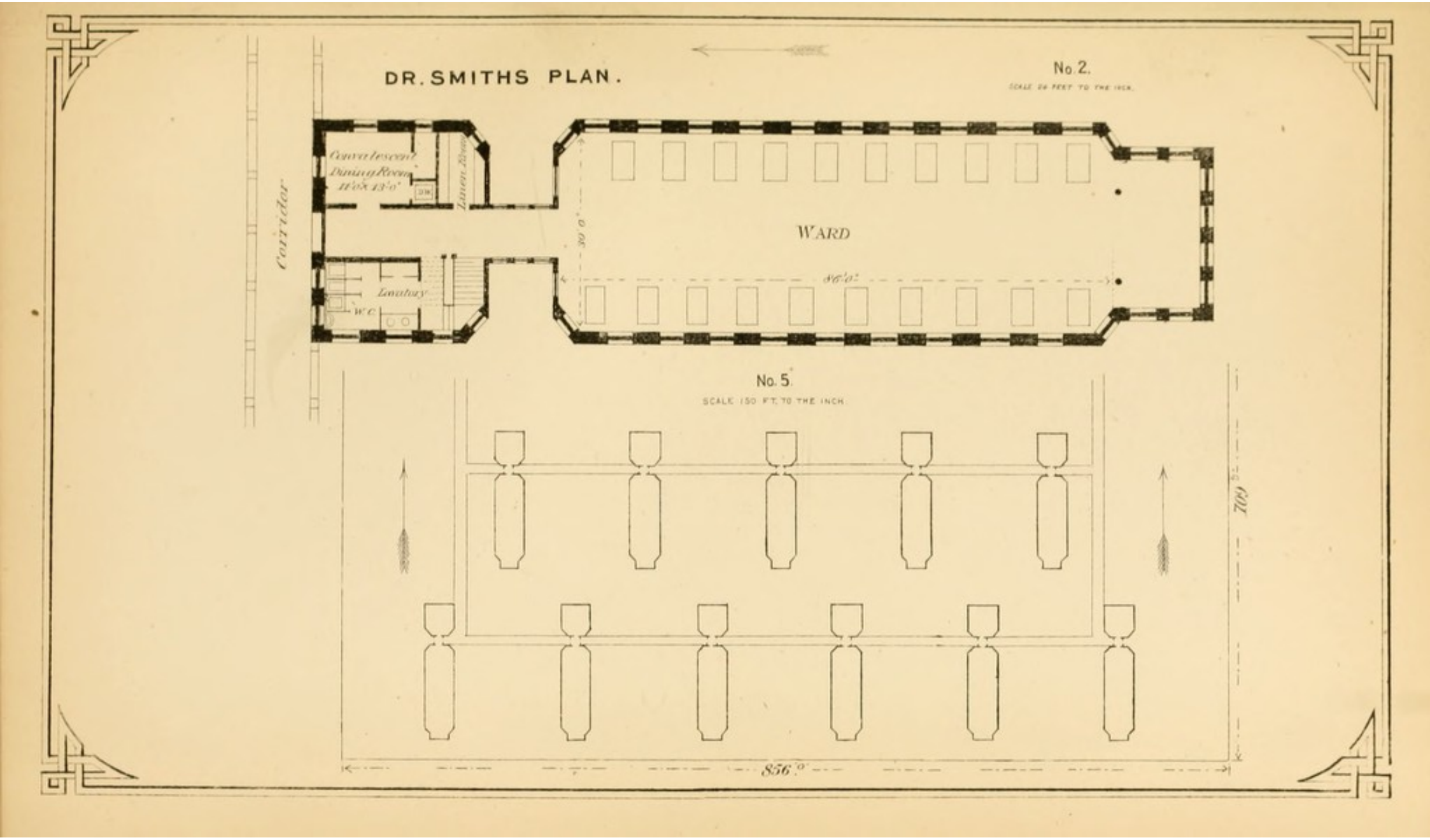
PLAN OF WINDOWS AND BEDS.

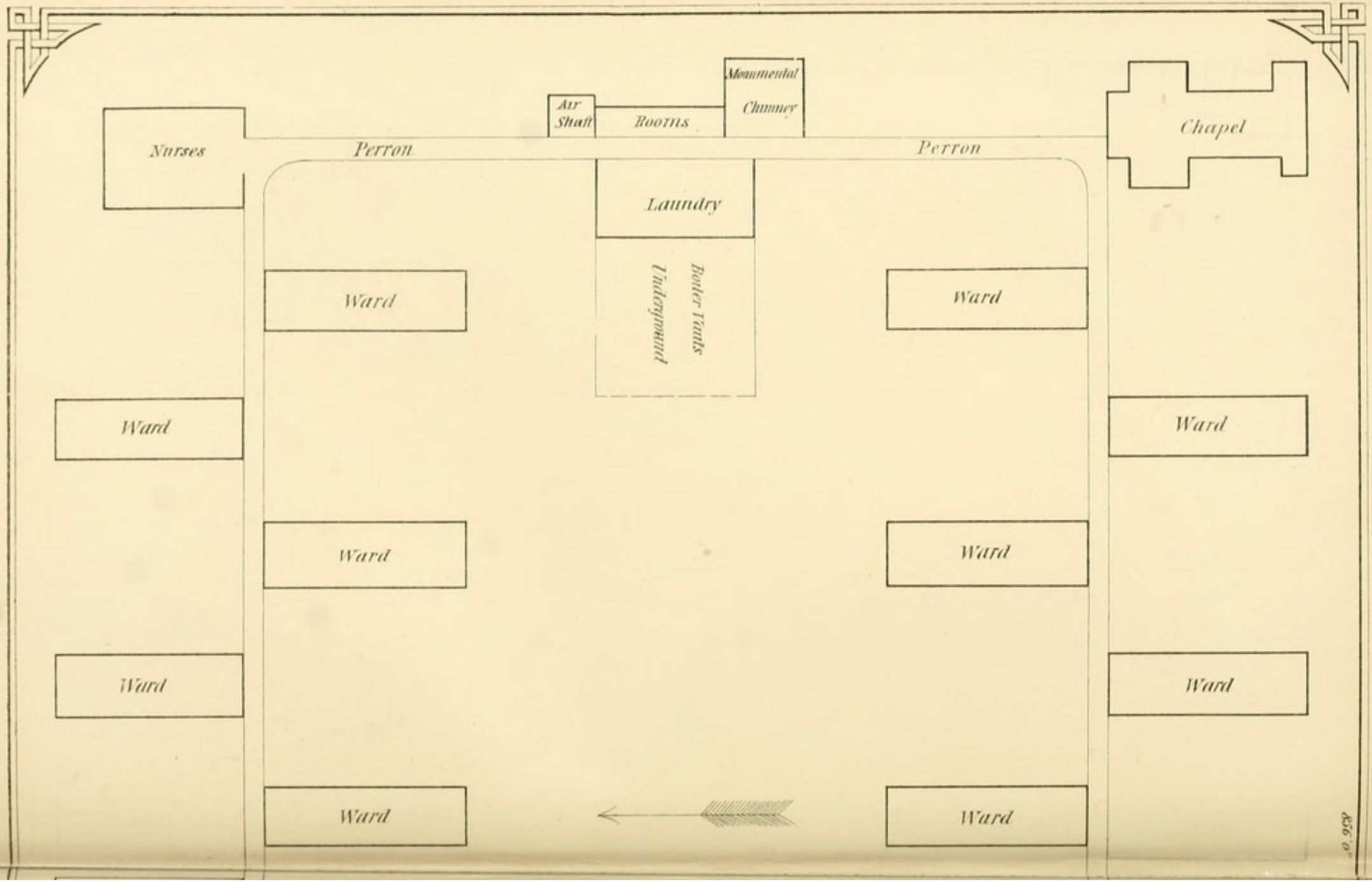
No. I.



DR. SMITHS PLAN.

B. Beds.
W. Windows.


DR. SMITHS PLAN.
No. 2.
SCALE 24 FEET TO THE INCH.
Convalescent Dining Room 11'0" x 13'0"
Linen Room
Corridor
Lavatory
W.C.
WARD
30'0"
86'0"
No. 5.
SCALE 150 FT. TO THE INCH.
709'0"
856'0"


Monumental Chimney
Air Shaft
Rooms
Nurses
Perron
Perron
Chapel
Laundry
Boiler Vaults Underground
Ward
Ward
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Ward
Ward
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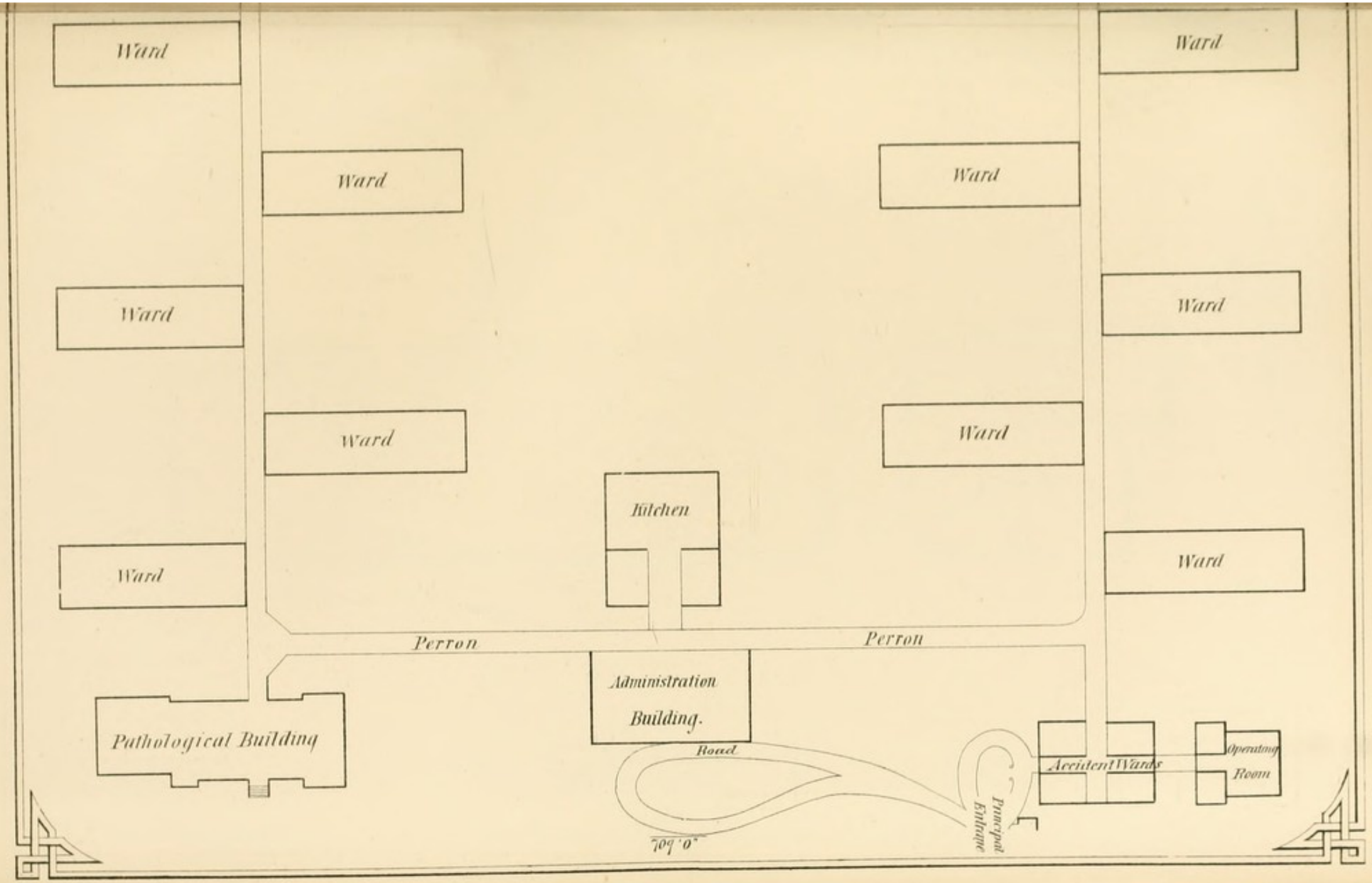
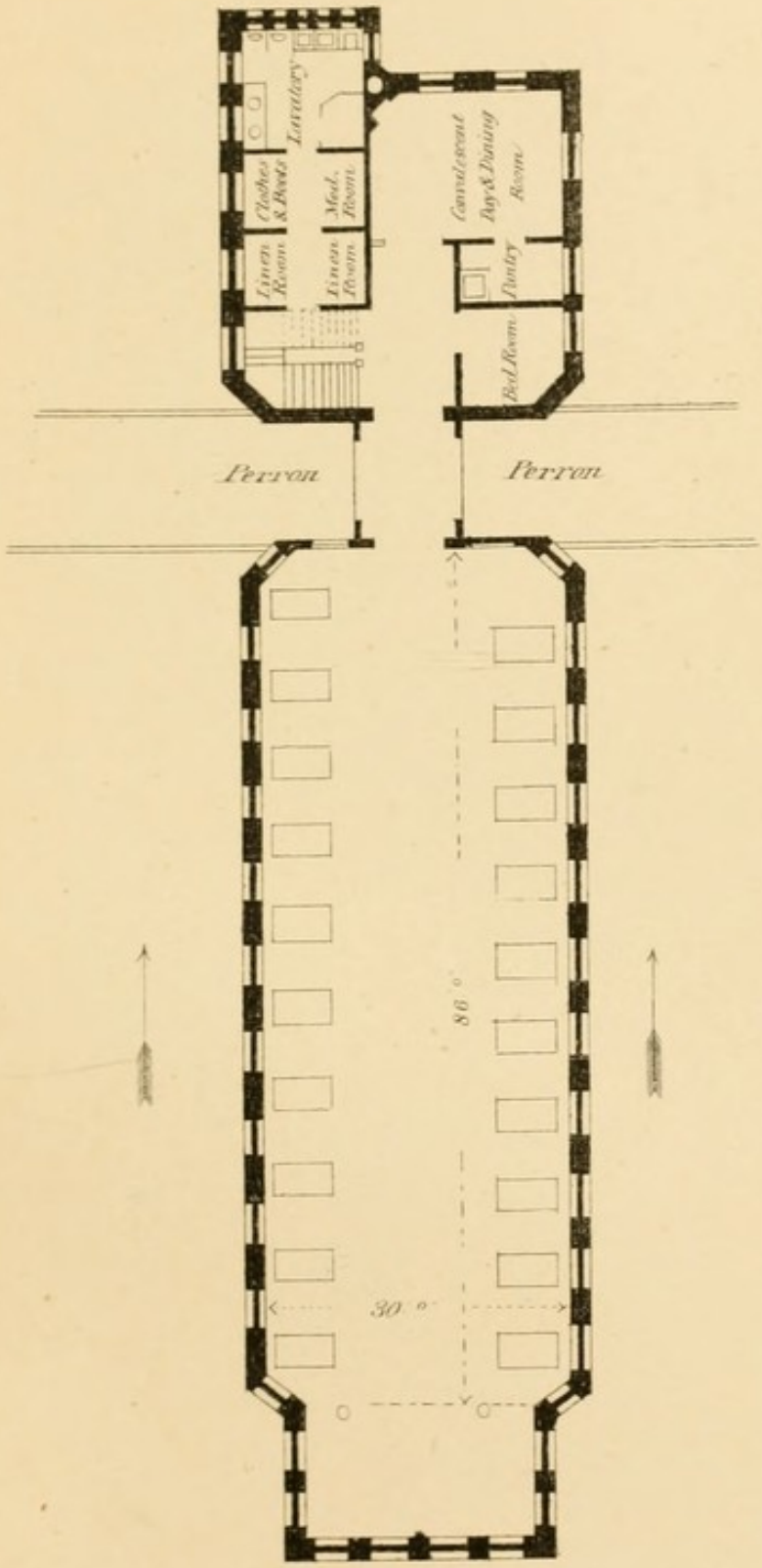
Ward


Ward
Ward
Ward
Ward
Ward
Ward
Ward
Ward
Ward
Ward
Kitchen
Perron
Perron
Administration Building.
Pathological Building
Road
709' 0"
Principal Entrance
Accident Wards
Operating Room

DR. SMITHS PLAN.

