

Hospitals, their history, construction, and hygiene, (being a thesis for graduation at the University of Edinburgh for which a gold medal was awarded) / by J. Francis Sutherland.

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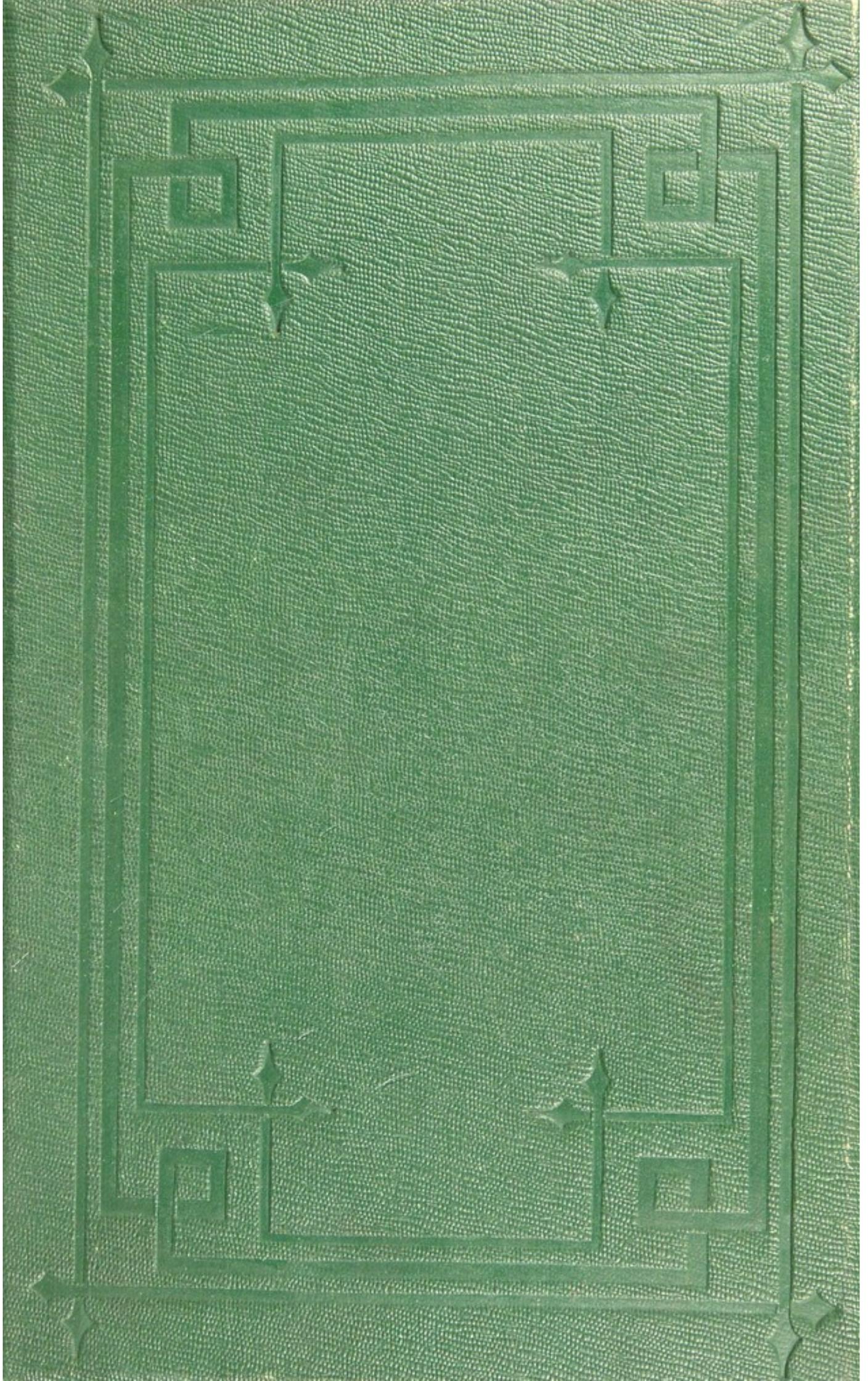
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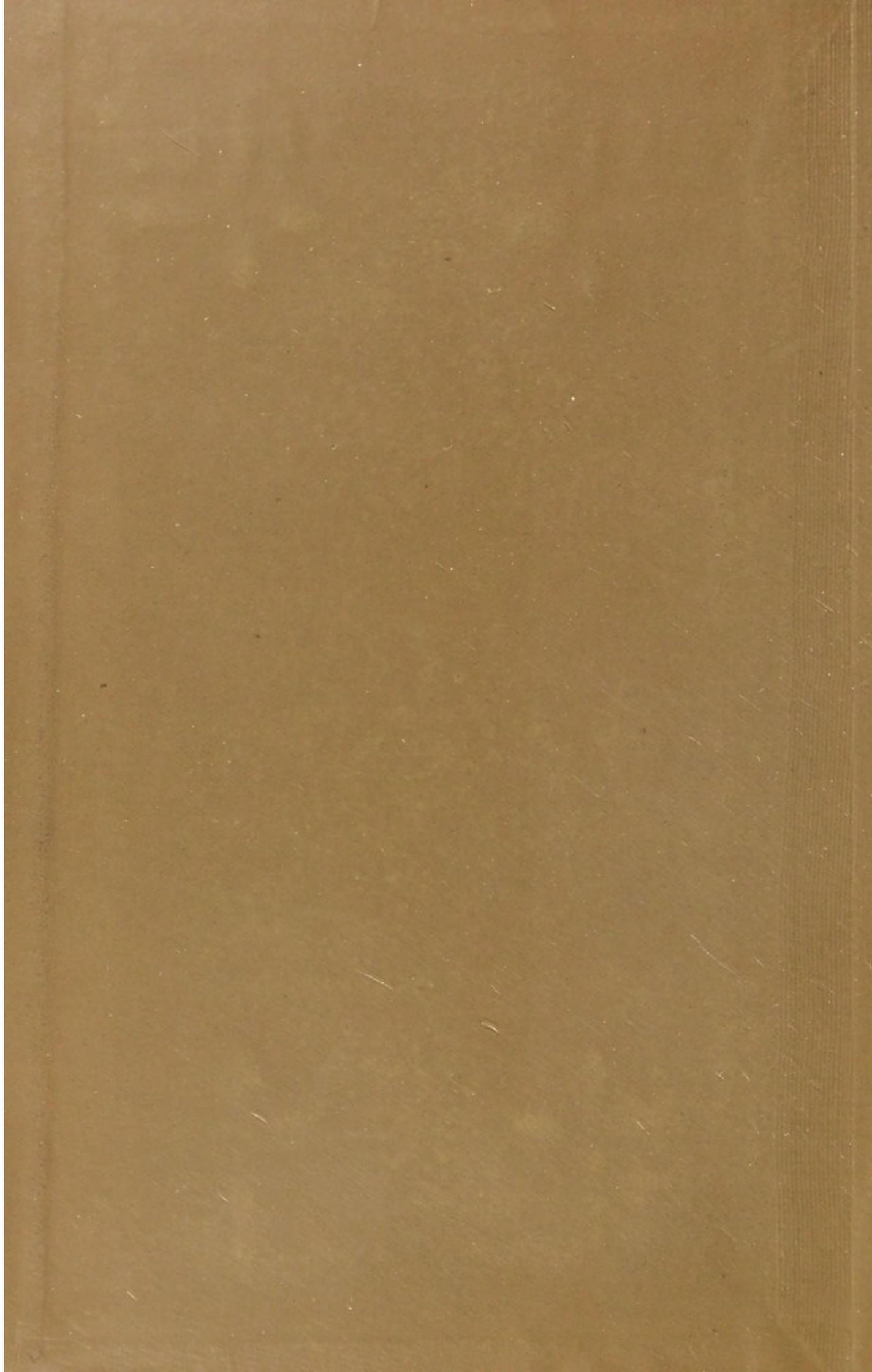
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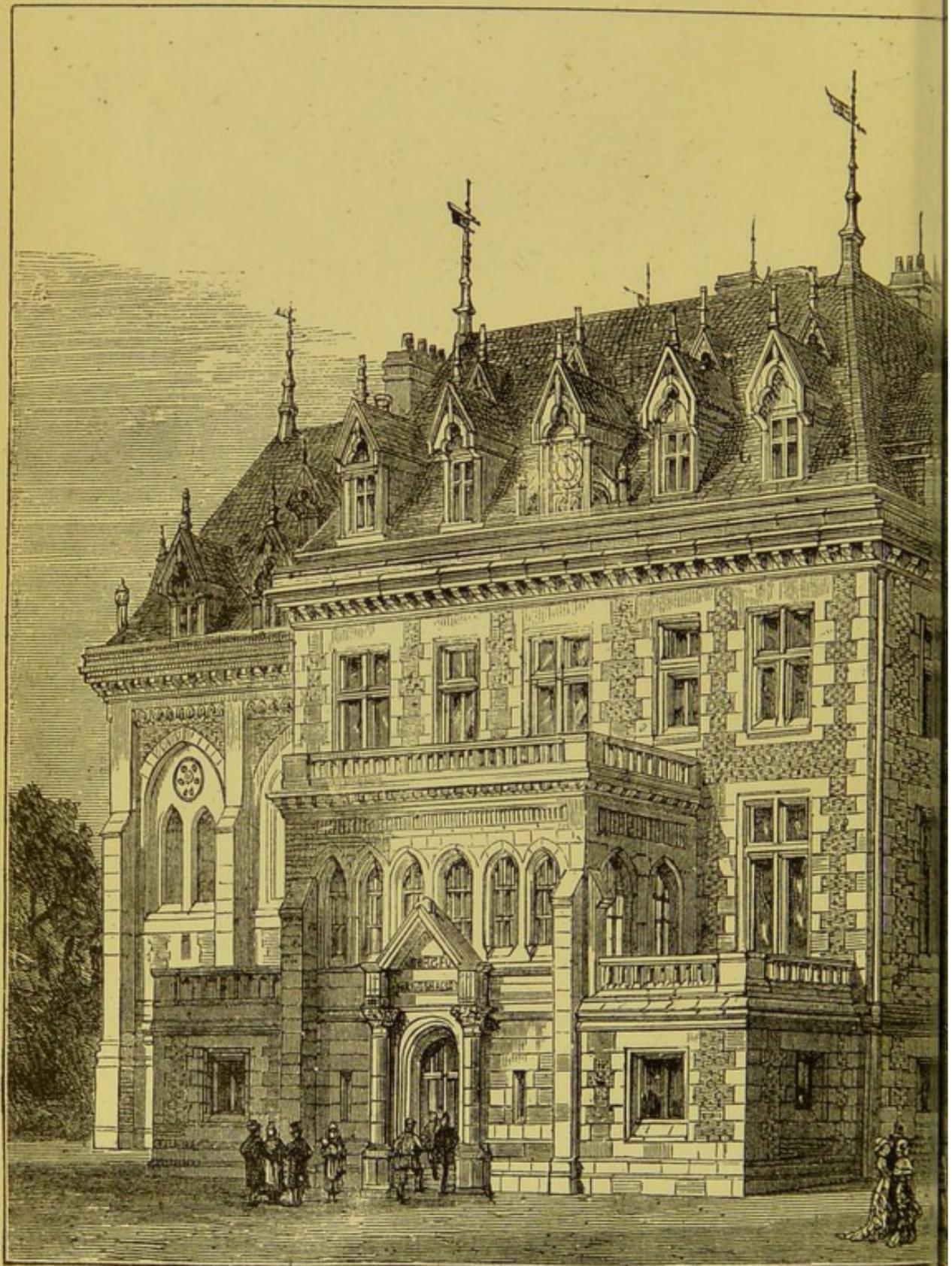


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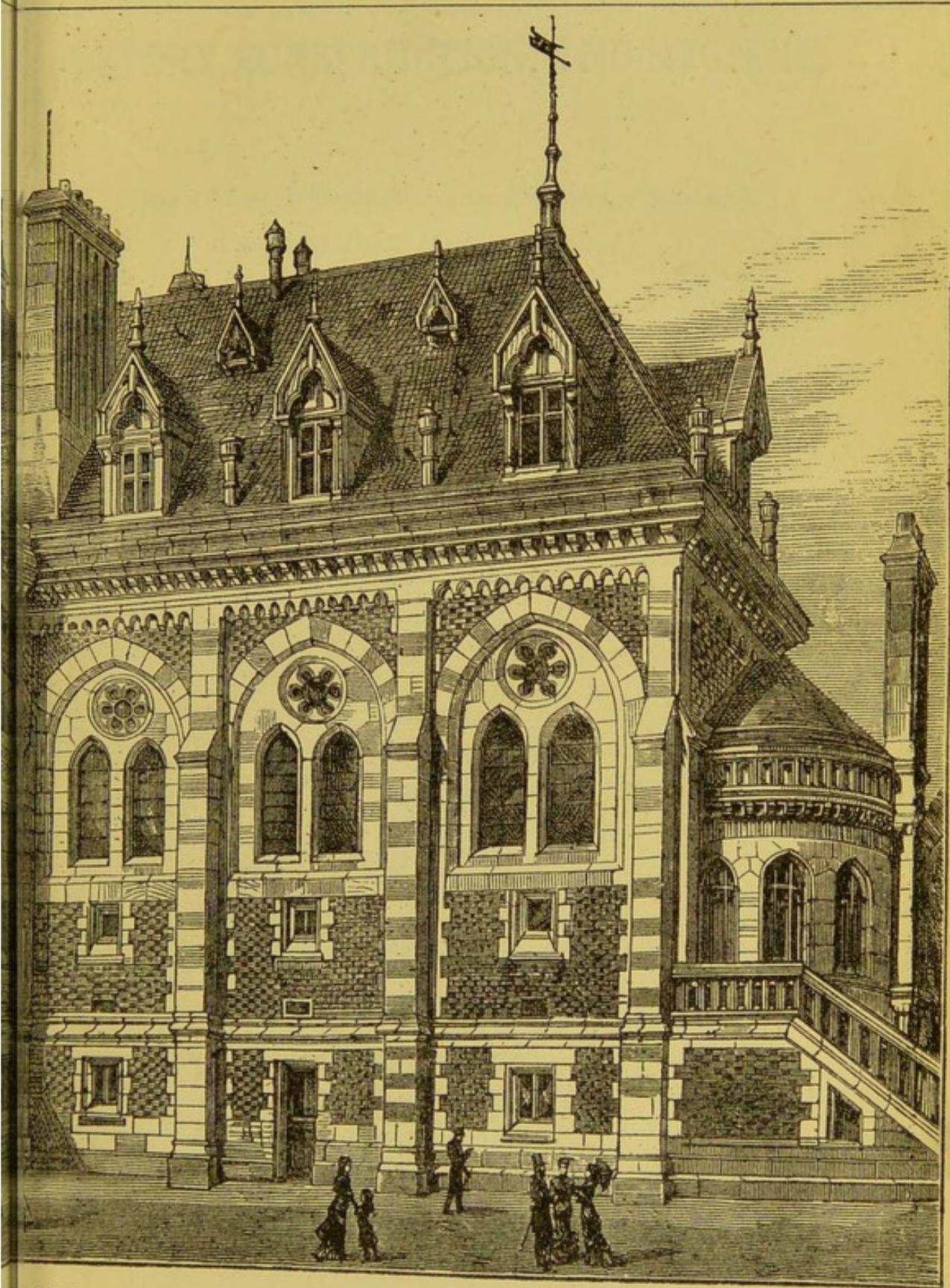




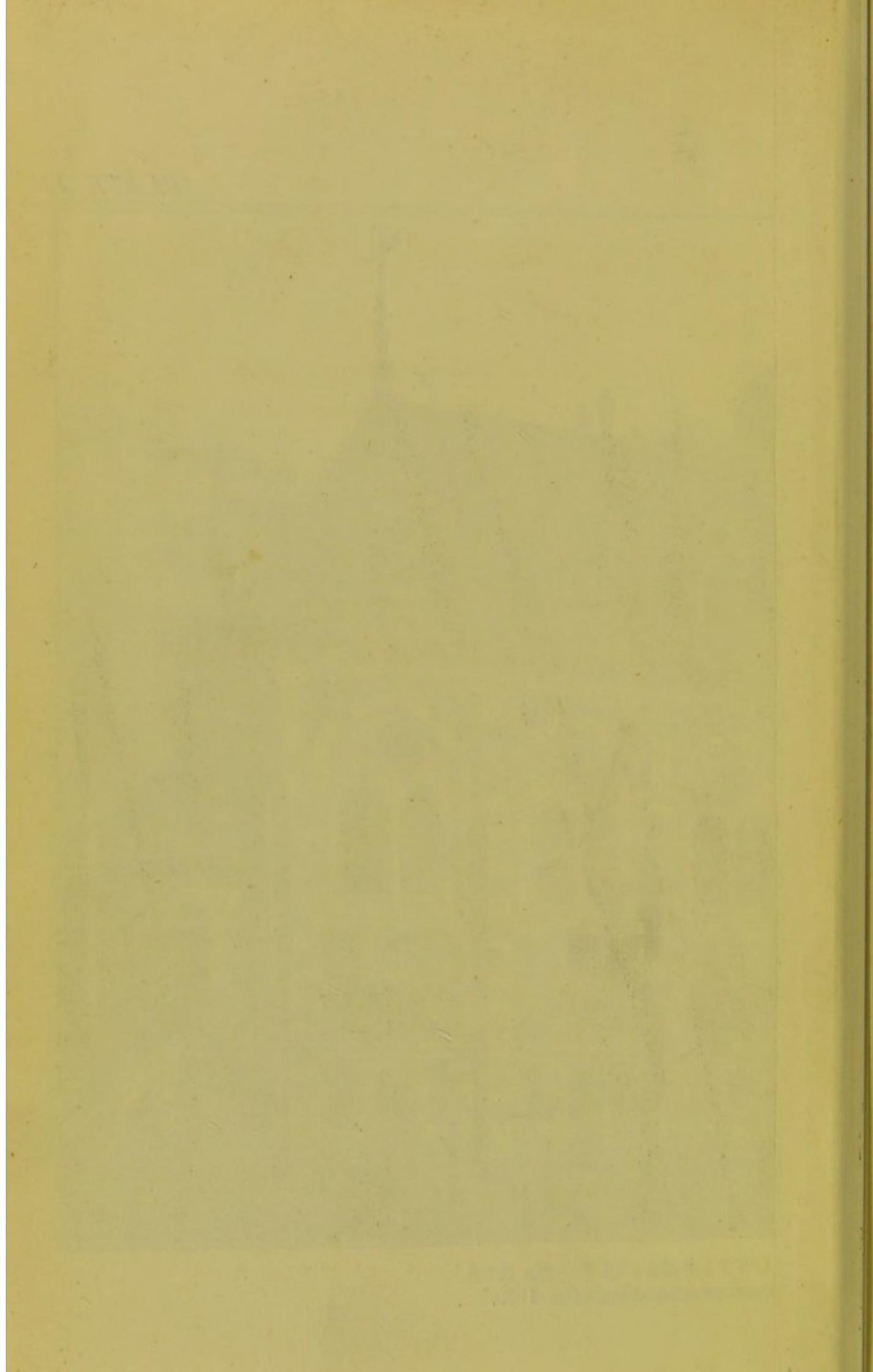




THE HERTFORD BRITISH MUSEUM
BUILT BY SIR RICHARD WALLACE



HOSPITAL AT PARIS
OPENED BY HIM APRIL 16TH 1879.



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THEIR

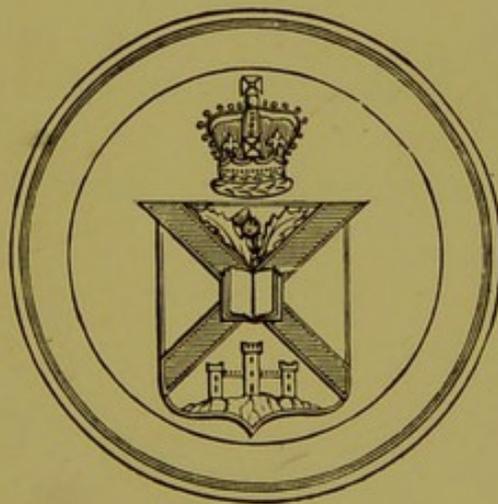
HISTORY, CONSTRUCTION, AND HYGIENE,

*(Being a Thesis for Graduation at the University of Edinburgh,
for which a Gold Medal was awarded.)*

BY

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“The quality of mercy is not strain'd,
It droppeth as the gentle rain from heaven
Upon the place beneath: it is twice blest;
It blesseth him that gives and him that takes:
’Tis mightiest in the mighty.”

—*Merchant of Venice*, Act IV.