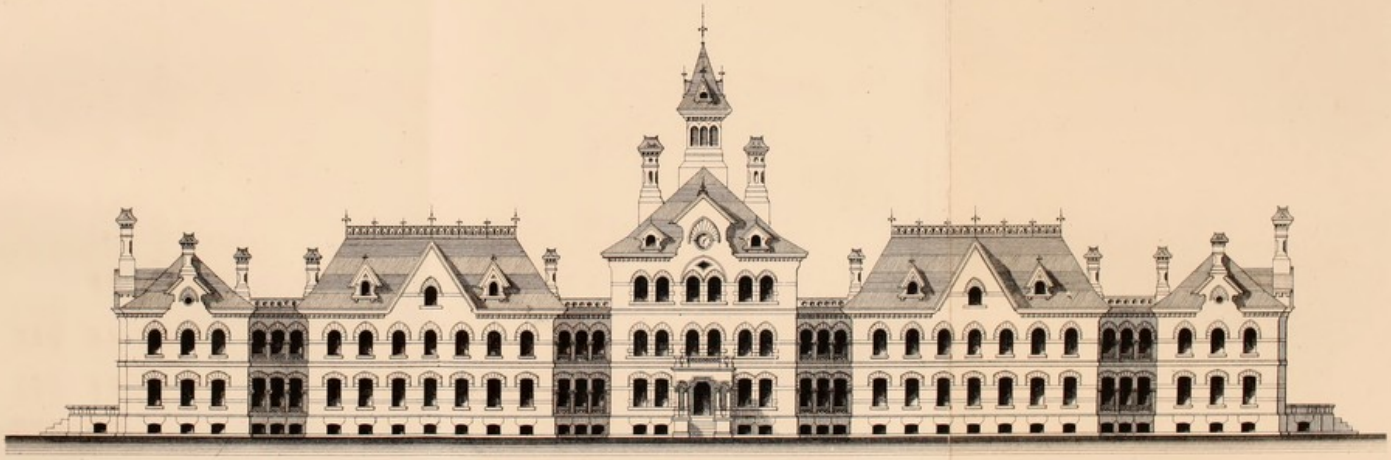
No. 4



tion of the entire staff to rules and duty which gives the necessary discipline in the wards, and effectiveness to the service. Nor should these duties be rendered onerous by too great confinement, nor by overwork. Nurses should be so frequently relieved that they cannot become weary, and when relieved they should be allowed to be entirely free from all care pertaining to their service. They should sleep in their own apartments, and have their own methods of recreation undisturbed. By the proper distribution of duty and recreation nurses will never flag in interest, nor allow the slightest breach of discipline to occur.

The Duties of Warden.—The warden should have supervision of the administrative department, and be responsible for the proper management of all its details.

APPENDICES.



JOHNS HOPKINS COLORED ORPHAN ASYLUM

No I.

SCALE 30 FEET = 1 INCH.

JOHN R. NIERNSEE, ARCHITECT.

APPENDIX I.

DESCRIPTION OF THE PLAN ADOPTED FOR THE "JOHNS HOPKINS' COLORED ORPHAN ASYLUM" FOR 300 CHILDREN, AT BALTIMORE, MD.,

BY

JOHN R. NIERNSÉE, F.A.I.A.,

ARCHITECT TO THE BOARD OF TRUSTEES "JOHNS HOPKINS' HOSPITAL, CORRESPONDING MEMBER OF THE AUSTRIAN INSTITUTE OF ARCHITECTS AND CIVIL ENGINEERS, MEMBER OF THE U. S. COMMISSION OF SCIENCE AND ART, AND OF THE JURY OF THE EXPOSITION OF VIENNA IN 1873.

THE building is designed in the simplest style of mediæval architecture—two stories in height for the wings, and three stories for the centre building. The third story of the centre building is altogether devoted to the Infirmary, thus being out of the reach of spreading contagion to the living part of the Institution, and located where most accessible to the greatest supply of pure air and sunlight.

The whole group of the block plan consists of six isolated buildings, connected by corridors with each other, a plan selected by the Trustees as affording the best and largest supply of light and ventilation from any side.

The space under the high pitched slate roofs is nowhere used for occupation, but only for protection against the heat and cold of the upper stories, and for the purpose of ventilation. At the same time this feature adds to the character and impressiveness of the style, and gives a pleasant effect to the beauty of the sky-line of the building group. For general effect, the boldness of the projections, the outlines of the various buildings of the group, with their gables, ornamental chimney, and ventilating shafts, high-pitched and band-coursed slate roofs, simple but effective brick or galvanized iron cornices, a few colored brick

bands and arches to break up the dulness of the large brick fronts around the group, and a central and useful belfry, are relied upon for the external architectural effect, without a dollar's worth of mere embellishment.

Every apartment will be provided with large open fireplaces, besides auxiliary hot-water or steam heating—both systems of heating combined with large air-flues for ventilation on the exhausting principle.

Liberal areas and cubic spaces have been provided for the various departments, in accordance with the sanitary requirements of the best medical authorities. Thus the school and class-rooms furnish an average area of 20 square feet or 305 cubic feet of space per head. The dormitories furnish 46 square feet or 687 cubic feet per head, and the infirmary 80 square feet or 1,253 cubic feet per head.

The stairs and connecting corridors are proposed to be fire-proof, all partitions to be of brick, and the floor directly under the roof to be made fire-proof by cement concreting. The north windows to be double-sash or double-glazed, for economizing heat and preserving a more uniform temperature in winter.

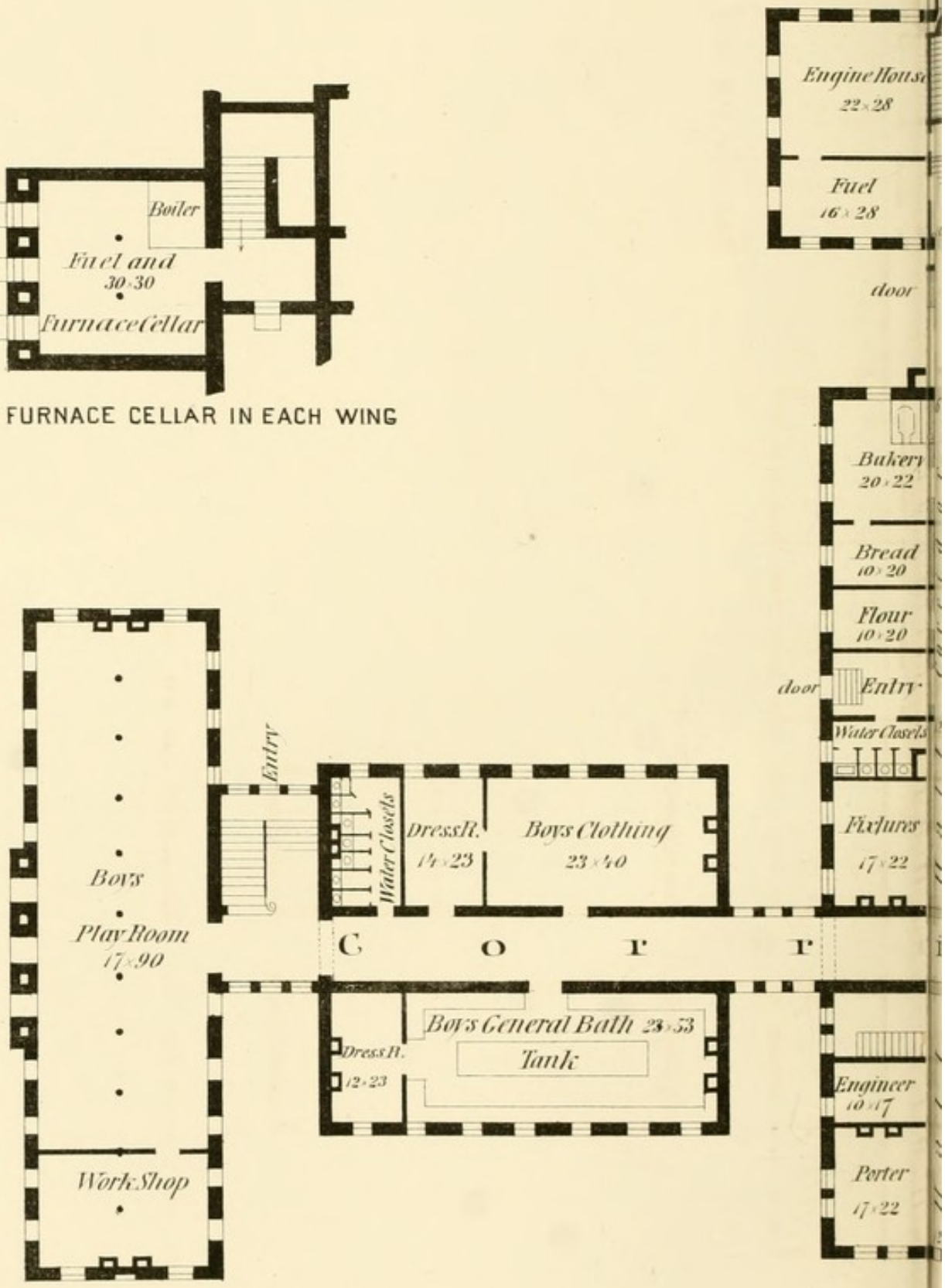
The double dormitories bordering on the corridor of the lateral front building and the infirmary-rooms on the third floor will have large transom ventilation over the corridor ceilings, lowered for that purpose, and connecting with a large ventilator at the centre space of the roof. Revolving, self-coiling outside shutters are proposed for all the windows, to take the place of the ordinary outside Venetian shutter. Ample accommodations have have been provided for three hundred (300) children and the necessary officers and attendants.

No. 1—Presents a front elevation of the buildings in the modified mediæval style, with gables and belfry, banded or figured slate roof and crestings, and large handsome central entrance porch. The whole extent of the front is 329 feet. There will be a basement of 11 feet in height throughout the building; the principal floor will be elevated from 6 to 7 feet above the ground; each of the two upper stories will be 15 feet clear height, and the central third or infirmary floor, 16 feet clear. The material employed will be brick, with colored brick bands and arches. The sills and base of the building will be of granite or of "Cheat River" freestone. The outline of the proportions and form