TO

SIR RICHARD WALLACE, BART., K.C.B., M.P.,

FOUNDER OF THE

HERTFORD BRITISH HOSPITAL, PARIS,

THE FRIEND OF

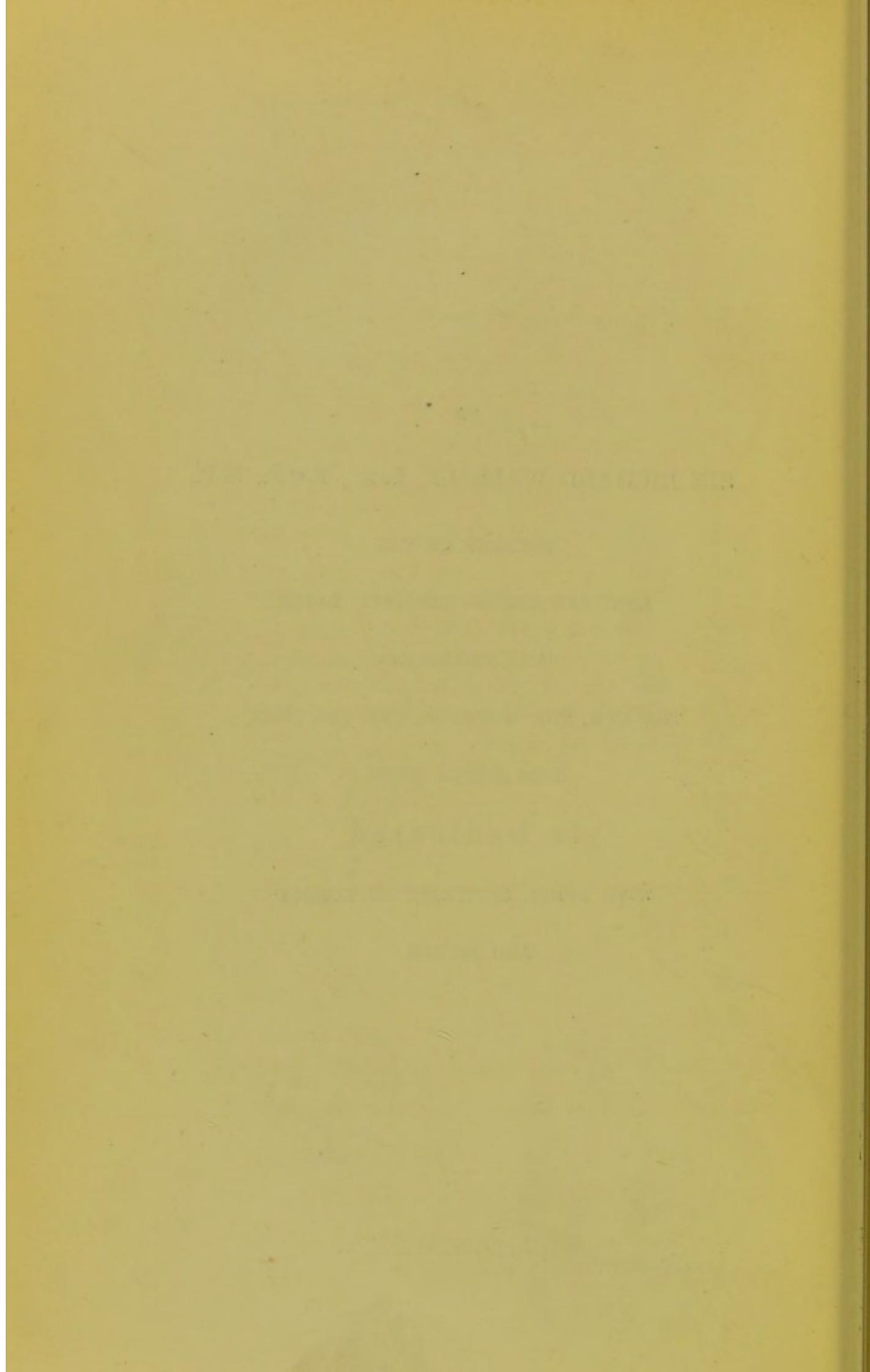
THE SICK, THE WOUNDED, AND THE POOR,

THIS LITTLE WORK

Is Dedicated

WITH EVERY SENTIMENT OF HONOUR

AND ESTEEM.



PREFACE.

THE present monograph is, with a few slight alterations, the Thesis which I presented in March, 1879, to the Medical Faculty of the University of Edinburgh for the degree of Doctor of Medicine. I had no intention, at the outset, of putting it into the hands of the printer; but when my Alma Mater put her *imprimatur* upon it by awarding it a Gold Medal, and its publication was urged by many of my medical friends, any scruples which I might have had were overcome, and I offer it to the profession and the public with all its imperfections. For many reasons, unnecessary to explain, its publication was delayed until now. Some value attaches to it by the acceptance of the dedication by Sir Richard Wallace, Bart., M.P., who has done so largely and so well for the hospitals of London and Paris, and whose name for deeds of charity is a household word. The Parisians have not been slow to acknowledge his princely munificence, and in addition to other recognitions they have given his name to one of the wards of the Hospital Tenon.

Some parts of the original do not appear in this publication, because I believed that their insertion

might give it the complexion of sameness, and render too technical what is intended to interest others as well as the profession.

The accompanying plans and sketches are taken from ancient and modern hospitals. They embrace every style that has had its day, and they help to show the evolution, so to speak, of hospitals from the primitive and unsuitable cloister, to the system of pavilions now almost universally accepted as the best.

And here I would express my thanks to Sir John Rose Cormack, K.B., M.D., and the Hon. Alan Herbert, M.D.—the physicians of the Hertford British Hospital—to the former for orders of admission to the prisons of La Roquette and St. Lazare, as well as to the asylum of his friend Dr. Magnan; to the latter for his kindness in furnishing me with many treatises bearing on the subject, and the plans of several hospitals.

My thanks are also due to Dr. John Sutherland, late Inspector - General of Hospitals, Bengal, for information regarding the hospitium of the Knights of St. John, Malta.

The greater number of the Plates have been executed by Mr. John Frater, Edinburgh.

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CHAPTER I.

INTRODUCTION.

THE subject which I have selected for my Thesis is one that has occupied the serious attention of sanitary legislators and hospital authorities, as far back as the middle of last century. In England, Cullen, Rollo, Munro, and Jackson who ranks first among military writers, did noble work to ameliorate the hospital system of their day; while in France, Tenon, Lavoisier, Bailly, and the Academy of Sciences, Paris, conscious of the defects of their hospital system, as evinced by the terrible mortalities recorded, strove hard to institute a new era in construction of hospitals, and at that time laid down principles which to-day are generally accepted as sound.

In case it might be thought in the present day that their ideas of Hygiene, and how best to procure it, were crude, by those who look at the question, assisted by the accumulated evidence and improvements of every decade since that period, let me state that such is far from being the case; as the principles they enunciated, not with feeble voice, will stand close investigation, when more modern ideas would go to the winds. It is too true that they were little acted upon by those then in authority, and the slight improvements that were decided upon

were carried out but imperfectly. There can be no doubt, had their successors taken up the matter as enthusiastically as they did, that we should not be nearing the close of the nineteenth century without finding anything good and valuable as the outcome of a long-continued agitation in favour of better hospitals. But a long time elapsed before a hygienist appeared worthy to assume the garments of Tenon or Munro.

One fact, however, is patent, that thirty years ago our hospital system was far from a state approaching perfection. Since that time a goodly band of earnest and devoted workers have been in the field—men and women: for to omit the name of Florence Nightingale, whose earnest and unwearied devotion to increase the comforts of the sick, whether in the battle-field, tent, or the hospital ward, entitle her to rank high among those who have been benefactors of mankind, would be a grave overlook when writing on this subject. Eminent British and French authorities have seriously taken up the question. The names of Galton, Robertson, Chaumont, Husson, Morin, Simpson, Sarazin, Erichsen, and Malgaigne, are familiar to every one who has studied this great public question. Scotland is as yet without a representative in the first rank; although in the no less important matters of ventilation, heating, and light, the name of the veteran Professor of Medical Jurisprudence and Public Health, Dr. Douglas Maclagan, is familiar to all. The result

of the combined labours and efforts of such men has been very gratifying. In Britain and France are to be found several instances of model hospitals, meeting the requirements of the age.

As might have been expected, a vast amount has been said and written on the subject, and much has been done at home and in France, by sanitary commissions and by reports, to ventilate the subject and put it on a sound basis. The difficulty, however, which I encountered, after perusing the works of men of large and matured experience, was that less had been done in the way of gathering its scattered elements into an intelligible whole, by comparing the systems and their results in the different countries from which reliable data could be procured. This difficulty I have humbly attempted to overcome in the pages which follow.

To make myself practically, as well as theoretically conversant with the subject, I have spent much time in a careful visitation and scrutiny of the hospitals, asylums, maternities, and prisons to be found in the city of Paris, as well as in Edinburgh, Glasgow, and Rome.

In the succeeding chapters little reference is made to many countries in Europe aspiring to a high place among the civilized nations of the world, because much remains to be done in providing hospital accommodation for their sick poor. No mention need be made of cities in Europe, where excellent medical instruction is given, but where

patients are massed or rather huddled together in their thousands, in tenements dignified with the name of hospitals, but in no other way fulfilling their high function.

It is quite possible for hospitals to provide healthy and commodious lodging for the sick, and schools of instruction for students in medicine and surgery. To consider them other than as serving this double purpose would be a mistake. Hospitals, undoubtedly, derive great benefits from the medical schools; but it is equally true that the latter derive great advantages from their connection with the former. In a sense, each is as dependent on the other as are the opposing beams in a roof. It is, therefore, desirable in erecting hospitals and announcing them free to the sick poor, that ample accommodation should be provided for their every comfort, especially in times when the natural constitution is encouraged to fight the battle for its own strength.

Various reasons have led me to the selection of this subject:—Of these I need only mention—1st, the growing importance of State Medicine, which now rightly forms a necessary part of the training of every graduate of medicine of the University of Edinburgh, and of other schools whose degrees are coveted; 2nd, the prominence given to the subject in the present day; 3rd, the many opportunities afforded me of making a thorough acquaintance with the subject in Britain and France; and 4th, the serious hygienic difficulties which beset

me immediately after entering upon the active duties of my profession.

For two years I visited almost daily the "Mars" Training Institution which, in some respects, may be looked upon as a floating hospital, containing nearly 400 boys, whose ages range from ten to sixteen. The utterly insufficient ventilation, and the limited cubic space, at times swelled the sick list enormously, although fortunately, or perhaps unfortunately, not the death-rate: for I believe that, had there been a high mortality, an investigation would have been made into the causes, and some improvements decided upon. The vessel lay in the tide-way of the Tay, about 200 yards from its south bank, and about a mile to the west of the village of Newport. Had the vessel lain close to the north bank, and near the town of Dundee, the immense volumes of gases, pregnant with minute solid and molecular particles issuing from the chimneys of its numerous factories, and lying in dense masses on the river in a calm and close state of the atmosphere, might to some extent have accounted for the diseases prevalent on board. The condition of the ship proved that, although free from every source of contagion save that mysteriously carried by the winds, and although her sides were swept by the fresh breezes coming down the valley of the Tay, or the pure ozone coming in from the German Ocean, the diseases prevalent on board—phthisis, scrofula, phlyctenular and interstitial keratitis, and ulcers on the extremities, not to mention

the many cases of *mal-aise*—were largely traceable to bad air and overcrowding. Every authority is agreed as to the part which impure air plays in the causation of these diseases, and the rapid propagation of them in predisposed constitutions. It often struck me as strange that these boys, taken from the slums, as they generally were, and of scrofulous taint, were comparatively healthy while roaming city-arabs; but no sooner were they converted, much against their wills, into caged birds, than a few months at the most sufficed to produce inflammation and suppuration of the lymphatics, and they began to droop.