JOHNS HOPKINS COLO

PLAN O

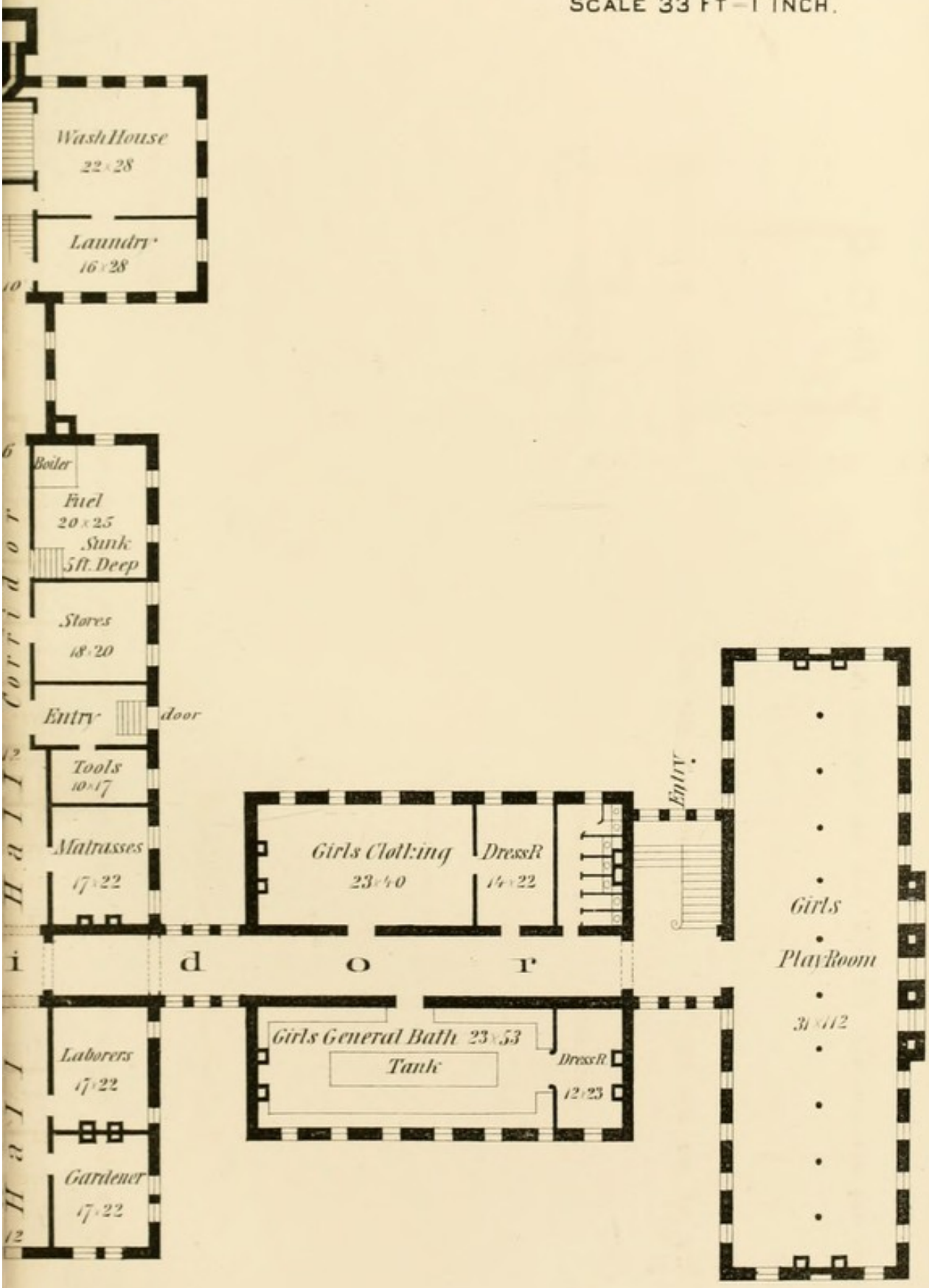
PLAN OF FURNACE CELLAR IN EACH WING



RED ORPHAN ASYLUM

BASEMENT

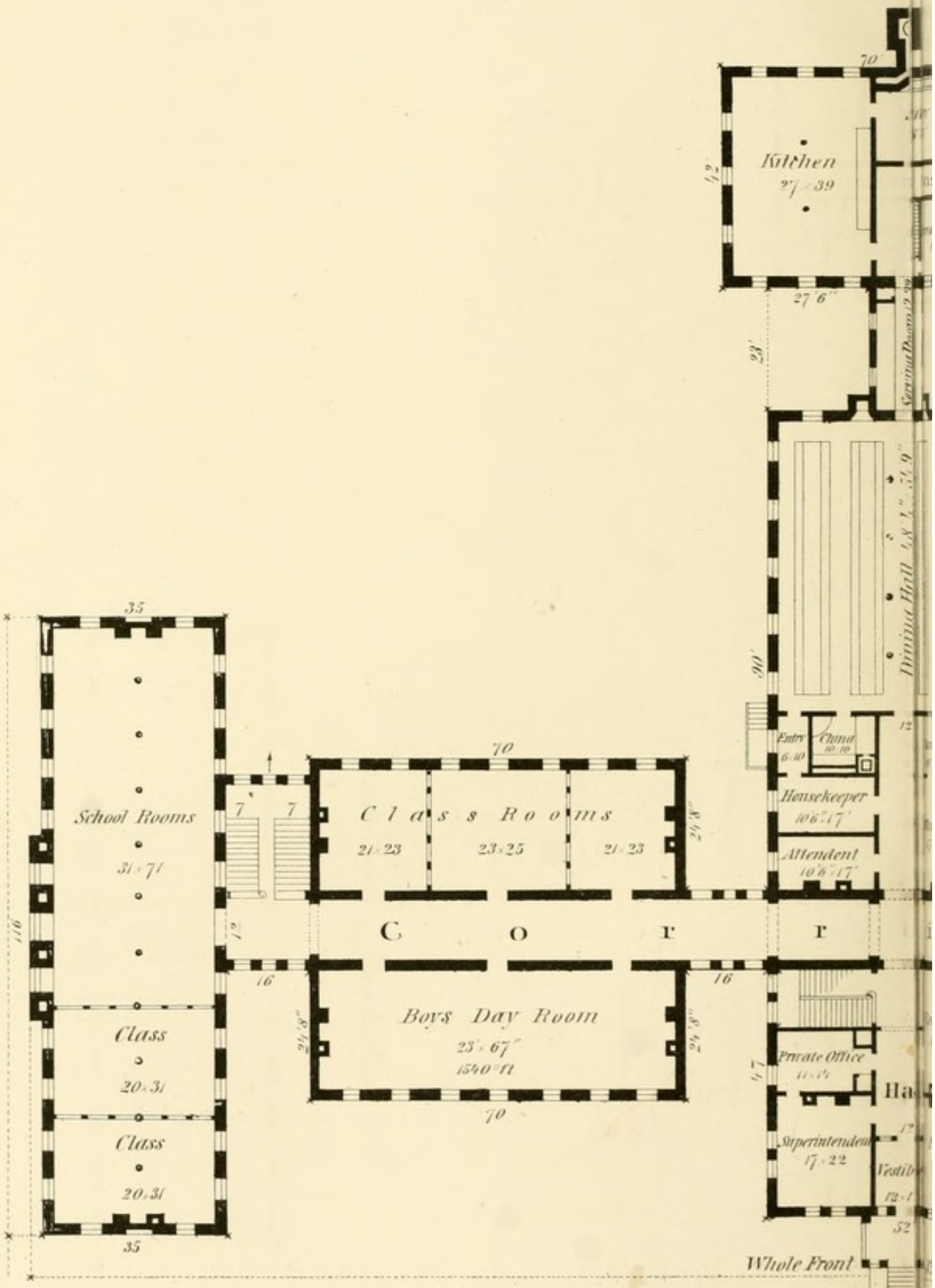
No. 2.
SCALE 33 FT – 1 INCH.



JOHN R. NIERNSEE, ARCHITECT.

JOHNS HOPKINS COL

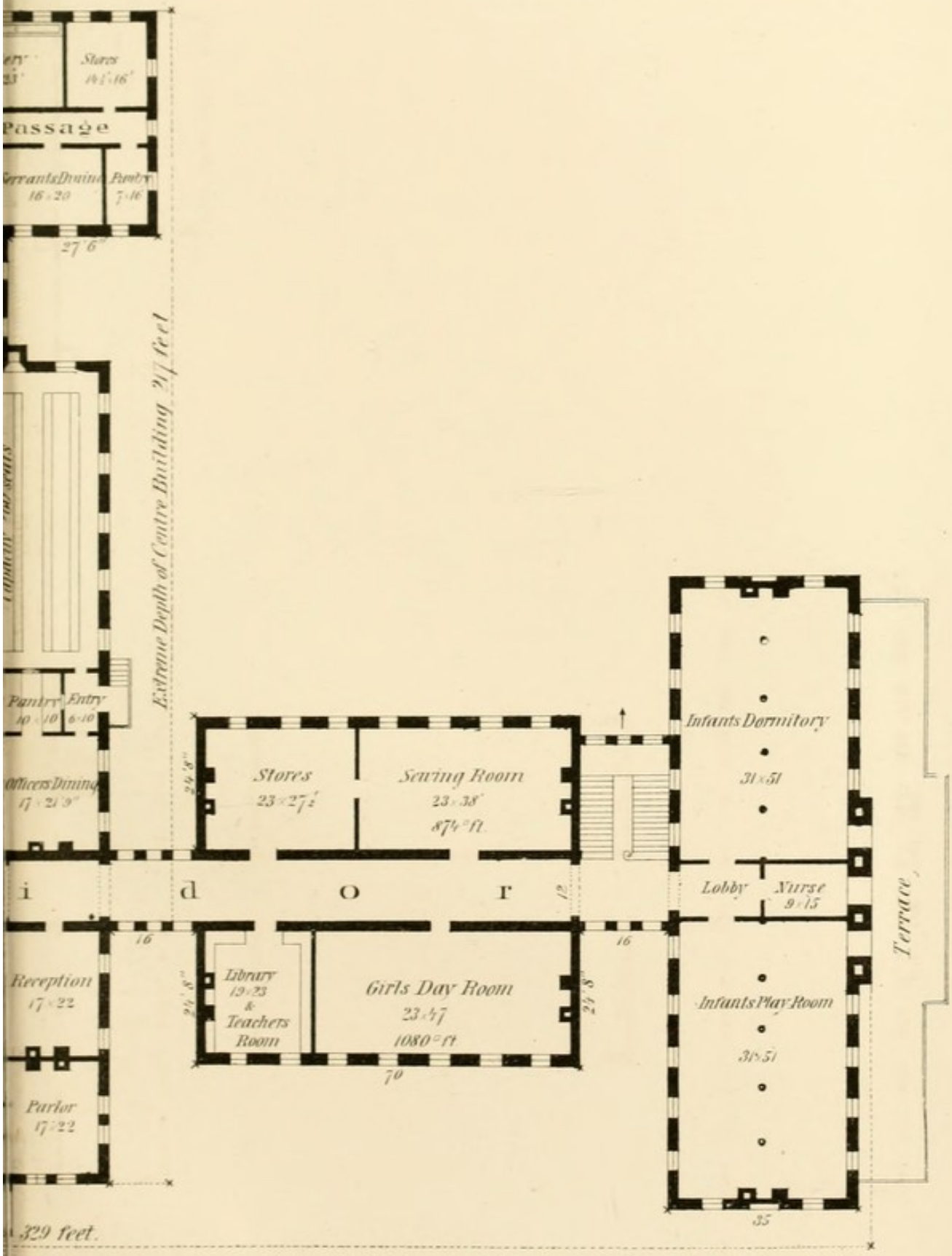
PLAN OF PRI



RED ORPHAN ASYLUM

PAL FLOOR.

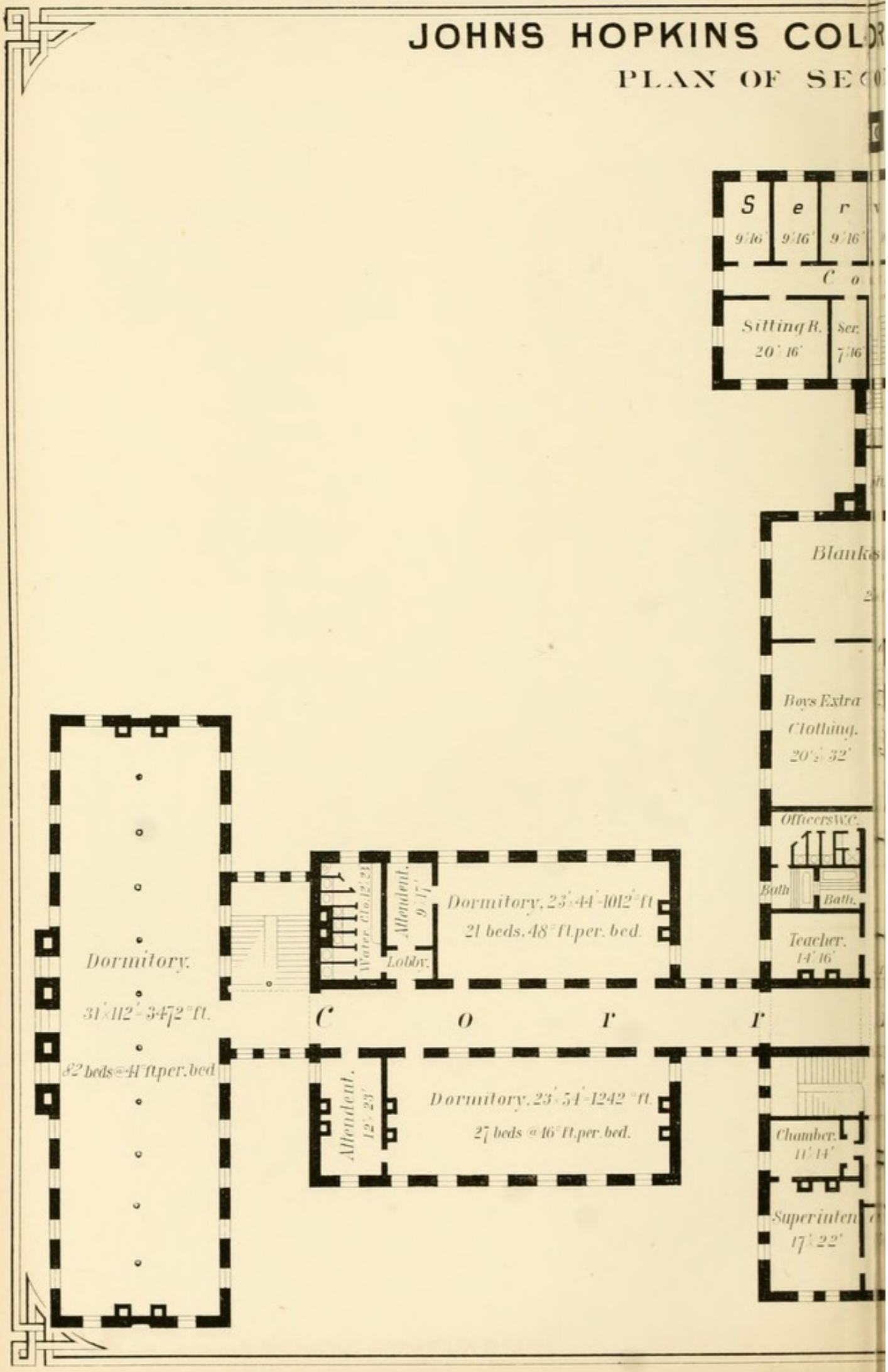
No. 3.
SCALE 33 FEET TO 1 INCH.



JOHN R. NIERNSEE, ARCHITECT.
BALTIMORE, Md.

JOHNS HOPKINS COL

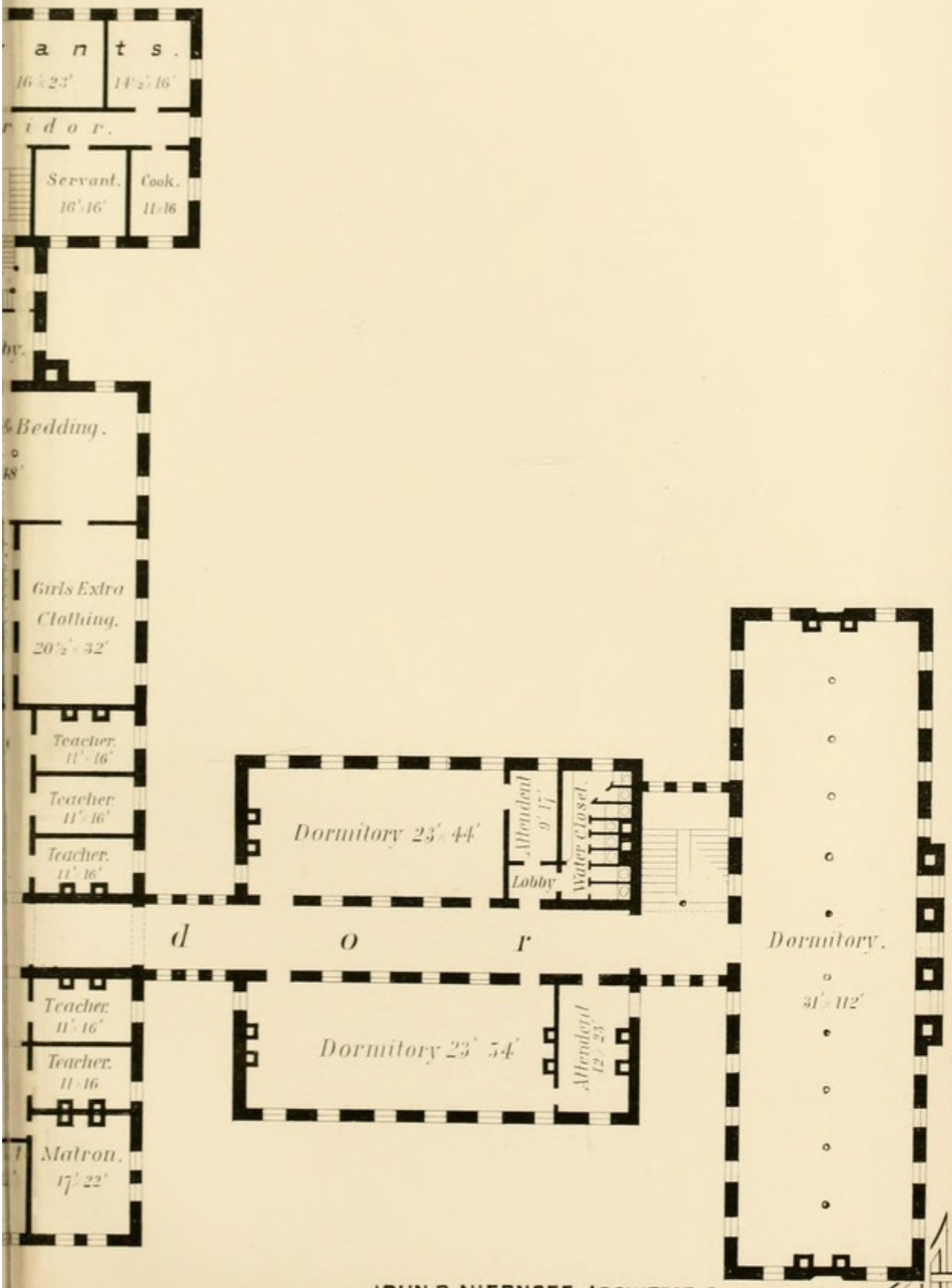
PLAN OF SEC



RED ORPHAN ASYLUM

OND FLOOR.