The low death-rate, and the expense connected with the maintenance of a small hospital on shore, are the only two reasons which I can think of why so little had been done by the directorate, to whom representations had been frequently made by Dr. John Stewart, to ameliorate, if possible, this unfortunate state of affairs. An epidemic breaking forth under such favourable conditions would make terrible havoc, and produce a startling mortality. It required no elaborate experiment, no thermometric or hygrometric observation, to prove that after the boys had lain in their hammocks for a few hours the atmosphere was most offensive, imparting to anyone who remained in it but for a short time *mal-aise* and headache. These facts, taken in conjunction with the diseases mentioned above, point beyond doubt to overcrowding and bad ventilation. The dimensions of the sick-bay were as follows:—Height, 7

feet; breadth, 14 feet; length, 21 feet; giving a total cubic space of 2078 feet. As there were generally four or five beds in the bay, this space would allow of something like 400 or 500 cubic feet per bed—an amount that proved utterly inadequate. In reality, one could not count upon more than 200 cubic feet to each bed, because the ventilation was bad, and the renewal of the air out of the question. Small quadragonal windows existed on one side, but they gave little light, and were unfortunate in their mode of opening, to admit the fresh air so necessary for the well-being and comfort of the sick. A worse condition of things was scarcely conceivable. That the sewage played no part in the causation of disease is evident, because the solid and liquid excretions were at once carried by a shaft, not into stagnant water, but into a river going at the rate of four miles an hour. And here I would state that the captain of the Institution did all he could in his individual capacity to rectify matters, by boring the decks and fixing cowls to exhaust the air, which was highly impure and peculiarly offensive from the nauseating effluvia generated in the bedding of the many cases of incontinence. [Since the above observations were made I have revisited the "Mars," and found the hygienic condition of the ship almost as satisfactory as it is possible to make it, without seriously remodelling the ship and introducing expensive and questionable forms of artificial ventilation. The mere mention of the application of anything artificial to a ship, so

favourably situated for natural ventilation, is palpably absurd. The alteration in the windows now admits of plenty of fresh air, at least in the sick-bay, without inconveniencing the sufferer. Each deck has got its ventilating exit shaft, which is sufficiently long and broad to cause a good up-draught. If it should be found after investigation, aided by the anemometer, that they do not satisfactorily perform their work, I would have one suggestion to make, which I believe would insure the production of an ascending current, and that is, the location in the shaft of a few coils of hot water pipes supplied from the boiler in the galley. This arrangement would lead to no expense, and would certainly produce rarefaction of the air in the shaft, and the escape of the imprisoned foul air. Some who claim respect as authorities on ventilation and cubic space, might be satisfied with smaller space for boys than men; but, remembering the sound principles enunciated by Professor Maclagan of Edinburgh, who always discountenanced any diminution of space, and my own experience of the "Mars," I have no hesitation in condemning any attempt on the part of those intrusted with the erection of hospitals and public institutions to adopt specifications which allowed smaller cubic space for children than adults, and I hold this to be doubly true in the case of boys taken from a most unhealthy class.]

In the chapters which follow I have gone fully into the construction, ventilation, and warming of the Hertford Hospital — a hospital which has

merited alike the favourable opinion of English and French architects, as well as eminent members of the medical profession in Britain and France. It is equipped with every modern requirement, and in many respects is unique. I am well aware that any investigation into the subject of hospitals would be incomplete which did not comprehend the supplementary establishment of convalescent homes, where pure air and gentle recreation complete what the physician and surgeon have begun, and which did not take into consideration the questions of finance, dieting, and nursing—matters of no light importance in themselves, and which, next to well-constructed hospitals, are most essential to the welfare of the patient and the success of the staff. It will be apparent, therefore, that special prominence is given to construction, site, ventilation, light, and warming, for the most potent of all reasons, that if the sick are invited into pest-houses, instead of salubrious hospitals, all other efforts, worthy in themselves, to secure good nursing and dieting, will be of little avail. The truth of these remarks is borne out by the terrible mortalities recorded in the Crimea, and more recently by the high death-rate in the hospitals of Munich. Referring to the Crimea, Miss Nightingale says:—"The sick at Scutari might have been loaded with medical comforts, attended to by the first medical men of the age; and under sanitary conditions such as then existed, they had not a chance."

As I have said, in the scope of this little work I never hoped to overtake an investigation and criticism of those interesting topics, without which any treatise on hospitals is deficient; but from the first it was my aim to confine myself, if not exclusively, as much as possible to the points I have specified, conscious that in no way did it make pretence to have exhausted every hospital detail. I have, for obvious reasons, been largely dependent on French writers, but by no means exclusively. Any thesis on this subject constructed without being dependent to some extent on the writings of Florence Nightingale, Galton, Robertson, and Chaumont (the foremost in the front rank of sanitary authorities), would bear the stamp of defect on every page. The prominence given to French writers does not arise so much from any omission to consult British authorities, as from a desire to promulgate the views of French hygienists, whose works are not so well known in Britain. It is also not my intention to traverse the domain of the architect, further than is within the legitimate province of every medical man who takes up the study of this great public question.

In concluding these prefatory remarks, I am proud to think that so much has been done at home of late to make hospitals something of the sanitoriums they pretended to be, and in stimulating hospital authorities to secure better sanitary arrangements and appliances. The invaluable observations of Florence Nightingale, given to the world after a long and

varied experience, have not been proclaimed in vain. She says, in her celebrated "Notes," published after the Crimean war, with reference to the sanitary condition of hospitals :—" I have here given the defects; few have had so sad or so large an experience of their results as I have had. I appeal to those who are wiser, and have more practical power than I have, for the remedies—to architects, to hospital committees, to civil and military engineers, to medical officers, to officers of health, to all men of science and benevolence, of whom our country is so justly proud. It is hard that in a country where everything is done by a despotic government (France in the days of the Empire) such advances in the sanitary construction of hospitals should have been made, and that our England, which ought to take the lead in everything good, should be left behind." When these telling sentences were penned, now twenty years ago, the truth only was told. On the British public they have had the effect for which they were intended, and to some extent as the outcome of her splendid personal efforts, we find model hospitals planted in many cities and towns.

CHAPTER II.

INSTITUTION OF HOSPITALS.

THE history of hospitals, interesting and instructive as it undoubtedly is to the student who has investigated their origin, and who has carefully observed the different stages of improvement through which they have passed, is a subject deserving perhaps of less attention than the more important matters relating to construction, ventilation, and warming. Be that as it may, the historical aspect of hospitals is full of interest, being interwoven with national life. Any thesis, therefore, that did not contain the researches of its author, as gathered from the archives of many nations, would be incomplete. The institution and history of hospitals in Britain and France are thus far valuable, because in these countries our sources of information are more reliable; and in the present day these, and, I may add, the United States, are the countries which have seriously taken up this public question. The healthy rivalry, if I may so call it, evident from the style of French writers, that has been going on for the last twenty years, has been productive of good results. For no sooner do we hear of a hospital erected in the French capital, of large pretensions, and considered by its partizans and sanitary legislators as an ideal, than Britain announces the erection of an establishment in many

ways superior. As yet we have no reply to our newest infirmaries in the way of counter-building. The French dispose of us with the trite remark "that our hospital edifices are merely imitations of the Hôpital Lariboisière in the French capital."

The term hospital, as every classical scholar knows, is equivalent to the *hospitium* of the Romans, and in later times to our own hotel. When the Church offered shelter and the healing art to all in distress, the cloister was chosen as the most suitable place for treating disease. This fact would probably account for the similarity between the architecture of modern hospitals and the ancient hospital at Delos, on the island of Rheneia. The similarity fortunately exists only in the architecture, for no sane man would now dream of bringing the wounded to be made whole, or the sick to be cured in the dim cloister, from which the light of day and the rays of the sun were for ever excluded.

As to the period when hospitals were first established we lack reliable information. The brief references to be found in the histories of Asiatic nations, as of the Greeks and Romans, are of very doubtful value. There are strong presumptions for thinking that no real hospital existed antecedent to the Christian era. Pagan antiquity could boast of none. The stately edifices of Babylon, Nineveh, Carthage, and Thebes were erected for other purposes than those of charity. "Neither Greece nor Rome, great and glorious as they were," says Baron

Ambert, "had their hospitals." A famous writer upon antiquities believes that no such institutions existed among the ancients, and he mentions that the chief places of study were the temples of Æsculapius, where the votive tablets furnished the Asclepiadæ—the hereditary physicians of Greece, and the supposed descendants of Æsculapius—with a collection of cases. The establishment of hospitals, as necessary then as now, came with the advancing tide of a true civilization, and as the outcome of the highest Christian virtue—charity. It is not then to be wondered that they did not exist in the dark ages of the majestic but hollow civilization, in which Greece and Rome were in the van. Their conception they owe to Christianity, which alone taught that all mankind were one—human nature much the same in all, and liable to the same ills. It was with the dawn of the Christian era that the abject, the forlorn, and sick received their charter of human rights—a charter the terms of which were never dreamed of in Grecian or Pagan philosophy. It is matter of history that no one of the rich men living in Rome ever conceived the idea of founding a hospital for the sick. How could they? The rhetorician of the imperial times talked about repelling poor men from him with scorn. With the Romans philanthropy was not even a speculative principle. To this and the last century is the credit due of raising benevolence to be the vast power for good which it has become.

Although the general impression of oriental

scholars is that no real hospital existed in India before the British, yet in justice it must be stated that several eminent writers believe hospitals did exist among the Brahmins and the Greeks. There are strong reasons, however, for thinking that these pre-Christian hospitals by no means partook of the nature of charitable institutions for the reception of the sick. Dr. W. W. Hunter, in the *Imperial Gazetteer of India*, states that "the public hospitals which the Buddhist princes established in every city were probably the true schools of Indian medicine. They supplied opportunities for the study of disease similar to those which the Greek physicians obtained at their hospital camps around the mineral springs." On the other hand, Tennant avers that "an hospital for sick poor was never known in India before the British." If the testimony of the latest and most eminent writer upon India (Dr. Hunter) be accepted, we are led to believe that the hospitals of the priest-physicians existed only for a time, and that during the best era of Indian medicine (250 B.C.—600 A.D.). There can be no question—judging from the conflict of opinions—a good deal of mystery surrounds the whole matter. And strange as it may seem, to hold that cities of antiquity possessed no hospitals, the absence of them cannot be explained on the ground that the ancients were ignorant of sanitary laws; for those shattered aqueducts, pier beyond pier, like "shadowy and countless troops of funeral mourners passing from a nation's grave," as

applied by Ruskin to their water-works, have outlived the destruction which has doomed the more imposing and less useful structures of Alexandria, Carthage, Rome, and Jerusalem.

In the New Testament the Pool of Bethesda is mentioned as a curing resort, to which a multitude of impotent folk, blind, withered, and halt, came "to await the moving of the waters." Possibly fanciful notions, based on real curative powers in the water at certain seasons, attracted those who hoped to be cured of rheumatism, atrophy, and other infirmities. For such charity had built five porches round the pool to afford the crowd a shelter. The steps leading down to the water were generally thronged with people, as are the steps of the sacred watering-places on the Ganges at the present day.

With the exception of the hospitals merely made mention of in the Transactions of the Council of Nicæa, A.D. 325—that erected at Cæsarea, A.D. 370, and richly endowed by the Emperor Valerius; that at Constantinople, by Chrysostom, four centuries before the appearance of the Mohammedan dynasty; and the foundling hospital established at Milan—we arrive near the close of the seventh century before we become acquainted with anything certain and reliable regarding such institutions. About this time the famous Hôtel-Dieu of Paris, also known as the Hospital of Saint Christopher, came into existence. It was situated near the great temple of the capital—the Nôtre-Dame. "The place where the people

pray, and the place where they suffer," says one writer, "are alike the house of God." The greater part of this ancient and historical edifice succumbed to the fire of 1772. After the Revolution it bore the well-deserved name of the "Grand hospice d'humanité." What remained of the old Hôtel-Dieu was well known to those who are now the older teachers of medicine and surgery in London and Edinburgh. The famous skin hospital of Paris, Saint Louis, was founded in 1612. At its origin it was exclusively set apart for the treatment of pest, from which loathsome malady 68,000 died in the Hôtel-Dieu since the epidemic of 1562 (Husson). A few years later the first military hospital in Europe was erected by order of Richelieu in the Piedmont, where it may still be seen. In Jerusalem an hospitium was erected by the Knights of St. John, capable of receiving 2000 guests, including an infirmary for the sick. After France, no country presents so valuable and interesting a field for investigation as Italy. The principal hospital in Rome is that of Saint Esprit, founded in 1198. It was by no means the first hospital in Rome, for two centuries earlier the city possessed a good many. From an architectural point of view Saint Esprit is truly remarkable; but it possesses numberless faults in its internal distribution, and the ventilation leaves much to be desired. Between the eleventh and the fifteenth centuries the necessity for hospitals on the Continent became urgent, owing to the misery entailed by wars,

more especially the Crusades, and the rapid spread of leprosy. About the fifteenth century field-hospitals were established, in which—strange to say—the wounded were not treated by the army surgeons, but by the clergy.

With the exception of an institution established for the reception of the sick, A.D. 1070, mentioned in the life of Lisfranc, England was possessed of no hospital until the founding of St. Bartholomew's in 1102 by Rahère, minstrel of Henry I. It was reorganized in 1547 by Henry VIII., and reconstructed in 1730. Then followed St. Thomas's in 1207, removed eight years later to a better locality by the Bishop of Winchester, for reasons which the present age would scarcely credit—reasons which showed that there were a few individuals even then who appreciated pure air and water (Highmore, p. 72). Bethlehem Hospital—the oldest lunatic asylum in Europe save that at Grenada—was founded in 1547. These three were included in the "Five Royal Hospitals" of London, which, prior to the Reformation, were monasteries in which the sick were cared for by the clergy. Guy's, London, was erected in 1724, the London in 1740, St. George's in 1733, and Westminster in 1719.

The famous old Edinburgh Royal Infirmary, the first reared in Scotland, traces its origin to the year 1721. For want of funds its erection was delayed till August, 1738. The means by which it was erected being unique, they are worthy of more than a pass-

ing notice. Unlike the Coliseum at Rome, reared, says tradition, by the forced labour of Jewish captives at the beck of a cruel despot, the old Edinburgh Royal Infirmary was completed, be it said to the credit of our Scottish ancestors, by the money of those who could afford to give in those days when Scotland was poor; by hands willing to toil for little or perhaps no remuneration; by contributions of stone, lime, wood, and glass, from subscribers who had not the ready money. As time passed on, considerable additions had to be made to the old building, to meet the necessities of the age. Not many years ago it was found no longer able to meet the demands of modern medical science. The old and venerable block, now deserted by the living, is tenanted only by the undying memories of the past.* It was there that Liston, Ferguson, Syme, Simpson, and Christison, made those discoveries which enriched the pages of medical science, which gave to themselves names of world-wide renown, and which made the Edinburgh medical school well-nigh the most famous in the world. Aberdeen, Dundee, and Glasgow followed the example of Edinburgh some years later. King's College, London, and other large hospitals throughout the country, were erected within the present century.

It is not to be inferred that prior to these large infirmaries there were no institutions that partook in the slightest degree of the nature of hospitals, for we know that leper houses and lands abounded

* Part of it is used as a fever hospital.

in the country. In fact, almost every large town in Great Britain had a leper-house near it, intended more for isolation than cure, and as a rule supported by charity. Of these France had something like 2000 before the twelfth century. In Shaw's *History of Moray*, reference is made to hospitals as far back as 1235, which were supported by lands granted at different times by royal charter. Such an hospital existed near Elgin; but it cannot in any sense have fulfilled the functions of an hospital as is understood in the present day. The Maison-Dieu of Elgin or *Domus Dei*, as it was named at first, was a place for entertaining strangers and maintaining poor infirm people.

The victims of the plague which visited Britain, from the first, in 430, to the great plague of 1664-1665, were treated principally in lazar-houses, which at that time abounded in London and took the place of hospitals. The following passage is culled from Green's *History of the English People*:—"The rapid progress of population within the boroughs had outstripped the sanitary regulations of the middle ages, and fever or plague, or the more terrible scourge of leprosy, festered in the wretched hovels of the suburbs.

. . . . The first work of the Franciscan friars lay in the noisome lazar-houses. It was among the lepers they commonly chose the site of their homes."

Happily for England we are now seldom visited by such scourges. And of this there can be little doubt that, with a more perfect hospital system, and

with an extending sanitary legislation, we shall have little to fear from scourges that in days gone by, from want of these things, and by the absence of cleanliness individually and in the community, have mowed down our people by thousands in precisely the same manner as they still continue to execute havoc in those countries where sanitation is as yet unknown.

Coming to more modern times, we find that after the Reformation, by the dissolution of monasteries, the way was paved for their conversion into charities. In fact the Reformation gave an impetus to the founding of hospitals, as it did to everything else connected with the greatness and prosperity of Great Britain. When England could not boast of a single hospital, the city of Rome had twenty-four, and Paris was justly proud of its famous Hôtel-Dieu. The nineteenth century tells another tale. It has found the relative positions of the three countries entirely changed. Not only have we made up lost ground, but we have completely outdistanced the French, who, with great and characteristic energy, have like ourselves paid most attention to this important subject.

Not many years ago Miss Nightingale awarded the palm to the French. More recently she had cause to alter her opinion. She says:—"All the advantages of Lariboisière and Vincennes, without any of their disadvantages, will be realized in the New Herbert Hospital at Woolwich." And this is only what we might expect, as the most recent structures are sup-

posed to avoid the defects of those that preceded them, and to possess all the latest improvements. The French, or more strictly speaking, the Parisians, who naturally look upon their hospital system as perfect, and their hospitals as models for every other country, point with just pride to Lariboisière, Vincennes, Hôtel-Dieu, and Menilmontant. They never condescend to contrast their hospitals with those of any other country but England, and, as might be expected from such comparison, prove beyond dispute, to themselves at least and their partizans in England, the superiority of their institutions over ours, giving us the credit of having, in late years, imitated them to some purpose. French writers have fully appreciated the testimony given in their favour by Miss Nightingale and Robertson of Manchester. But it must be borne in mind that the French hospitals have not been without their detractors. Malgaigne, the eminent surgeon, at a meeting of the Imperial Academy of Medicine in 1862, pronounced the memorable words, "The hospitals of Paris are the most detestable of all the hospitals of Europe. Sarazin, another French authority, in the *Nouveau Dictionnaire de Médecine et de Chirurgie*, p. 694, states that "the English, and above all the Americans, have surpassed us in carrying out the reforms, which it was ours to initiate." The palm no longer remains with them. I feel certain from my experience of the French hospitals, that we have stolen a march upon our jealous neighbours,

whom we may with feelings of pride invite to imitate the new Edinburgh Royal Infirmary, the Blackburn and Leeds Infirmary, the Herbert at Woolwich, and the Glasgow Western Infirmary.

In the infancy of scientific knowledge, when due sanitary precautions were not taken, hospitals were erected in localities far from carrying out the intentions of their benevolent founders. The frightful mortalities in Scutari, where two out of every four admitted perished, and the continual presence of surgical fever, pyæmia, and erysipelas, in many of our hospitals, have given us a sad but useful experience. In the present day, it may be said without fear of contradiction, that no country in the Old or New World can boast of such magnificent charities as ours, gracing as they do our cities, and esteemed by the stranger, who is lost in admiration, as the "memorials that renown them." It is true when Miss Nightingale published her excellent *Notes on Hospitals*—a work, the importance of which it is impossible to overrate—the new Edinburgh Royal Infirmary had not found a place in the hearts of the Scottish people ; but were it possible for her to revisit now the "gray capital of the north," there she would see what is admitted by general consent to be the handsomest and most perfect public hospital in Britain, if not in the world, reared, like its predecessor, solely by private munificence. I could mention others that have come into existence since Miss Nightingale passed her sweeping criticism.

The value put upon hospitals in France by the legislature, or by the public, may be gathered from the following narrative:—Napoleon III., in spite of his many failings, saw the necessity for the immediate construction of a modern Hôtel-Dieu, which he intended should rise up simultaneously with the Grand Opera, to fulfil the double function of providing a home to meet the wants of the sick, and adding beauty to a city famed for its magnificence. The reverses of war prevented him from carrying out his good intentions, and a republican government succeeded. Be it said to their shame, instead of carrying out the plans executed by the highest authorities in Paris, and proceeding with the structure in course of erection, which at the time was sorely needed and the want of which was palpably felt, the Hôtel-Dieu was allowed to remain *in statu quo*, and the Opera was completed. Possessed of this knowledge, Miss Nightingale would have reason to alter her opinion regarding that nation, whose philanthropy may truly be said to be cosmopolitan.

In Britain hospitals are generally maintained by private munificence. One or two of the London hospitals possess endowments. In France the hospitals are maintained at the expense of the State. The French system has one great advantage over ours, viz., that in constructing them, less attention is paid to economy than in England, where the same has to be done by voluntary contributions. Under the influence of a benign religion, and acting

upon that perfect ideal of beneficence that it was "better to give than to receive, to minister than to be ministered unto," we find our native land and our colonies studded with the most noble institutions for the sick and the distressed—institutions whose motto is, "Sick, and ye visited me; naked, and ye clothed me"—institutions to which all are welcome, of whatever nation or creed, the sole title for admission being disease and suffering. The British public have anticipated the famous lines of Tennyson, and have

" Flung their doors wide !
 Whatever man lies wounded—friend or foe,
 Shall enter if he will."

The poet-laureate has given us the true portal. I have learned that to some hospitals admission is gained by subscribers' letters. Provided this system be not abused, to the exclusion of the needy who are without influence and friendless, there would be no cause for complaint. I believe this system of privilege has, as a rule, no place in our great hospitals. It were well if all our hospitals had the system known at Guy's. The sick are received into the wards without letters of recommendation (Highmore, p. 124). On the fly-leaf of the Report of the Edinburgh Royal Infirmary, one reads this noble sentence:—"The selection of the patients to be admitted shall be regulated solely by a regard to the relative urgency of their ailments." The hospitals of America receive the sick poor "without regard to sex, age, or colour."

Perhaps no utterance more significant and comprehensive has been made, than that by Dr. Andrew Buchanan, of Glasgow. In declaring the Glasgow Ear Hospital open to the public, he said it was *open to those of every tongue and clime, of every faith, and to those who have no faith, to all who choose to come.* Were the system of privilege common, it would most certainly cast an air of sham over our boasted hospital system.