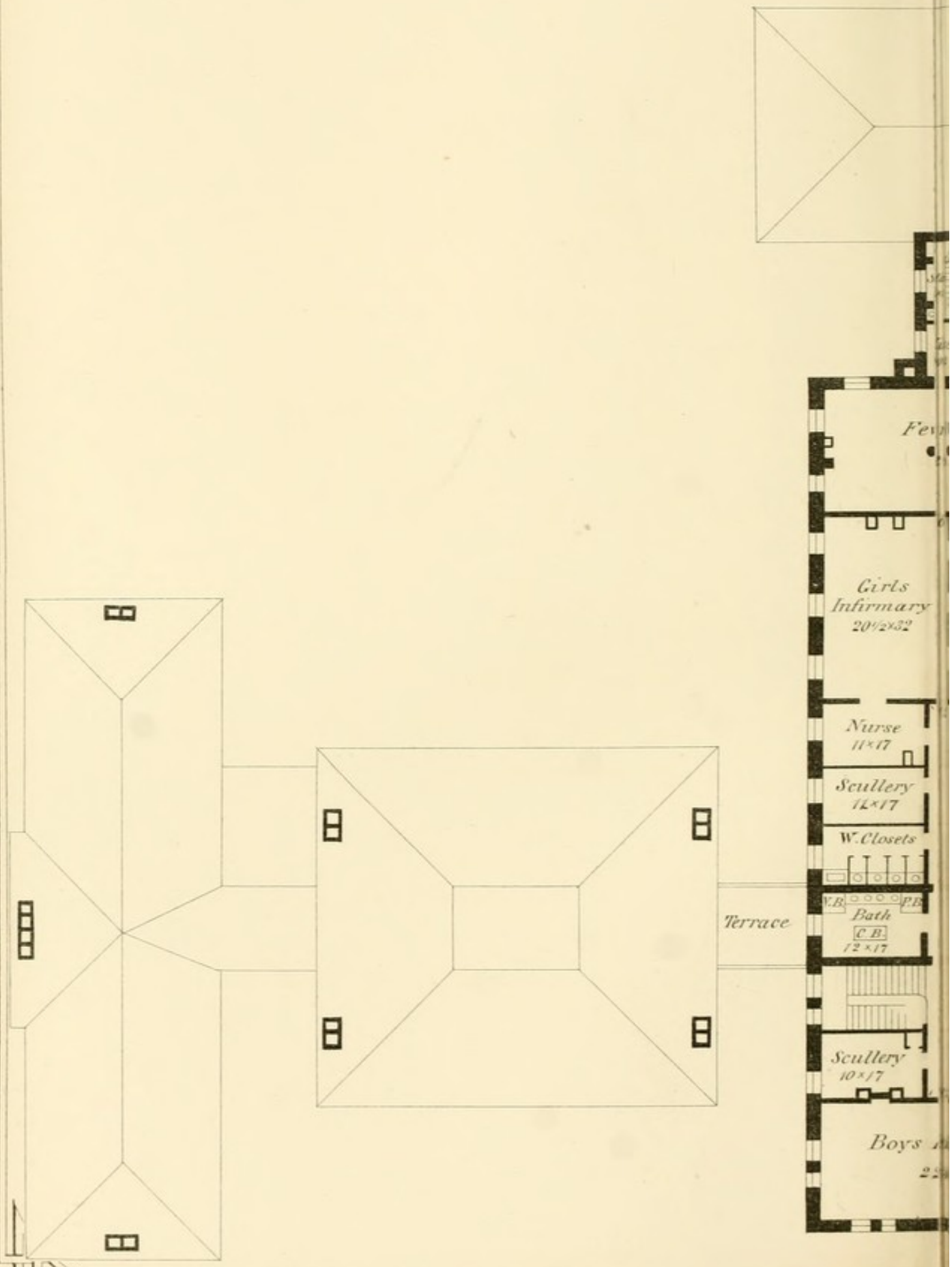
No. 4.
SCALE 30 — 1 INCH



JOHN R. NIERNSEE, ARCHITECT, BALTIMORE, MD.

JOHNS HOPKINS COL

PLAN OF THIRD O

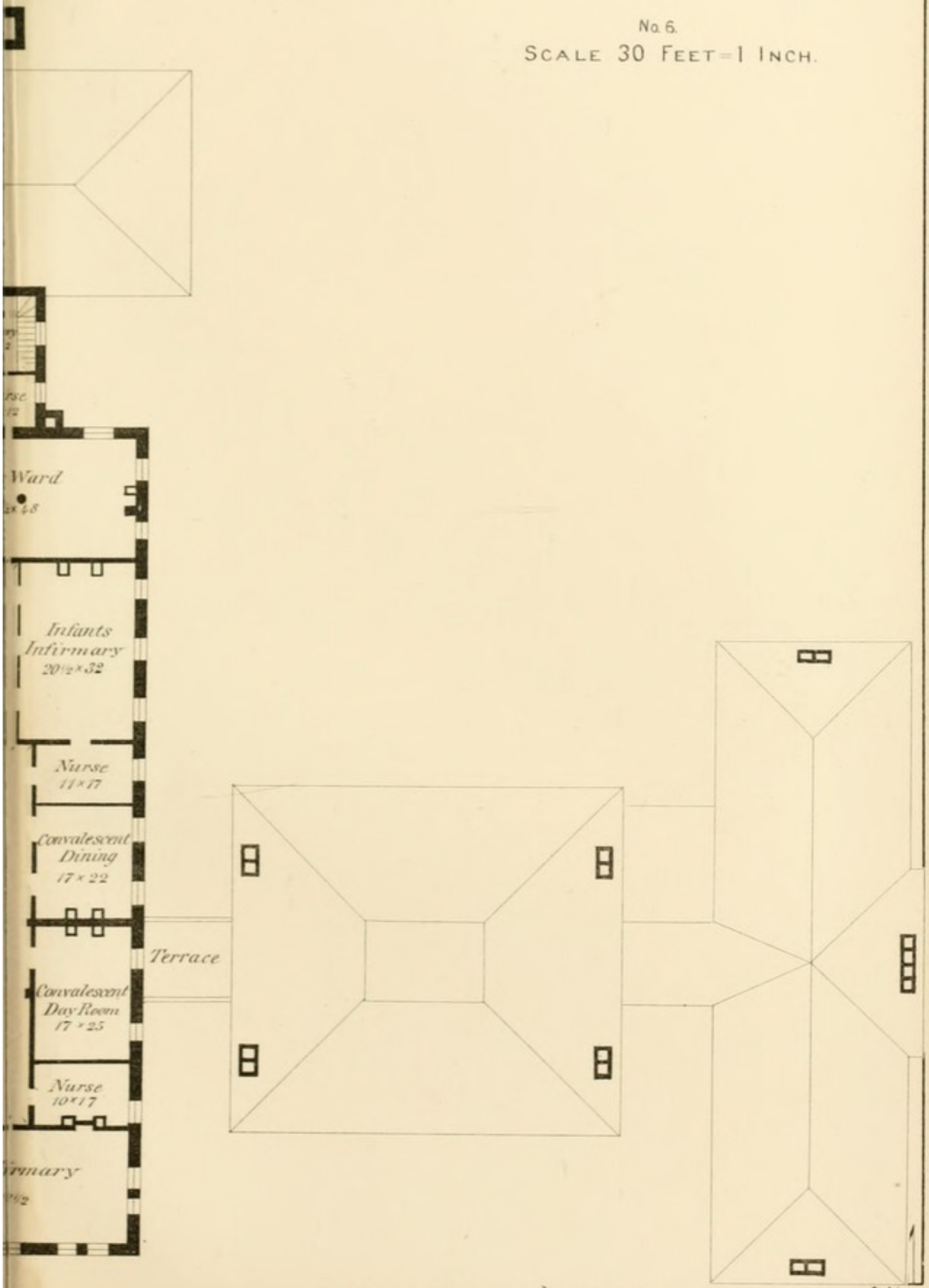


RED ORPHAN ASYLUM

INFIRMARY FLOOR.

No. 6.

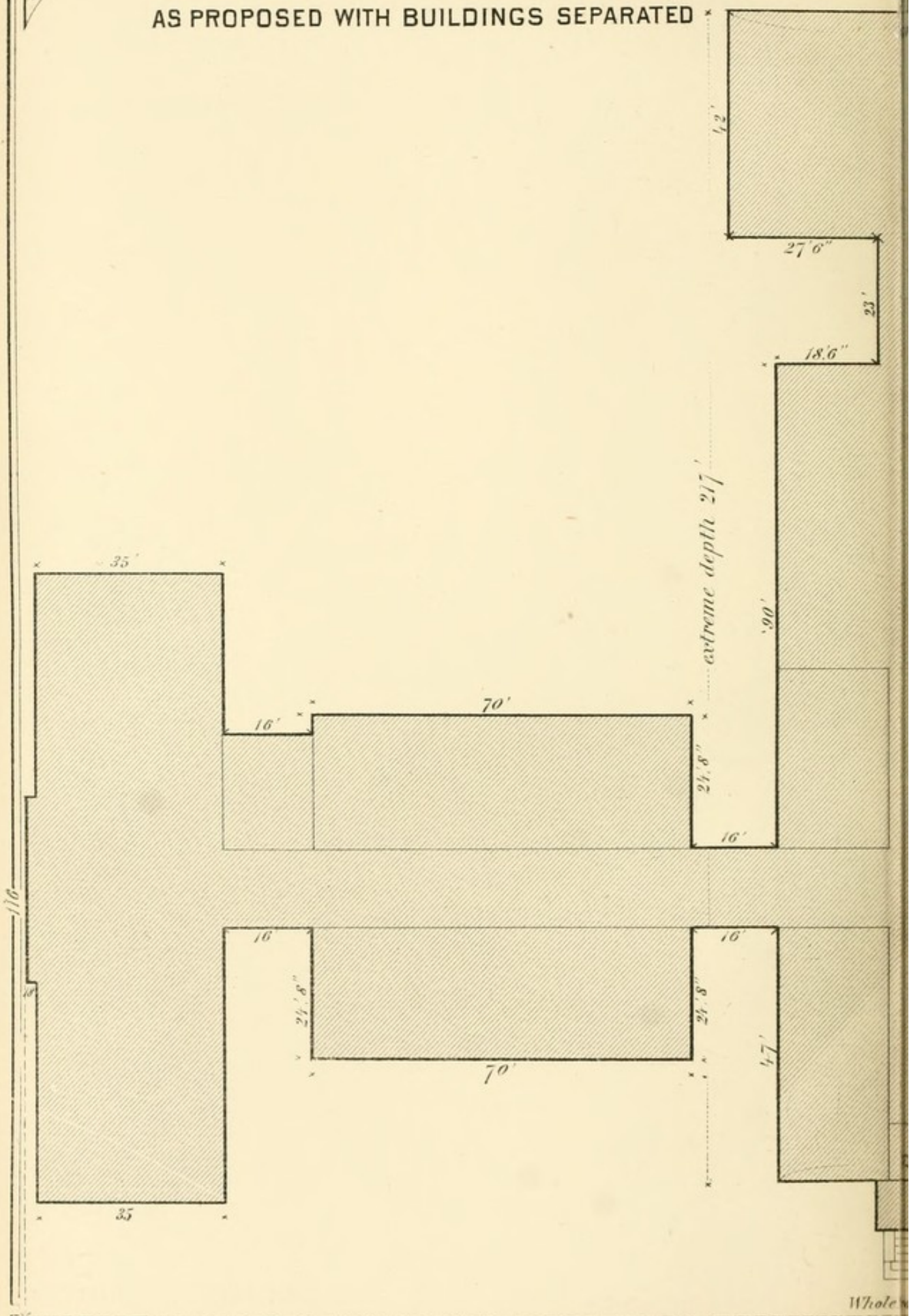
SCALE 30 FEET = 1 INCH.



JOHN R. NIERNSEE, ARCHITECT.

BLOCK PLAN OF THE JOHNS HOPKINS COLORED

AS PROPOSED WITH BUILDINGS SEPARATED

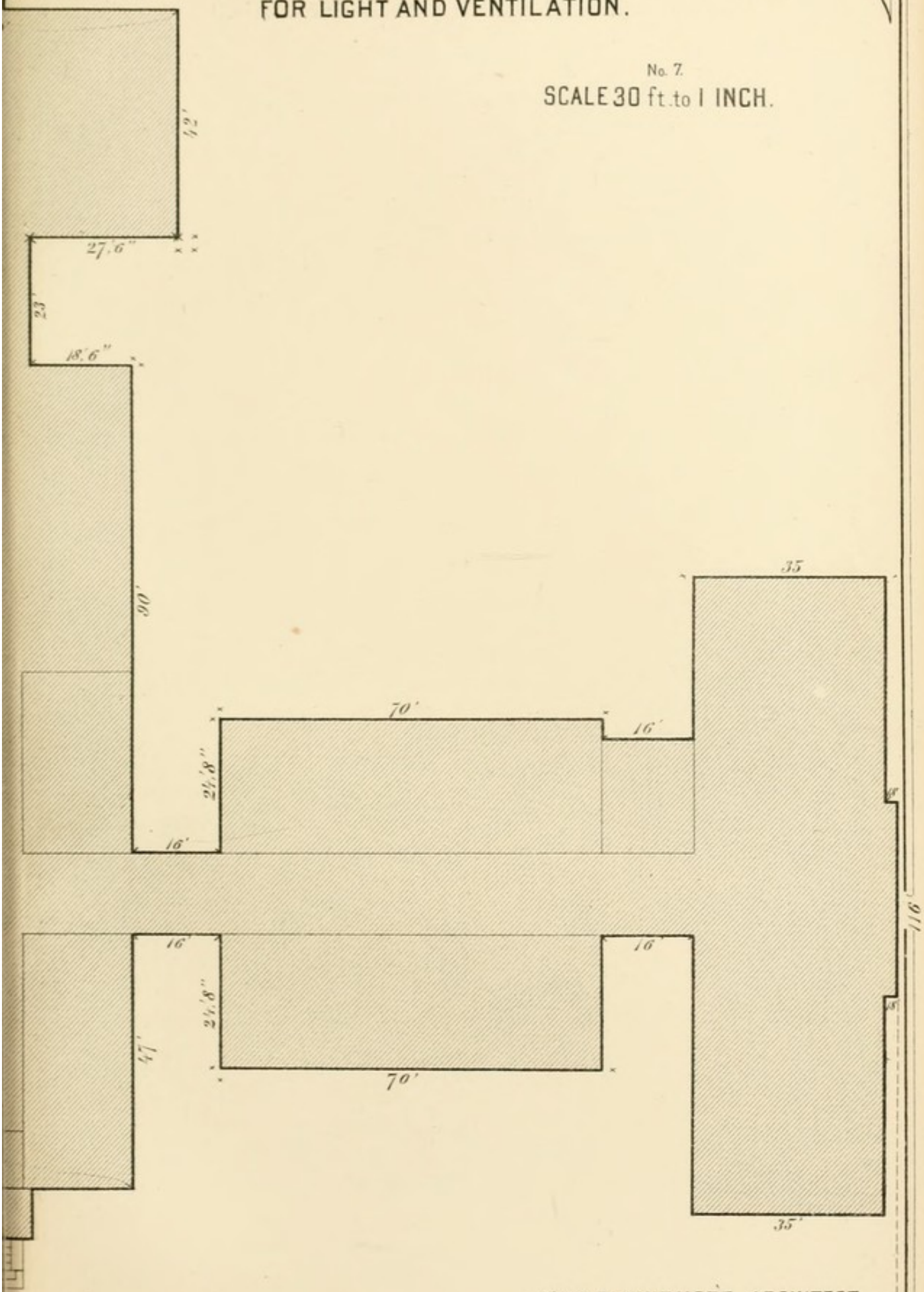


Whole

ORPHAN ASYLUM FOR 300 CHILDREN
FOR LIGHT AND VENTILATION.

No. 7.

SCALE 30 ft. to 1 INCH.



JOHN R. NIERNSEE. ARCHITECT.

1329 feet.

of the building will be mainly depended upon for its architectural effect, excluding as much as possible all merely decorative features, for, while it is intended to construct the edifice with a pleasing and expressive external effect, the principal effort will be to make it a well-arranged, pleasant, and healthy home for the orphans, contributing at the same time to discipline and instruction.

No. 2—Is a plan of the basement and furnace cellars of the building. No living rooms are located in this basement, with the exception of rooms for the engineer, firemen, and laborers in the front part of the centre building, the floor of which will, however, be ventilated by a space and air-ducts below, and areas on the outside walls. The engine-room and laundry will be on this floor, in the extreme back-centre building, and so located on the premises as to bring that floor entirely above ground. The uses of the various apartments on this floor are designated on the plan.

No. 3—Plan of first or principal floor; the uses and sizes of the various apartments are designated on the plan. To the extreme wing on the left is attached an ample terrace, directly accessible from the infants' department for their exercise in fair weather. At the back of the two main stairs for the children, indicated by an arrow on the plan, the stairs lead down to a platform on a level with the grounds outside, giving a direct connection with the school-rooms by three large doors. Side entries from the outside are also provided for direct access to the dining-room, also outside access to the basement floor. Three dumb-waiters, accessible from the basement, are provided for the convenience of conveying food, etc., to the infirmary department on the third floor. Besides the main front stair, a separate service stair connects the infirmary directly with the culinary department. Clothes and dust shafts are also amply provided. Ample kitchen, scullery, pantry, and store-rooms, besides a domestics' dining-room, are embraced in the extreme back-centre building. By means of rolled iron girders, the columns of the two upper floors of the extreme front-wing buildings can be avoided if judged desirable.

No. 4—Shows plan of the second floor; the uses of the various rooms are all designated on the plan. The domestics' chambers and sitting-room in the extreme back-centre building afford

ample accommodations for from twelve (12) to fifteen (15) domestics, confined to their own building, but affording communication with the whole group.

No. 5—Shows the detail of the arrangement of the beds in one of the large dormitories for eighty-two (82) children; it will be seen that the beds are perfectly isolated, the smallest space between those on the piers being sixteen (16) inches, the larger space being three and one half (3½) feet, allowing for a single seat or locker between the one, and a double one in the larger space. Ample window space for air and sunlight is provided from all four sides of the building. The smaller double dormitories, in the inner lateral tract, are thoroughly ventilated by a series of large transoms in the corridor walls above the lowered corridor ceiling, into and through the roof.

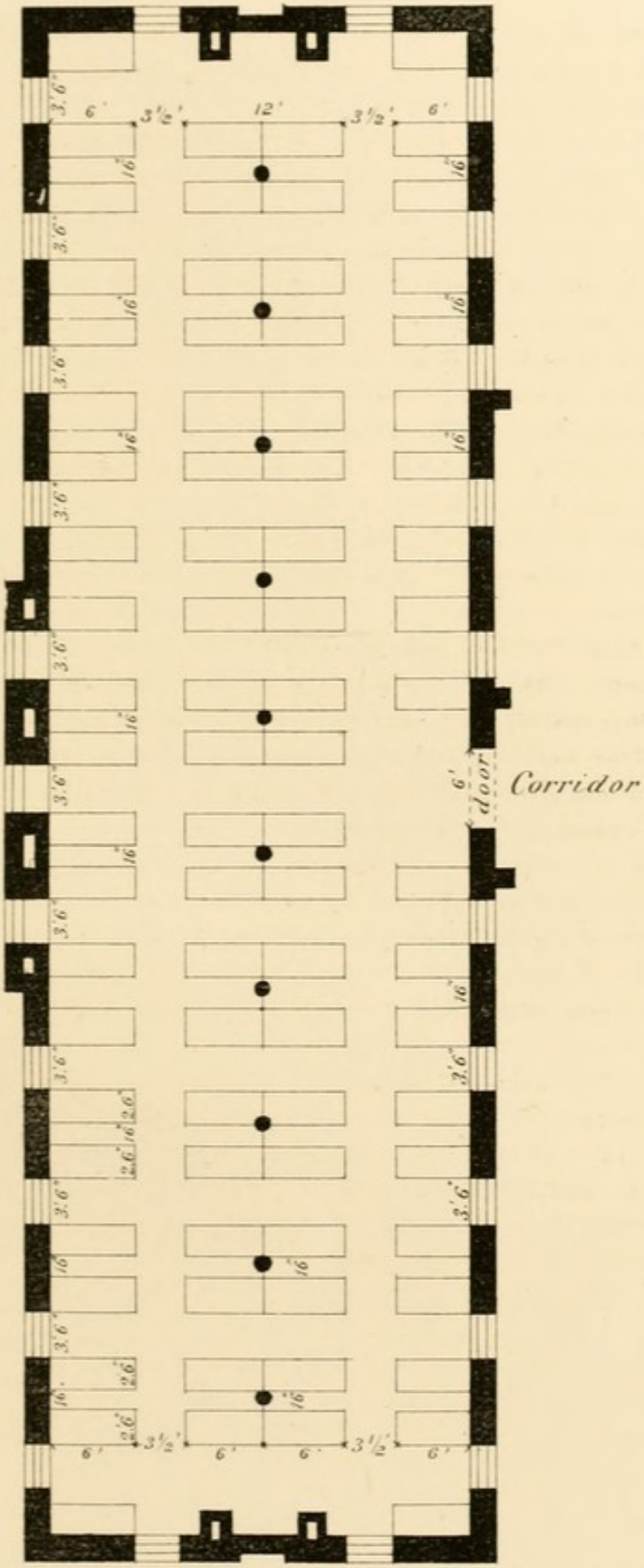
No. 6—Plan of the third story central or infirmary floor; shows extensive accommodations for forty-four (44) patients, divided into fever or contagious disease ward, boys', girls', and infants' wards, convalescents' day and dining rooms, water-closets, bath and sculleries each of the latter provided with a dumb-waiter and service stairs, communicating with the lower service and culinary department. There are also two terraces over the side corridors, affording a fine airing-place for the convalescent in fair weather.

No. 7—Shows a block plan of all the buildings, separated from each other by intervening corridors, as proposed, for proper and efficient lighting and ventilation.

No. 8—Shows a block plan of the same group of buildings standing close to each other. It must impress the observer at a glance with the serious defects such an arrangement would produce in the lighting and ventilation of the whole structure; for although the latter form would naturally save a total distance of sixty-four (64) feet length of walk and building, at a cost of some eight thousand ($8000) dollars, yet it can stand no comparison with the other, as dictated by more modern and enlightened sanitary requirements.

JOHNS HOPKINS COLORED ORPHAN ASYLUM

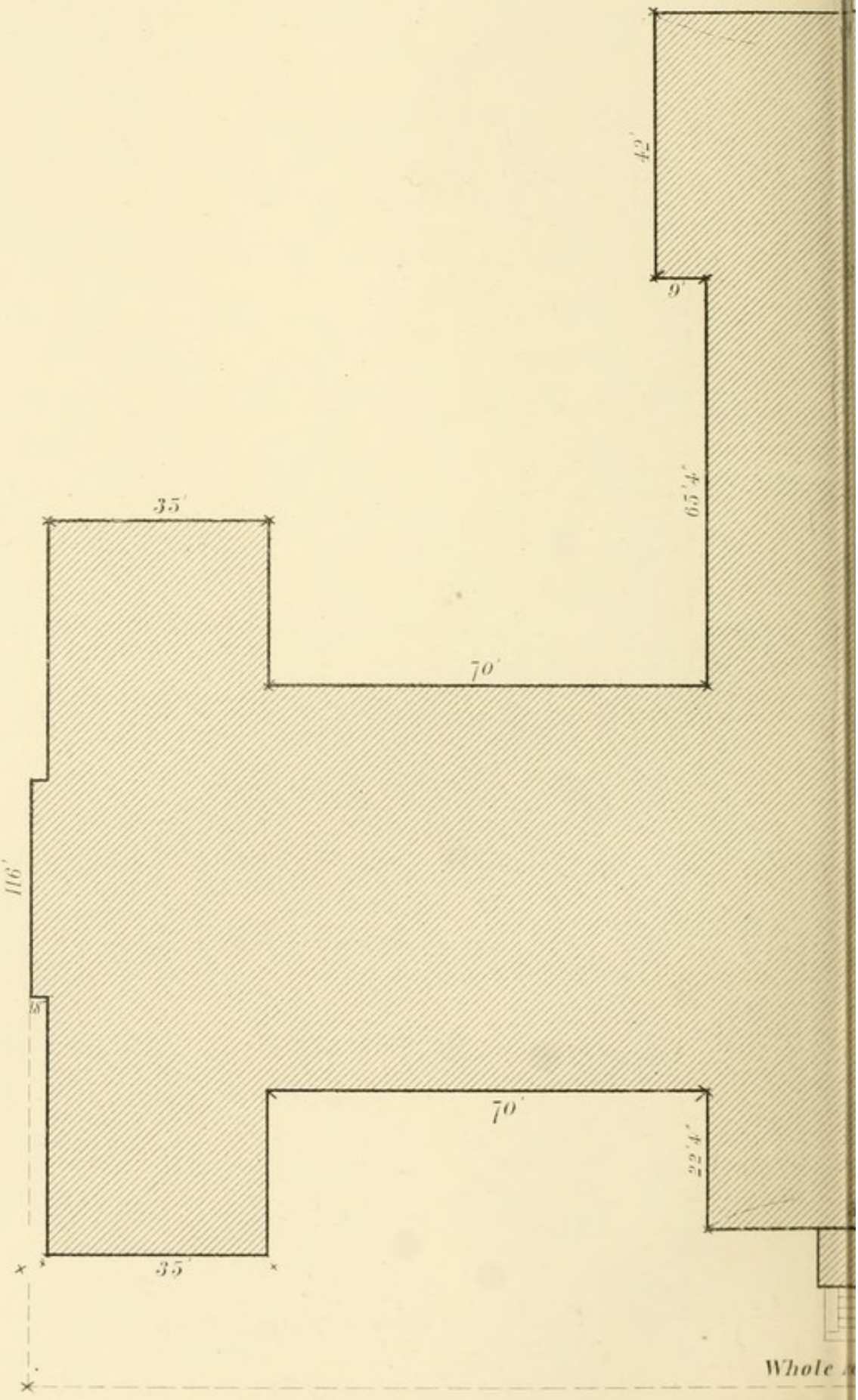
DETAIL OF LARGE DORMITORY FOR 82 BEDS.