The question is often put, Is the French hospital system superior to ours? but is seldom answered satisfactorily. A residence in Paris for more than a year has led me to make the following deductions. Their open portal to all in sickness and distress is an admirable feature of their system, but with their limited hospital accommodation has its alloy in the difficulty of preventing overcrowding, which is sure to happen, and, as a consequence, an increase in the mortality. When I visited the Hôpitaux Lariboisière, Hôtel-Dieu, Beaujon, and Menilmontant, hundreds of patients above the specified number were lying on mattresses on the floor, principally cases unsuited for hospital treatment; and this, I have been told on good authority, is no uncommon occurrence. In a letter published in the paper *L'Estafette* in March of this year (1880) the writer, Dr. Landur, says, "To-day the hospitals of Paris are insufficient for the population; but the municipal council has turned a deaf ear to a proposal to erect new hospitals, their intention being to give assist-

ance at the homes of the poor, and organizing the 'Bureaux de bienfaisance' on a new basis." There is the strongest objection to an hospital doing the duty of a workhouse or depôt of mendicity. True, their only portal is "human suffering;" but if it should lead to overcrowding, as it undoubtedly has done in the past, it must, in the interests of all seeking its aid, be severely condemned. There can be no question that hospitals supported and controlled by the State have their advantages. Most likely, with State-supported hospitals, we would not witness the unseemly squabbles which have occurred in Guy's and elsewhere, by an abortive attempt on the part of a paid official and a self-constituted court of directors, to make the physicians and surgeons—whose voice should be supreme in all things relating to the sick—second in importance to matrons and paid treasurers with newly-fledged aspirations. The voice of the people and of the legislature must be heard before this question is finally adjusted, and we doubt not it will be given with no uncertain sound in favour of the medical staff. Husson says, "In Paris we are in the habit of meeting every requirement, and we prefer to add in emergencies supplementary beds, so that the sick who could not be treated in their homes are not left to die for want of succour." To correct this great evil, for nothing else can it be, when one knows this overcrowding to be occasioned by the lowest class of

society who, in severe winters such as the past, are on the eve of starvation, the administration should increase their accommodation. As far back as 1862, I have been informed, the administration consulted as to remedying this crying evil, but the year 1882 has been reached and no adequate remedy provided. There is one conclusion to be derived from this, and that is—the poor and destitute of Paris are as yet insufficiently provided for, whereas in London, a city of much greater magnitude and with more distress in proportion, the wants of all are amply secured by hospitals and workhouses. The universal diffusion of charity throughout Britain presents a marked contrast to the almost entire absence of this virtue in France; money for charitable purposes only being wrenched from them by the attraction of the lottery, in which there is the chance of winning as well as losing. I am fully convinced that charity is not only a duty of humanity, but a privilege, which the more fortunate classes of society possess, of lightening the burden of those who it may be have been cradled in adversity, or rendered by disease unfit for their duties in life.

In concluding this brief sketch of the past and present of hospitals, I may state that I can conceive of no money left, no estate bequeathed, for a nobler object than the erection and endowment of hospitals, and more productive of greater blessings and happier results. As a splendid example of magnanimity and philanthropy few can compare with the Hertford

British Hospital. The conception of a more elegant and befitting memorial is scarcely possible. It is a living monument, ever productive of blessings. Looking at this handsome edifice, styled by the French the "Château Wallace," as you approach it from the Rue de Villiers or from its own grounds, one immediately realizes the justice of the eulogium of Thomson on the art of the architect, and recognises it as in reality

"The art where most magnificent appears
The little builder—Man."

To every hospital, I trust, in course of time there will be but one gate of entrance—disease and suffering; and that those who are forced to be the recipients of charity, no matter whether their unfortunate condition be the outcome of their own actions or misfortunes, will accept and enjoy it without the fear of humiliation.

CHAPTER III.

SITE.

Choice of a site.—Recent discussions have imparted much interest to the question of site. It may be said with certainty that were sanitary considerations alone to prevail in the selection, apart from matters of economy and the pressing necessities of the poor in crowded localities, hospitals would be located in the vicinity of large towns. In cities and large towns the choice of a site must primarily depend on the population whose wants it is intended to relieve; and this condition renders the procuring of a site oftentimes difficult. There is nothing easier than to settle in an abstract manner the site which one ought to choose upon which to build a hospital; but in many cases when the abstract has to take practical shape, numberless unseen difficulties arise. A large tract of ground is indispensable, and this, if possible, should be secured beyond the suburbs where nothing is to be feared from the rapid increase of the population, whose movements, continual and eccentric, tend to invade the approaches to the towns. The present Lariboisière in Paris is an apt illustration of this. Once it stood upon ground far apart from dwellings and factories: now it is hedged in upon all sides, and this circumstance, in the opinion of many, accounts for the high mortality of the first pavilion

hospital. Few hospitals, it may be noted, are to be found in the localities best suited for them. If a suitable site cannot be secured in the outskirts, then the next most suitable locality is a large unoccupied space in the interior. But how few hospitals are to be found even there, if we except the more recent additions to hospital architecture in Edinburgh, Glasgow, Paris, and London. And if the location of general hospitals be so important a matter, how much more important must be the location of special hospitals for the reception of small-pox, cholera, and scarlet fever. At the meeting of the Social Science Congress in Edinburgh in the autumn of last year, Sir John Rose Cormack threw much light upon this subject by a communication entitled, "The Location and Administration of Special and General Hospitals, in which Contagious Diseases are treated"—a communication which, while it seemed to take aback so eminent an authority as Sir Robert Christison, Bart., whose long and distinguished hospital services in Edinburgh gave great weight to his opinions in all matters relating to this question, was supported by stubborn facts—facts which I can humbly verify. In future, when the sites of special hospitals are being discussed, the distance to which the winds may waft the poison-charged "drift" must be taken into account. In Paris the so-called centres of isolation for small-pox became *foci* for propagating the disease, as was the case in the four "arrondissements" in which the small-pox depots existed;

specially so in the Sorbonne, because there was located the principal depot—the Hôtel-Dieu Annexe—a wretched, dingy tenement which, when I visited it, was crowded with patients in all stages of the malady. Intimately acquainted with this “arrondissement” of Paris, I believe that the spread in one direction is accounted for by the nearness of the adjoining streets, composed of Cowgate-like dwellings piled one above another, and sparingly supplied with light and air, affording, as Sir John remarks, “the very best conditions for receiving and retaining on their grimy walls the drift of variolous dust from the Annexe,” from which the epidemic spreads like wildfire. In a short time this street becomes a focus, from which the poison-charged “epithelial drift” from the desquamating skin is wafted to the next street, equally favourable for the reception and propagation of the disease. The small-pox did not spread on the other side of the Annexe, because the river and an open space—the historic island—intervened. It is clear that it will never do to locate hospitals, special or general, in or near dirty, crowded, and closely-built districts. Sir John spoke from a long experience of splendid work accomplished in the fever dens of Edinburgh, which to a great extent the city improvements have demolished, and from his investigations into the spread of small-pox in certain districts of Paris.

The site of every hospital, large or small, special or general, should be of established healthiness, having

nothing to prevent the free circulation of air on all sides. An eminence or rising ground is, for many reasons, better than the plain, which can never be acceptable, as the ventilation and aeration are never sufficient, the humidity of the ground is extreme, and the drainage so necessary to the welfare of hospitals, is only accomplished with difficulty. The soil should be dry and porous, and as much as possible of a calcareous nature. The neighbourhood of marshes giving off deleterious gases, clayey soil retaining the ground water, and the vicinity of graveyards saturated with organic matter, should be avoided. The same applies to stagnant water and canals, which in many places are little short of public nuisances. The hospital ought to have a southern exposure, and be sheltered as much as possible from the biting north and east winds. A French writer makes light of the idea of attaching much importance to orientation, but those who are better acquainted with the climate of Northern Europe think differently. The principal hydropathics in Britain may be taken as illustrating the desirability of exposure to the "sunny south." The neighbourhood of a river is a precious advantage, provided it be suitable in every other respect, as its clear waters, flowing rapidly, sweep away the sewage, rendering it innocuous at once. This can only be said with respect to tidal rivers, but of late the utilization even of these has been called in question; engineers and sanitary authorities having in the meantime

abandoned the idea of utilizing rivers as sewers, because of their insufficiency, and because the amenity of towns on the lower reaches, often fashionable watering-places, is partially destroyed. Estuaries, such as the Tay and Severn, may be excepted. The Clyde, Mersey, and Thames may be mentioned as tidal rivers discharging large volumes of water into the sea, which are utilized as sewers with the result that in some places they are little better than cesspools, with the most offensive gases bubbling up from the black liquid—seen and perceived with ease—in whose praise the most that can be said is, and I admit it is a great deal, the death-rate is not significantly increased. In my own mind the high mortality, and the continual presence of typhoid, small-pox, and diphtheria in Paris, is largely due to the insufficiency of the Seine as a sewer, and the stagnant canals that intersect the city.

The Chirurgical Society of Paris, in 1864, came to the conclusion that no hospital should stand on less space of clear ground than 540 feet to each patient, so that an institution with 80 beds should occupy one acre of ground. This amount has in later times, however, been deemed insufficient; and we find, in the new Edinburgh Royal Infirmary, containing nearly 600 beds, that each patient is allowed somewhere about 1000 feet. The freest possible circulation of air should be secured around the building and within every portion of it, and to make certain of this circulation, the pavilion

system has been adopted. Hospitals situated on an eminence, with a gentle slope to facilitate drainage and ventilation, will go a long way to neutralize the disadvantages of locality, for which at present there seems no remedy, unless the Utopian one of Government enforcing every corporation or landowner to grant feus for hospitals at a nominal figure. When one thinks of the enormous sums of the voluntary contributions of the public squandered or spent on sites to the impoverishment of the useful edifice to be raised upon it, we are bound to comment on the absence in many cases of that philanthropy so characteristic of the Anglo-Saxon race. If ground is of such priceless value in the interior, why not go beyond the city bounds? There less difficulty would be experienced in obtaining a desirable site at a reasonable figure. Modern hospital authorities would do well to remember that it was the custom of the ancients to place their Æsculapian temples, not in crowded cities, but on the breezy hill tops.

CHAPTER IV.

DIMENSIONS.

AFTER a suitable site has been chosen, it devolves upon those to whom is intrusted the erection of the hospital, to settle what form it should take, and what its dimensions should be. The latter ought always to be in proportion to the population whose wants it is intended to relieve—wants subject to frequent and considerable variations, as in times of destitution, of epidemics, and of war. In our sea-girt isle we are not likely to contemplate so remote a contingency as this last. The question has often been asked, but not always satisfactorily answered, whether it is wise to construct hospitals relatively small and numerous and separated from one another, or to erect one large one to do the same service. It has been established by the clearest evidence—more particularly that of Sir James Y. Simpson—and, in fact, it is generally admitted, that the sick and wounded recover more quickly and that the death-rate is lower in the small than in the large, all other conditions being equal. To small hospitals there is one strong objection—viz., the greater expense of construction and maintenance, and the difficulty of proper administration; and this is no chimerical objection in times when public charity is strained to its utmost for their support.