No. 5.
SCALE 1/16

J. R. NIERNSEE, ARCHITECT.

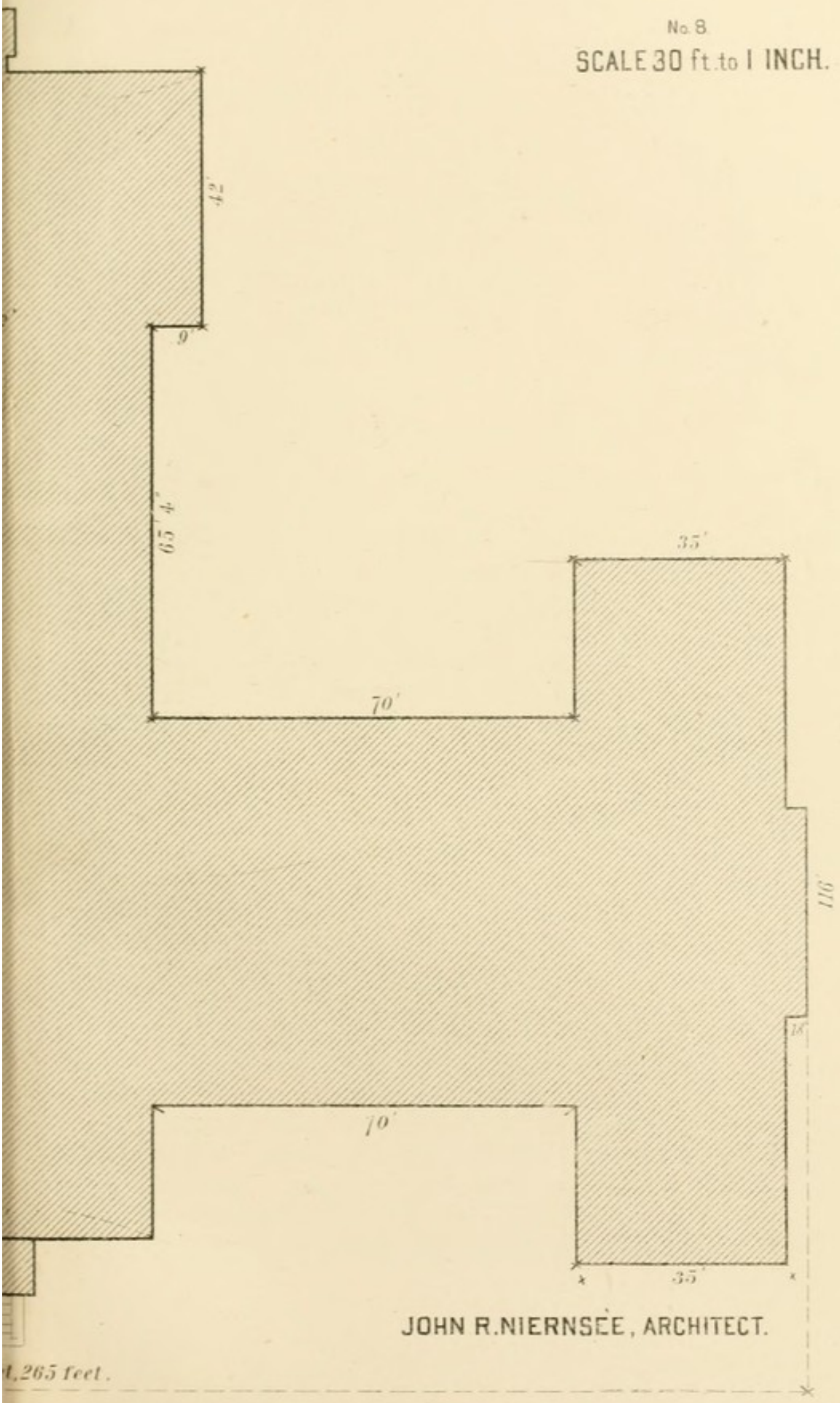
BLOCK PLAN OF THE JOHNS HOPKINS COLORED ORPHAN



LUM FOR 300 CHILDREN WITH BUILDINGS STANDING CLOSE.

No. 8.

SCALE 30 ft. to 1 INCH.



JOHN R. NIERNSEE, ARCHITECT.

t, 265 feet.

335

APPENDIX II.

BALTIMORE, *July* 12, 1875.

FRANCIS T. KING, ESQ.,
President of the Johns Hopkins' Hospital.

SIR:—I avail myself of the privilege which you granted me, to append to your published Essays upon Hospital Construction and Management some studies of octagon pavilions for hospital wards, either of one or two stories in height, as well as a brief description of their construction and the principles developed in connection with their heating and ventilation. I have not gone into the general subject.

I have the honor to be, with great respect,
Your obedient servant,
JOHN R. NIERNSÉE.

Before entering upon a description of the octagon plans herewith presented, I beg leave to mention briefly the motives which caused me to investigate carefully, and try to develop, the full capacity of the octagon plan of a ward for permanent pavilions. I found in the best books on hospital construction that form is but briefly alluded to, as "*being best adapted* for *convalescents;*" if that be so, it must mean comfort, space, areage, cheerfulness, and many other points which ought to be as desirable for the really *sick* as for those recovering from sickness. Having made *hospital construction* a close and careful study as regards the various plans and the best authorities, and having examined personally many of the best and latest constructed hospitals in this country and in Europe, I am impressed with the following facts:—

1st. That the old plan of collecting from 1,000 to 2,000 sick

in one block of buildings of several stories in height, whether solid or embracing one or more enclosed courts, has been entirely abandoned and condemned, at least so far as the construction of new buildings is concerned.

2d. In the construction of every modern hospital, during the past 20 years, the separation or more perfect isolation of the various wards has been aimed at.

3d. The number of beds per ward has been materially diminished, ranging from twenty-four to forty.

4th. More area and cubic space per bed has been allowed.

5th. Better heating and ventilation have been attempted.

6th. That the axiom has been adopted by the best medical authorities, that "natural ventilation" is both more efficient and less costly than artificial; and open fires or radiators supplied with fresh and pure air are both desirable in connection with ventilation as well as heating.

7th. That hot-water heating is the most desirable and effective mode, as auxiliary in connection with open fires.

8th. That the most impervious material should be used for inside construction of hospitals.

9th. That the baths and water-closets should be separated from the wards by well-ventilated lobbies, with independent heating and ventilation, and no soil or water pipes should pass under any part of the hospital buildings. (See "Herbert Hospital Commission.")

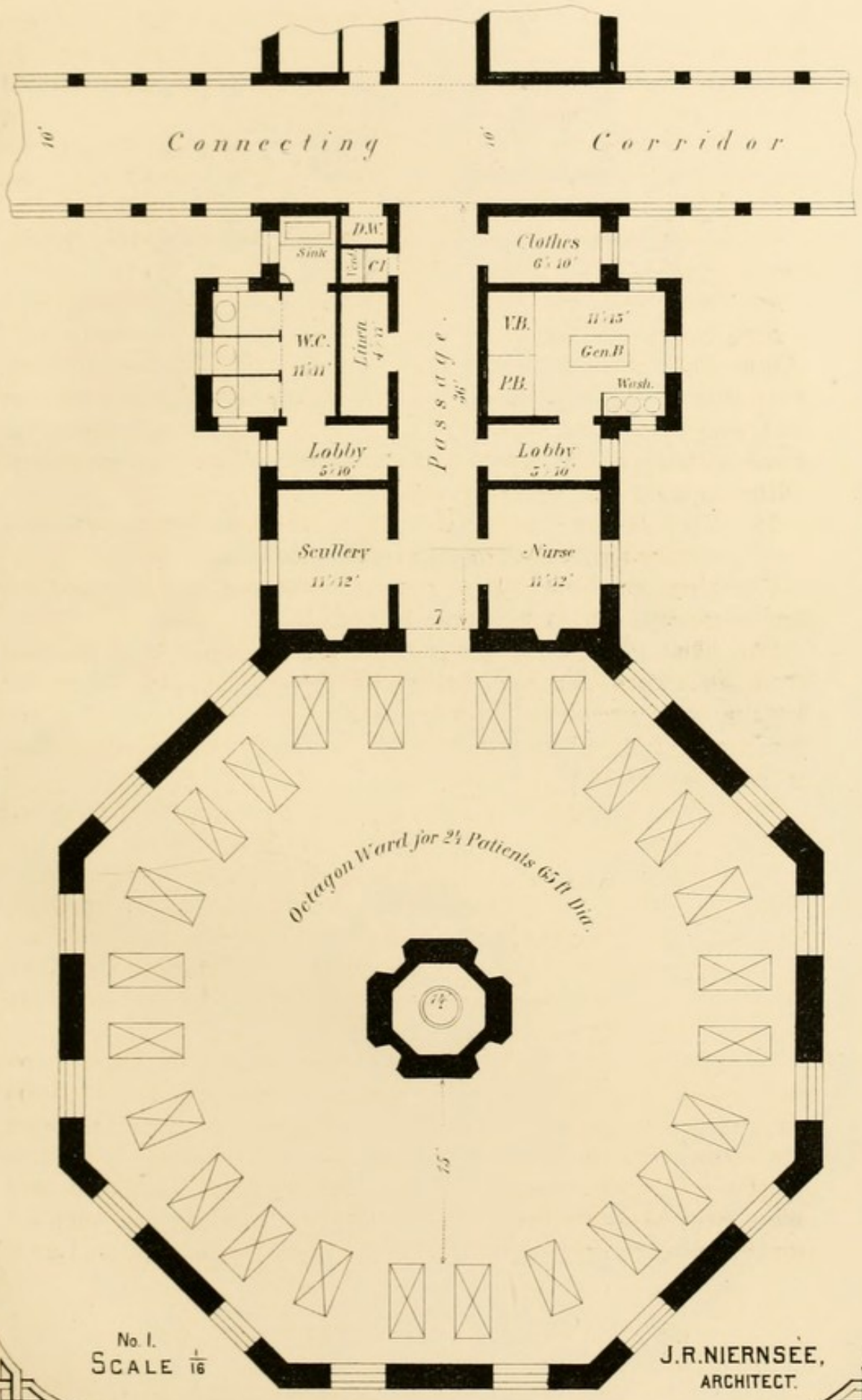
10th. That the pavilion system, in various forms, for hospitals has met with more favor and approval than any other.

While the foregoing main points met with strong support from the best medical authorities, the question of temporary (barracks or even tents) or of permanent pavilions, their complete *separation* and absolute disconnection from each other, seems yet to be an open one, as well as whether these pavilions should be one or two stories in height.

The military-medical experience of the late wars, both at home and abroad, shows a larger percentage of recovery in temporary wooden buildings (tents and other frail and comparatively open structures) than in more permanent and solid ones. When we consider that the majority of the sick soldiers must not only have been surgical cases, but *as soldiers* used to the open air, and sleeping in tents or even without them during a campaign of

PLAN OF

ONE STORY OCTAGON PAVILION FOR TWENTY-FOUR BEDS.



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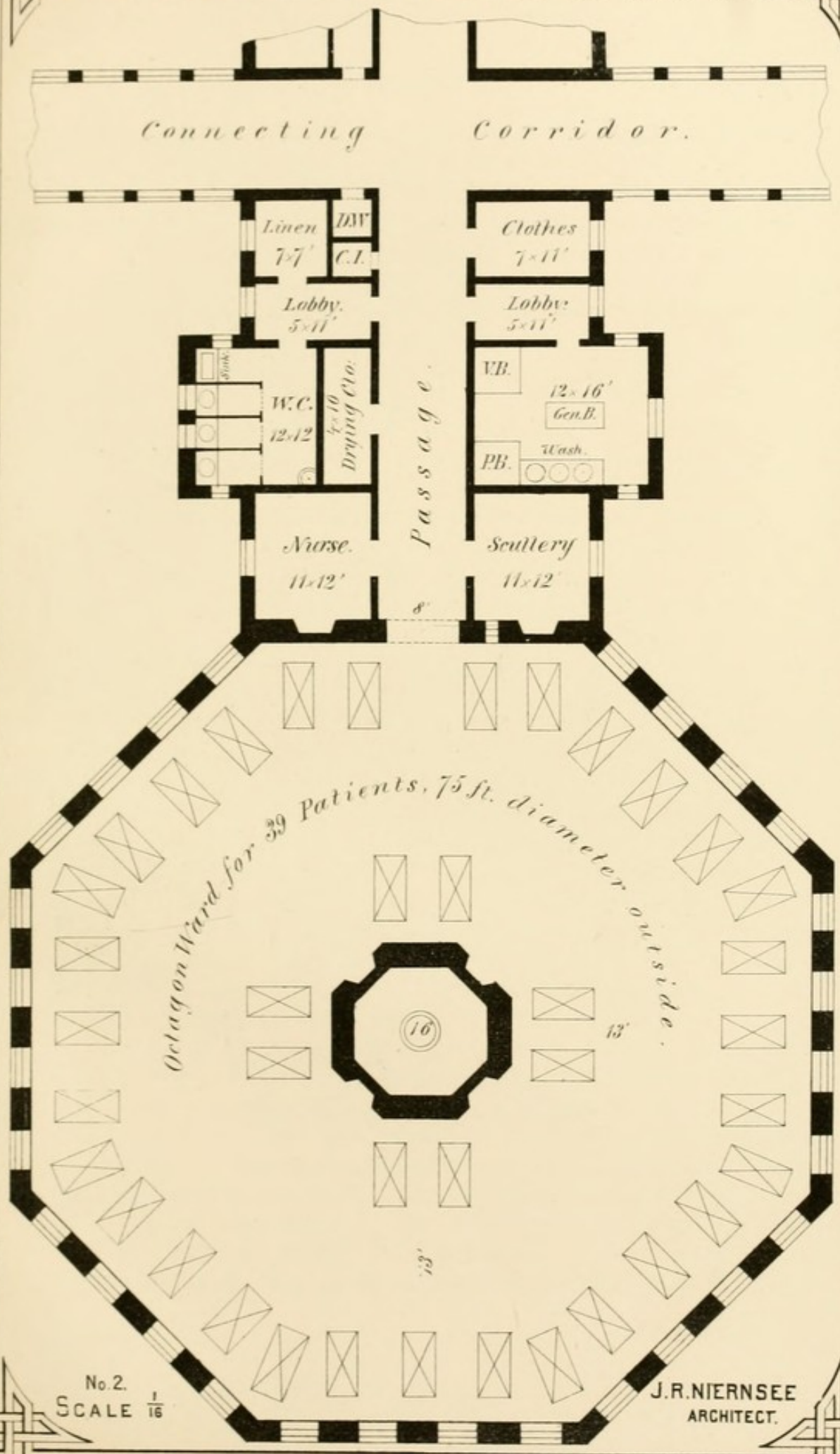
J.R. NIERNSEE,
ARCHITECT.

PLAN OF ONE STORY OCTAGON PAVILION FOR THIRTY NINE BEDS



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J.R. NIERNSEE
ARCHITECT.

several years, the war experience is not so thoroughly applicable to the civilian sick who occupy our town hospitals.

In regard to the question of building the pavilions one or two stories in height, we have high authority for saying that "they can see no reason *why* a two (2) story ward could not be so arranged and constructed as to be equal in its salubrity to a one-story building, provided the materials used are as impermeable as can be obtained—the heating and ventilation being independent for each story—and the stairs isolated, and separately ventilated from the wards." We assume that open fireplaces, or stoves, should be chiefly relied upon for heating and ventilating hospitals (see "Herbert's Commission," Oppert, and other high medical authorities), and that apparently the only way of securing a fair average distribution of open fire-heating for the oblong, or *Herbert ward*, is the patent stove-heating, by placing two or more of them at equal distances in the central aisle of the ward, as in the Herbert; or placing open fireplaces at the centre of the length of the wards in the outer wall, or cutting off the four angles at the end, octagon shape, and placing a fireplace in each—all of which modes are very well adapted for ventilation; but they distribute the heat to the various beds in a very unequal ratio—the parties nearest the stove or fireplace being necessarily over-heated, while those at the extremities must be uncomfortably cool, if not cold.

Therefore, the advantages of both the square and octagon ward over the oblong shape in that respect are so apparent and decided, that I was led to the investigation of the further developments and possibilities of the octagon ward, stimulated by the inspection of Dr. Folsom's temporary one-story square pavilions, lately erected in connection with the Massachusetts General Hospital in Boston. Said wards are 45 feet square, with central ventilator and chimney, two open fireplaces, and two projecting Franklin stoves (one heater on each of the four sides of the central chimney), thus radiating the heat equally (or almost so) to the four sides or quarters of the patients' beds, with central and outer transom window ventilation, and auxiliary furnace-heating through registers in the floor—the service buildings being all at one, or the entrance side, thus allowing *three full sides open* to light and air instead of only *two*, as in the Herbert plan. But as the beds in the corners range irregularly, and the four

angles afford some dead spaces for stagnant air, I conceived the octagon form as entirely avoiding those defects, placing all the beds at equal distances from each other, and from the fireplaces and ventilators.

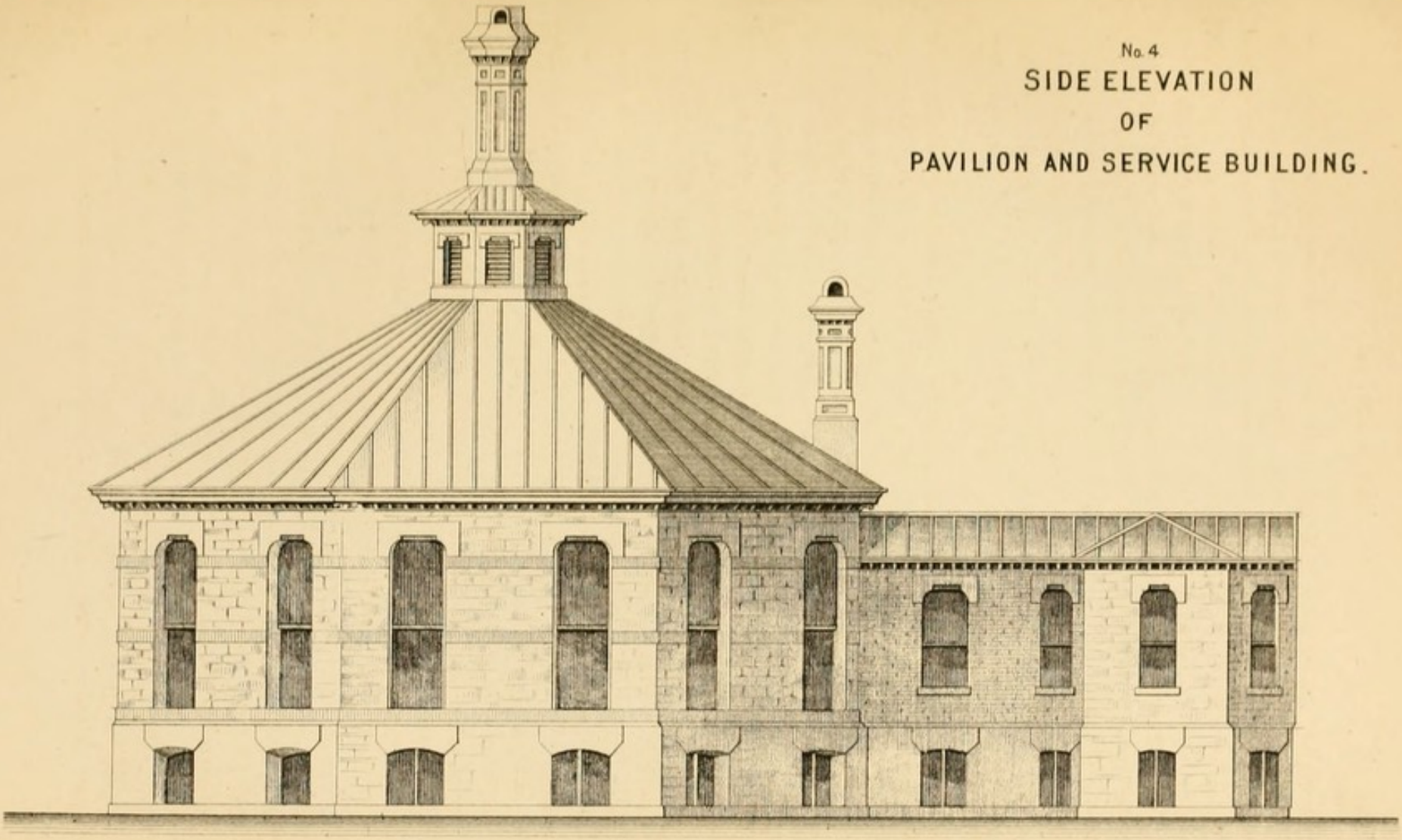
By concentrating all the service building at the entrance side with the acknowledged improvements of the Herbert plan of baths and water-closets, we have *more* sides of the ward entirely free *for the largest possible amount of sunlight and heat* than in any of the other forms.

Constructing the outer walls double or hollow, as in the Herbert Hospital, with floors and ceilings fire-proof, the whole coated with Parian cement and polished, it will form an impermeable interior coating, and at a reasonable cost, with no joints whatever. The same effect may be obtained by a covering of Dutch tiles, or glazed earthenware; but it should be used in large slabs, as in the German stoves of that material; or the walls could be lined with large sheets of ¼ inch corrugated glass, both of which latter materials would be absolutely impermeable, but their cost would be materially greater than the Parian cement, which also can be tinted to any desired shade in the *material itself, before its application.* The floors can be laid with encaustic tiles, or plain hardwood parquete-tablets well impregnated with a disinfecting solution (silica), or stained and waxed, as in some of the French and German hospitals. All unnecessary woodwork on doors, windows, and casings should be avoided. Both the boxes and sashes of the windows can be made of cast-iron at a small advance over the cost of hardwood frames, and have the advantage of being less absorbent and more fire-proof.

The American sash window, double hung, and also *double sash*, is by far the best in use. The double casement or French window is almost universally used in France, Germany, and Austria, but is only adapted to their very thick walls, which admit the opening and fastening of one fold (or one-half the width of the window) *within* the thickness of their walls, which are generally from 2½ to 3 feet. But we have either in the whole or partial opening of that description of window always a direct and distinct vertical centre streak or volume of air passing into the room, running from top to bottom, and blowing directly on the inmates. For the correction of this defect, and to

No. 4

SIDE ELEVATION OF PAVILION AND SERVICE BUILDING.



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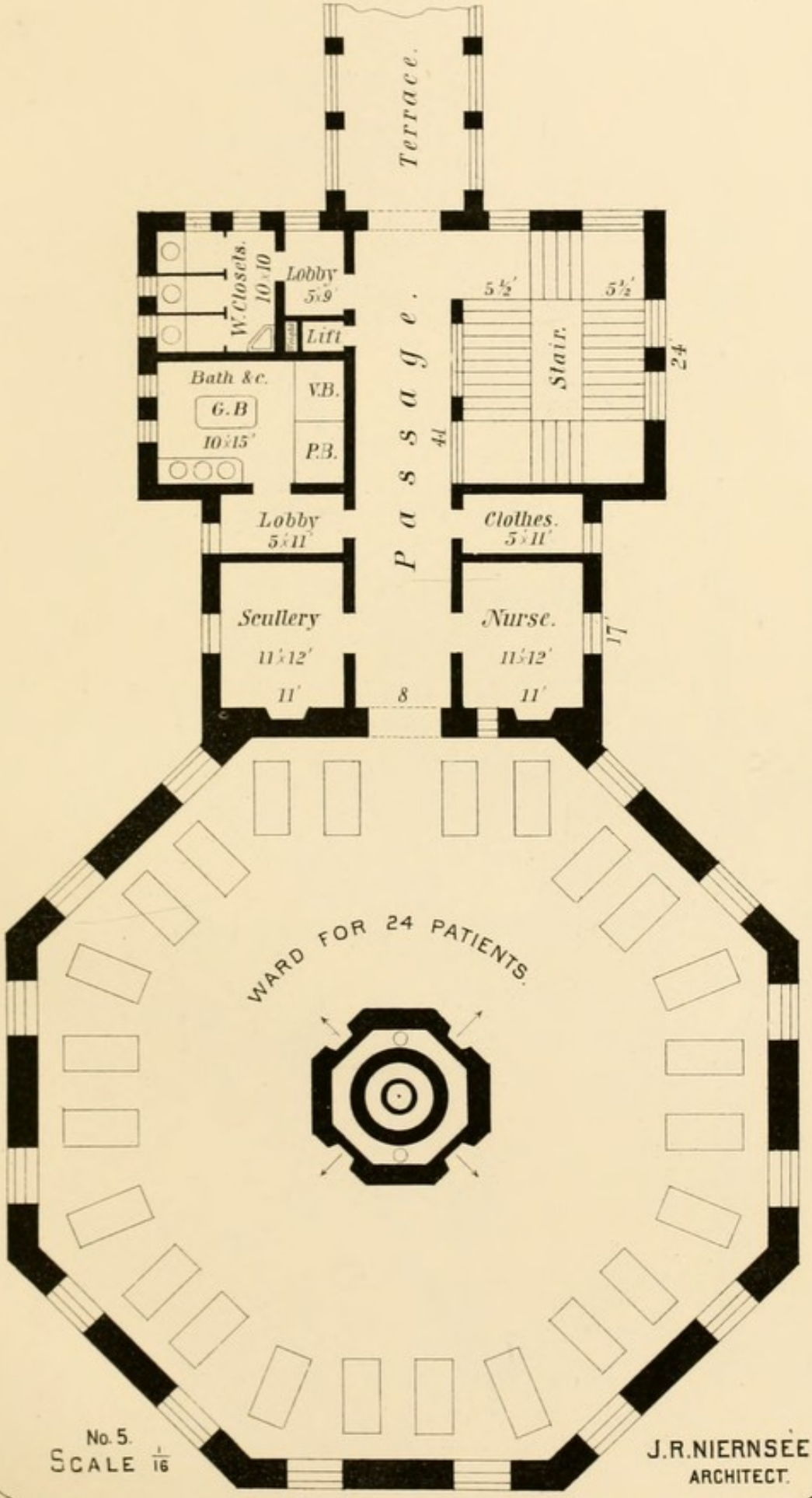
PLAN OF PRINCIPAL FLOOR OF TWO STORY OCTAGON PAVILION.



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ARCHITECT.

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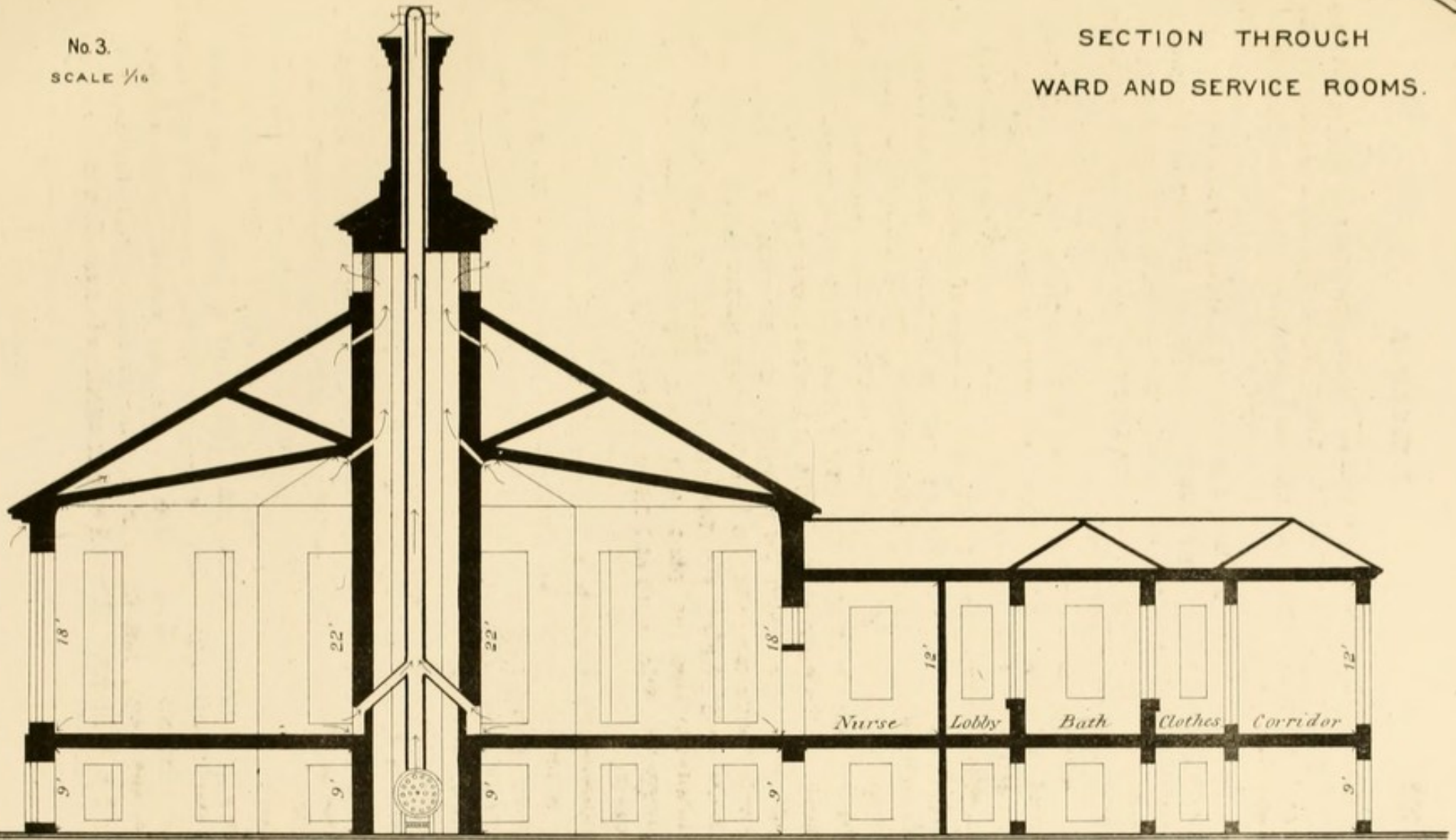
SECTION THROUGH

WARD AND SERVICE ROOMS.



J. R. NIERNSEE, ARCHITECT.

secure partial ventilation, they open only *one pane of glass*, set in a metal frame above the reach of a person's head. This, however, makes the whole contrivance both complicated and liable to derangement—particularly in *double windows*. By double windows we mean both an inner and an outer one, separated or standing from 8 to 12 inches apart. These are always used, even in private dwellings, to save the heat of the room in winter, and as a protection against the scorching rays of the sun in summer. Others, like the new square pavilions of the Massachusetts General Hospital, have adopted low transom windows above the ordinary window. These are moveable (Louvre fashion) by rachets and pulleys. All of which is better and more perfectly accomplished by the double sash (*American hoisting window*). This, with the double or hollow walls, accomplishes not only the great *desideratum* (in a hospital) of keeping the rooms or wards at a more uniform temperature—not affected by the frequent changes of the external one—but the double windows also afford the simplest mode of window ventilation, without direct draught, dust, rain, or snow driving into the wards. This is effected by opening the upper outer sash on top and the lower inner one at the bottom, either more or less entire, or *vice versa*, and thus affording either a top or bottom ventilation. This may be yet further subdivided into any number of very minute air-streams by a perforated tin or wire screen fastened horizontally to the meeting rail of the inner lower sash between the double windows.