Sarazin has said, with some degree of truth, that it is impossible to reconcile hospital hygiene with the parsimonious wisdom of the administration. There can be no question that the tendency of the present day is to erect large establishments, containing as many as six and eight hundred beds, in this respect reverting to a system prevalent centuries ago. It may be accepted as a fact that an hospital of large dimensions, provided it be erected on the pavilion system, may be rendered by proper and wise precautions sufficiently salubrious to produce good results. The pavilion system, now generally adopted in the construction of hospitals, is nothing more nor less than an aggregation of small blocks grouped around the administration. It would be too much to assert that the general principles of construction are yet finally settled on a scientific basis of observed facts; for, in studying this question, one has only to read the writings of different men in the same country, be it in England or in France, to find opinions as abundant as persons—opinions marked by all that decision and breadth of statement which are characteristic of men unbewildered by the slightest experience. The pavilion system is not, however, without its detractors. There are still a few, whose opinions on this subject carry some weight, who prefer wards with the corridor at one side to those with opposite windows, because with the latter there might be too much ventila-

tion for the sick man. The hollowness of such an objection to the pavilion style of ward is very apparent. It should in all cases be the cherished wish of administrators of the public money to erect buildings on the most modern hygienic principles, while at the same time due regard is paid to economy, which at one time was considered the appanage of large institutions, but now more appropriately appertains to the pavilion system.

Miss Nightingale's experience has shown very forcibly the wisdom of restricting the number of the sick treated in the same establishment. And this precaution is above all indispensable for Maternities, where disastrous results may ensue, unless such special arrangements of the wards, as are to be found in the new Maternity, Paris, over which Professor Depaul presides, are attended to. On this point the wise precepts of Tarnier and Lorain are fully stated by St. Germain in his article on Maternities (*Nouveau Dictionnaire de Médecine et de Chirurgie*, p. 754). Taking for granted that no hospital should have accommodation for more than 600 or 800 patients, how many should each pavilion contain? Most authorities are agreed that the number should not exceed 100; but the answer will be best arrived at by a study of the different plans which, up to this date, have been adopted in the construction of hospitals. The pavilions of Lariboisière contain 102 beds; Val de Grâce, 150; Vincennes, 300; Beaujon, 60-80; Hôtel-Dieu, 100;

Ténon, 100 ; Edinburgh Royal Infirmary, 70-75. Lawson Tait, writing in a similar strain to that of the late Sir James Simpson, believes "that after the number of beds exceeds 100, the risks to life are increased."

In a discussion with reference to the reconstruction of the Hôtel-Dieu, in the Chirurgical Society of Paris, Trélat gave it as his opinion that the pavilions should not contain more than 100 beds each, and this number was wisely accepted by a majority of the Society as a maximum. One thing is obvious, a third storey is necessary if the numbers are more than 100, and the existence of it increase the chances of overshadowing.

When the death knell of palatial structures was sounded by Sir James Simpson, the mortality statistics he collected did not refer to pavilion hospitals, such as have sprung into existence within the last few years, but to tenements where hundreds were aggregated together on a small superficial area. In advocating institutions better than those from which he culled his statistics, this eminent surgeon saw what he had to combat. He desired hospitals that could resist those influences which seem at present to "set utterly at defiance all the proudest advances of practical medicine."

CONSTRUCTION AND INTERNAL DISTRIBUTION.

- I. *The plan of the ward.*
- II. *The union of the wards to form a pavilion.*
- III. *The arrangement of the pavilions to form an hospital.*

With regard to the vexed question of construction, it would seem as if the majority of medical men and others who have devoted special attention to the subject prefer wards of one storey, and favour isolation of the pavilions, because they believe that with these conditions ventilation is better and more easily carried on. For such a disposition of construction greater expenditure is necessary for ground and building material, and this is a consideration that operates largely upon the minds of hospital managers who are intrusted with a judicious and economical disposal of public money. Some difficulty may be experienced in the selection of one particular plan to the exclusion of all others, because it cannot be said that the excellent system of pavilions generally adopted in the present day has passed out of the region of criticism and into the calm of general acceptance. This much, however, may safely be said, that we are not likely to witness any material departure from the system now carried out. With almost every existing hospital there is more or less dissatisfaction, and the results of the more recent attempts to produce perfect structures are not yet known. In these later erections the pavilion system has been adopted; but in them two and three tiers of wards are superimposed, thus showing that the excellent arrangements of the Baltimore hospital, or St. Elöi, Montpellier, have not as yet found imitators.

Believing the ward to be the basis of hospital con-

struction, the size of which is to be determined by the number of patients which it is meant to accommodate, it may be as well to take up for consideration—

I. *The plan of the ward.*—The cubic space for the sick should always be greater than that allowed for those in health, because the impurities given off more abundantly from the former contaminate the atmosphere more readily, and diminish the amount of those health-giving elements, so necessary to the repair of waste, which exist all around in immeasurable quantities waiting for admission. For children, except the very youngest, the same estimate should be made as for adults. The framers of the Glasgow Police Act thought otherwise, and allowed for children only half the adult space, on account of the chest capacity being less. Such a distinction should be carefully avoided for reasons much more cogent than adduced by those who are guided in the division of space by chest capacity—at least, so long as adults are furnished with less than 2000 cubic feet. To carry this distinction to its legitimate conclusion men with large chests and extensive surface area should be specially considered. But the arguments of Professor Maclagan in discountenancing a diminution of cubic space for children are incontestable. He says, in support of his view, that in children “although chest capacity is less yet respiration is quicker, and the vital functions are more active, and at this period the vital organs are more liable to disease.”

With the hope that, in the future, children and adults will be more liberally considered in this respect, it may be asked, what is the maximum number of sick which a ward should contain? Miss Nightingale has fixed the number at thirty-two, and remarks that "a head nurse can efficiently supervise, and a night nurse carefully watch thirty-two beds in one ward, whereas with thirty-two in four wards it is quite impossible." Sarazin fixes the number at twenty-four, and this figure stands midway between Blackburn Infirmary, 8-10, and Miss Nightingale's number, 32.

1. *Dimensions of a ward.*—(a) Breadth, 30 feet. (b) Height, 16-20 feet. (c) The length cannot be exactly fixed; it will depend on the number of beds: but given the number of patients, the other dimensions, and the cubic space, the length is easily calculated. (d) Cubic space not less than 2000—4000 is not considered too much in acute cases. (e) Superficial area, 100-120 square feet per bed.

2. *The floors.*—Next in importance to the cubic space which the four walls should contain, come the floors upon which the heavy and solid impurities settle. There can be no question that oak laid concrete, makes by far the best flooring, especially when polished with wax or "frotted," and thus rendered impervious to the filtration of air charged with the hospital miasm. In many cases, pine, well dried, carefully jointed, and "frotted," seems to be favourably regarded. In the new Maternity Hospital,

Paris, which is in course of construction, I was struck with the novel way of making the flooring and walls. Small fragments of variegated marble were mixed up with stucco and cement, and after some degree of hardening the projecting edges of the marble were smoothed down and polished, and the whole surface gave a beautifully smooth and glassy appearance.

3. *The walls.*—The material for the lining of the walls is quite as important as the flooring. White wash, or a mixture of lime and white wash, has long been discarded as useless. The internal walls of hospitals, prisons, and maternities, should be made of Parian cement, glazed tiles, varnished stucco, or plaster coated with paint; in fact, of any material that will admit of thorough periodical cleansing with warm or carbolised water. A suitable cheerful paper varnished three or four times, such as is to be found in the Glasgow Western Infirmary, makes an excellent wall lining. It has been demonstrated over and over again by hospital and prison authorities that walls, other than these, afford a suitable nidus for the special miasms begotten in them, which set up on the walls a fermentative process. In fact, fermentation would seem to be the only explanation of the *sui generis* smell which meets any one entering a hospital ward, a prison cell, or a filthy house, and which continues, in spite of all ventilation and floor cleansing. Until the walls of a ward or cell admit of washing, the

dispersion of these odours is out of the question. In the beautiful St. Eloï hospital at Montpellier the ward is built upon the plan of the Gothic arch, in order to avoid stagnation of the air and the accretion of organic matters in corners and angles.

4. *The windows.*—There should be one window for every two beds, exclusive of the end window, which adds greatly to the cheerfulness, and materially assists in the ventilation; and the wall space between adjacent windows should not be less than 9 feet. Their form, position, and size are deserving of more attention than is generally devoted to them, when compared with other portions of the ward. The height of the window should be regulated by that of the ward, and should extend from within 3 feet of the floor to within 1 foot of the ceiling. It must not be forgotten that, on a suitable division of the window into sections, depends in a large measure the admission of fresh air into the ward. Although the windows of many hospitals—notably the Parisian—possess the requisite proportions, yet they cannot be pronounced faultless. Take the windows of Lariboisière as an example. There the dimensions are:—breadth 4 feet 8 inches, height 13 feet, with a wall space between windows of 9 feet 2 inches. No larger window than this could be desired; but, when it is remembered that in nearly all the Parisian hospitals the windows are composed of two compartments, on the principle of the casement window, opening longitudinally in the

median line, it must be evident that this arrangement is unfortunate, as it allows the internal air to rush in on a level with the beds situated near, and thus to inconvenience the patients. Perhaps the curtains, which French hospital authorities have at last resolved to consign to the flames, served one good purpose, viz., warding off those draughts. As far as the windows are concerned, the French have made little progress since the days of Claude Villefrand, the architect of the St. Louis Hospital. The windows of the newly-constructed pavilions of St. Louis were, as in the Hospital Cochin, pierced at the height of the lateral wall, with the intention of preventing currents of air, often foul, from injuring the sick ; but this arrangement, carried out for the best, deprived them of sufficient light and the diversion of the outer world. These latter defects were in existence in Tenon's time, and continued until Clavareau, in 1804, presented his report to the French emperor on the state of the "Hospitiaux et Hospices civils," in which he pointed out the urgent necessity for alterations. This opinion was expressed contrary to the dictum of the Commission of the Academy of Sciences, and carried into effect by applying himself at once to cause the removal of these defects. I cite him textually :—"To lower as I have done at St. Louis all the windows of the infirmaries which, after ancient ecclesiastical custom, are elevated from 8-9 feet above the floor." He gave the following reasons for the change :—"The

beautiful hospital of St. Louis, which by its situation enjoys all the benefits of pure air, had its windows situated 9 feet above the floor, while the unwholesome emanations from the skin and lungs—emanations denser in contagious maladies than the other—only rose to a height of 2 feet, and settled round the beds of the sick, who were living habitually in a morbid atmosphere.” While admitting the truth of his statement and the necessity of lowering the windows, this authority of the commencement of the century forgot, or was unconscious, that under the influence of the heat developed by respiration the air in contact with the sick constantly tends to rise, carrying with it some of the miasmatic germs and the lighter solid particles with which it is charged. Clavareau’s ideas were sound, and the adoption of a plan which admits of abundance of fresh air and sunlight, provided the latter does not inconvenience the patient, is worthy of all praise.