The necessity of doubling the windows in some way has been felt and acknowledged by the almost universal employment of the French casement double-window on the continent of Europe; by the glazing of some of the more modern hospital single windows *with plate-glass three-eighths of an inch* in thickness; and also by the putting into single sashes *two sheets* of extra thick (one-eighth inch) common glass, set half an inch apart from each other. It requires great precaution in setting the glasses in a dry and warm atmosphere.

As in large hospitals and other public buildings there is always an engineer and fireman employed to attend to the engine, and hoisting and heating apparatus (who can thus attend, with little additional labor, just as well to a score of separate fires as to two), I would propose to dispense with the usual

large and expensive heating apparatus concentrated in one place (which requires an extent of pipes of over a thousand feet in length, with a consequent expense and loss of heat), and place instead a small boiler within the central chimney and ventilator in the basement of each pavilion. The smoke from the furnace of said boilers, as well as from the four fires in the wards above, will be led by a cast-iron smoke-pipe into a high chimney; the annular space between said smoke-pipe and brick walls forming a ventilation-shaft, in which the air is rarefied by the heat from the smoke-pipe; a small extra fire-grate is also placed at the other end of the boiler-grate to provide for summer ventilation.

For a two-story pavilion, the same arrangement of smoke-pipe and ventilator is doubled by an annular division within the ventilating shaft on the second floor. By this arrangement an entire insulated heating and ventilating system for each story of a pavilion can be obtained, considerable economy in first cost of apparatus and heat acquired, and the heat and ventilation better regulated and graduated for the separate wants of each ward, or entirely dispensed with, if any one ward is not in use, etc. The employment of either the square or octagonal form of ward for hospital purposes seems only to interfere in some degree with *one* of the requirements of a sick ward, viz., "that the beds should be so arranged as to allow the attendants a view of every patient"; but as this does not mean the necessity of such minute and close individual surveillance as in the workshops of a penitentiary or other penal institution, and as there is generally more than one attendant present, it can amount only to a very minor defect when we consider how many other important requisites are accomplished by the adoption of that form of ward.

Finally, in considering the construction of hospitals, the relative position and connection of the various wards with each other, and the central culinary and administrative buildings, we find generally the basement and its connecting corridors used for the transportation and distribution of food, patients, utensils, furniture, clothing, etc.; and the upper connecting corridors, whether for one or two-story buildings, used merely by the attending physicians, visitors, and as a place of in-door exercise for convalescent patients. The upper corridors, if they are left open on their sides, as in the Free Hospital of Boston, afford lit-

tle protection against rain, snow, or cold, and if closed, as in the Herbert and most other new pavilion plans, they form (with the enclosed basement corridor) a barrier to the circulation between the respective pavilions of two (2) to three (3) stories in height, which must prove some obstruction to the perfect free circulation of air around and between the blocks. It was this consideration, no doubt, which induced the authorities of the great new hospital at Berlin to construct their two-story and basement pavilions, culinary and administrative buildings *entirely detached from each other*, while all the service and visiting communication between the various buildings is accomplished merely by the out-door walks through the grounds.

In this last case of entire separation, the service and visitors are exposed to the inclemency of the weather in all seasons; and in the closed connecting-corridor system of three stories high, the free circulation of the outer air between and around the various pavilions must be to some extent obstructed. I therefore conceived the plan shown by Section No. 7, for either a one or two-story pavilion; that is, by forming the covered connecting link between the various buildings *only by closed basement corridors* with sashes and ventilators, available at all seasons, and intended for the uses of all *communication* between them, having a flat terrace roof on a level with the first floor, surrounded by a railing or balustrade. This terrace can be used for the exercise of patients and general communication in *fair weather;* thus the free circulation of air *all around* the wards would be left *entirely unobstructed above the first floor*.

Besides this advantage, the saving in cost of construction of some 900 feet of corridor (if one or two-story pavilions are adopted), of iron and glass—wood being too perishable and unsafe—would be a very material consideration. The louvres of the octagon ventilator, opening on eight sides, will likewise allow a majority of them always free from the direction of the prevailing wind. Even on the weather side, the down or return draft can be counteracted and entirely prevented by employing for each of the eight openings the outside foot-valve, or Winans' valve, which opens and closes with a very slight pressure of air from either side. These valves are light frames covered with painted linen, mica plates, or isinglass, hung freely on a centre-pin, so as to move with the slightest pressure in either direction.

Explanation of the Octagon Plans herewith annexed.

Plan No. 1—represents a one-story octagon ward of 65 feet, outside diameter, for 24 patients, with central heating and ventilating shaft, containing four open fire places; the service buildings are all placed at the entrance side, communicating with the general connecting corridor. The average space between the beds is 4 feet. The general details are visible on the plans and section.

No. 2—represents a one-story octagon ward of 75 feet, outside diameter, for 39 patients, with variations of service building.

No. 3—shows a section through the ward, service buildings and basement, central heating and ventilating shaft.

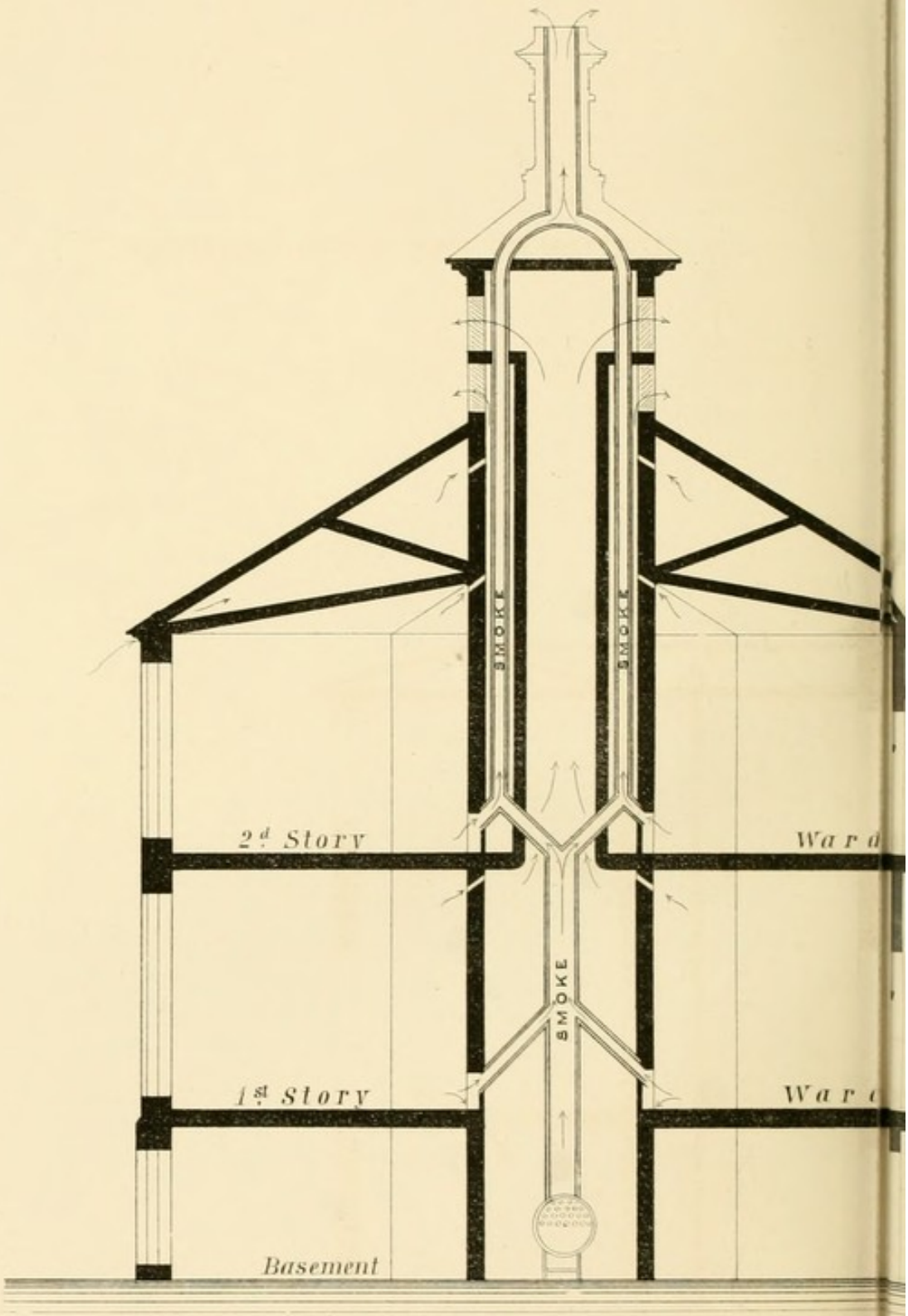
No. 4—shows a side elevation of a one-story octagon pavilion, with basement and service building attached.

No. 5—represents the plan of a two (2) story octagon pavilion, with basement staircase and connecting basement corridor.

No. 6—shows a section through the same, with the central annular ventilating and heating shaft.

From the following table it will appear evident that in planning hospital wards, where the largest area per bed for the minimum of cost is desirable, it is certainly worthy of consideration not to ignore entirely the axiom, "that the same length of line (*ergo*, wall) encloses a larger area of space within the *circle* than in any other form." Adopting the principle, as laid down by the Herbert Hospital Commission, "that the great point to be considered in a ward is to obtain *the largest area per bed*, as of more importance than mere cubic contents," we observe from the above table of comparison that the 61 ft. diameter octagon plan affords 122 sq. ft. of area per bed against 99⅔ sq. ft. of the Herbert plan, each for 24 patients, and that the octagon ward at 14¾ ft. height offers the same cubic contents, viz., 1800 cub. ft. per bed, as the Herbert plan at 18 ft. height. *Ergo*, more area by 22 per cent. is gained at the same expense.

JOHN R. NIERNSÉE,
Architect to the Trustees of the Johns Hopkins' Hospital and Orphan Asylum.



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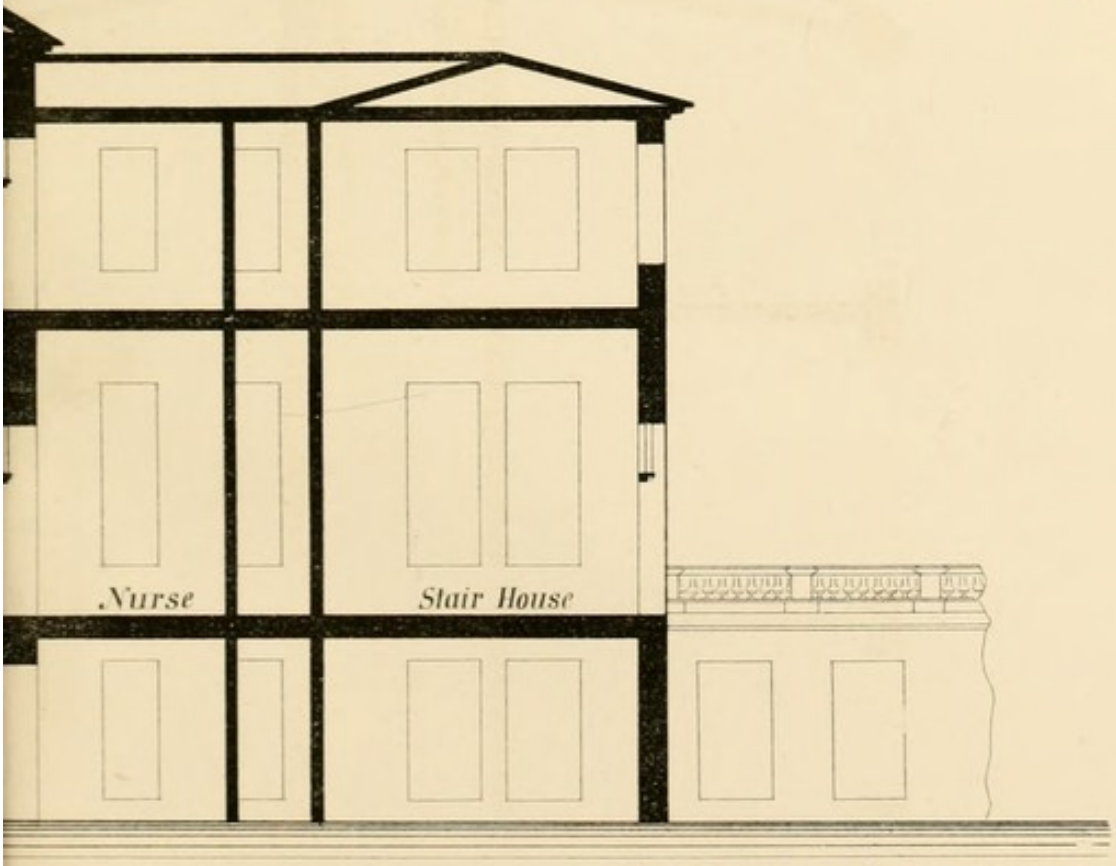
No. 6.

SECTION OF TWO STORY PAVILION.



JOHN R. NIERNSEE, ARCHITECT.

COMPARATIVE TABLE OF DIAGRAMS

OF

APPENDIX II.

J. R. NIERNSÉE.

COMPARATIVE TABLE OF DIAGRAMS.

COMPARATIVE TABLE OF DIAGRAMS AND PROPERTIES OF VARIOUS KINDS OF WARDS.

	Length of circumference in feet.	Length of outside walls and centre shaft.	Area enclosed, in square feet.	Area of ward, deducting centre shaft.	Number of beds per ward.	Area of bed per ward, without the shaft.	Square feet of window per bed.	Cubic contents of ward 18 ft. high inclusive of centre shaft.	Cubic contents of ward 18 ft. high exclusive of centre shaft.	Real cubic feet per bed for ward 18 ft. high.	Height of ward required for 1800 cubic ft. per bed.
61 feet diameter. Octagon	200	232	3.050	2.930	24	122	47	54.900	52.740	2.197½	14¾
71 feet diameter. Octagon	236	280	4.188	3.980	39	102	42	75.384	71.640	1.837	17¼
Dr. Folsom's Square Ward of 44 feet. Massachusetts General Hospital	176	198	1.936	1.900	20	95	60	34.848	34.200	1.710	19

Dr. Folsom's Square Ward	200	236	2.500	2.400	24	100	60	45.000	43.200	1.800	18
Herbert Rectangular Ward of 50 feet	202	....	1.950	.....	20	97½	40	.....	35.100	1.755	18⅔
do. do. do.	236	...	2.392	.....	24	99½	44	.....	43.056	1.794	18
do. do. do.	286	....	3.051	.....	32	95⅔	40	.....	54.918	1.716	18⅔
do.	346	....	3.822	.....	40	95⅔	40	.....	68.796	1.720	18⅔

The principles laid down by the Herbert Hospital Commission are: 7 ft. 3 in. wall space for each bed. Height of ward, 14 ft., width 26 ft. Area for each bed, 87 sq. ft. Cubic contents per bed, 1200 ft. The largest superficial window space per bed is 31 ft., used in the Netley Hospital.

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