The sketches (*vide* Plate II.) represent the style of window in use in different hospitals. Fig. 3, which is a drawing of the tripartite window in use in the Middlesex Hospital, is a good arrangement. Fig. 4 shows a window which can be opened by means of a key to any angle that may be desired. Fig. 5, without the upper section, is the form of window in use in the General Hospital, Hanover; Saint Jean, Brussels; and most of the French hospitals. Fig. 6 is the sketch of a window that has been largely adopted in this country. The upper portion



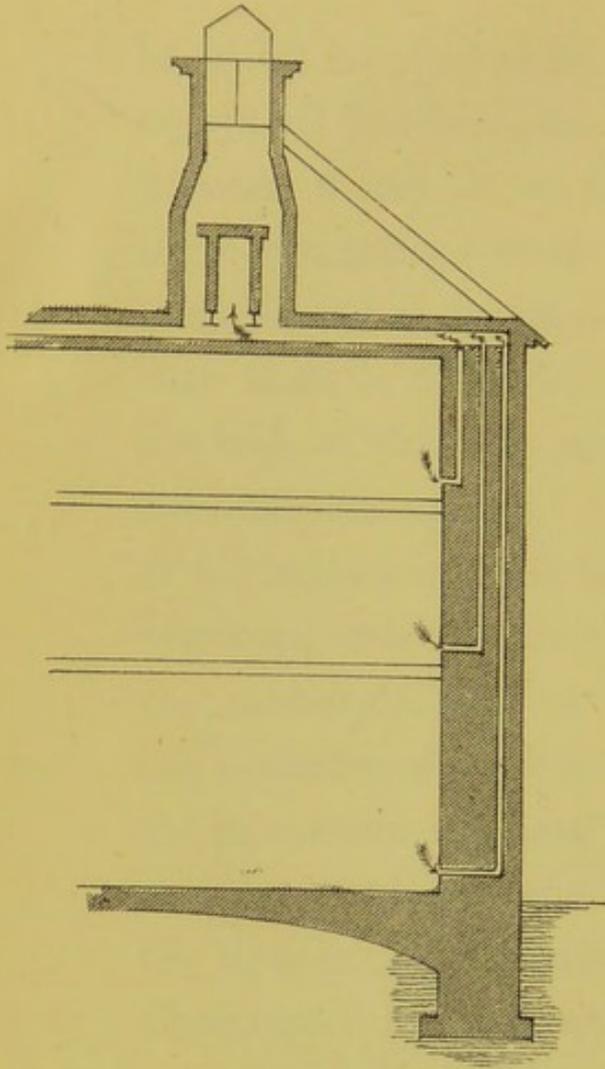


FIG. 1

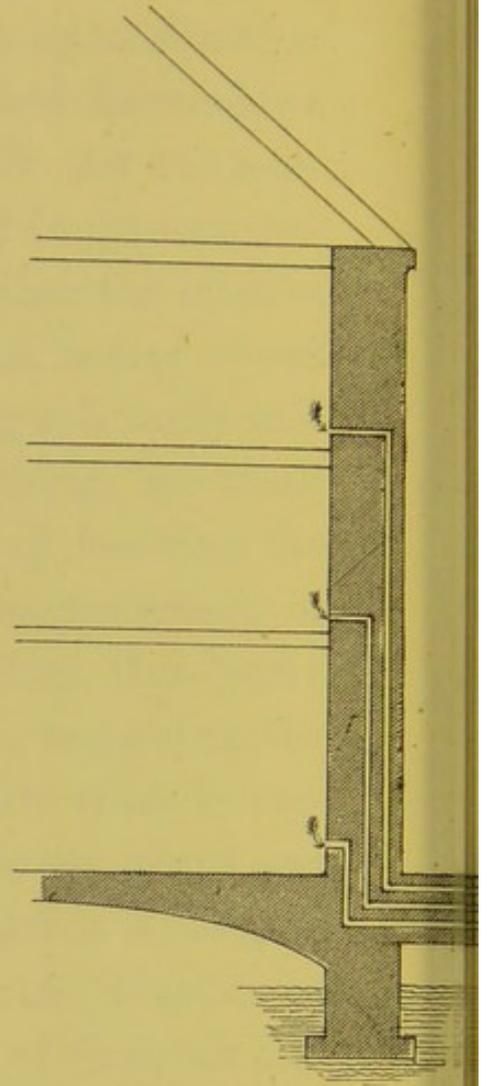


FIG. 2

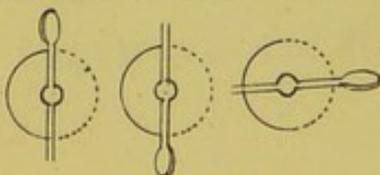
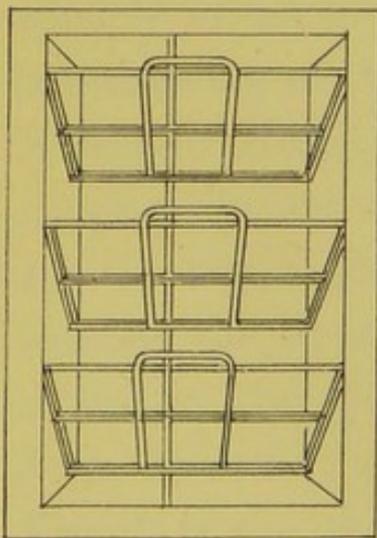


FIG. 3

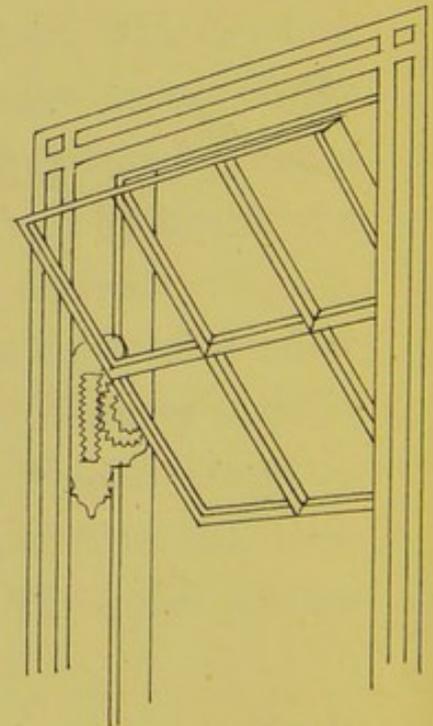


FIG. 4

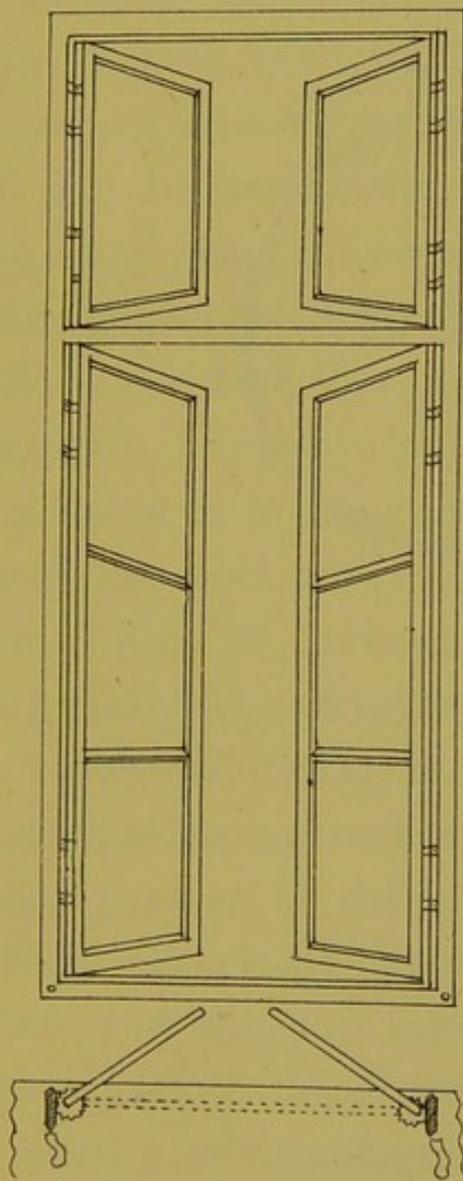


FIG. 5

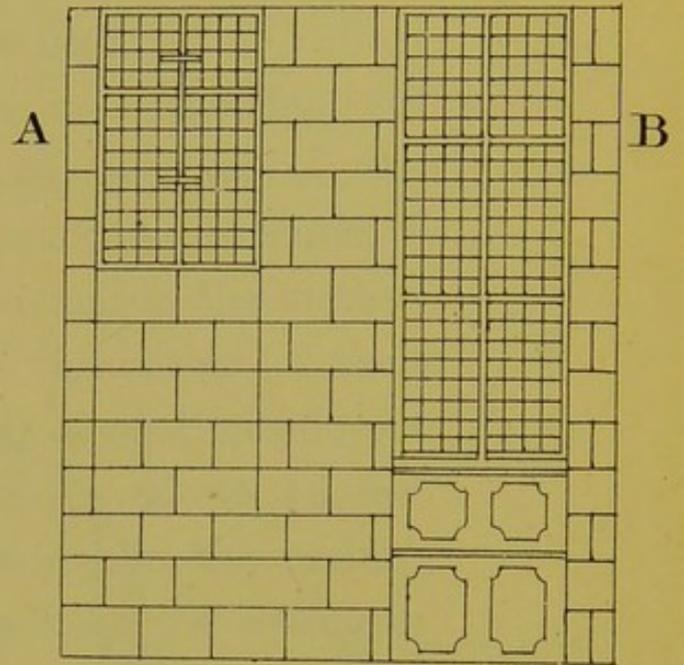


FIG. 7

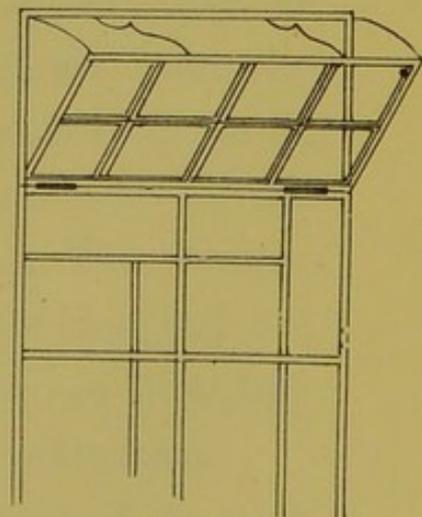


FIG. 6



will open by a pulley and cord, so as to fall inwards like a louvre, and to throw any strong air-currents up towards the ceiling. Fig. 7 is the design of windows proposed by Tenon in 1788—A, for convalescent and fever wards; B, for surgical wards, prolonged to within 3 feet of the floor.

While I have no hesitation in expressing my approval of the magnitude and position of the windows in the more recent structures in Paris, I have as little hesitation in condemning the method by which these windows, from the nature of their arrangement, admit the fresh air or oft-times do not admit it. In many instances the windows, 13 feet by $4\frac{1}{2}$ broad, have only one division in the middle, extending longitudinally almost from the ceiling to the floor. When they are opened (I refer more particularly to the winter season, as it is less objectionable in summer in a climate like that of France), the cold air rushes in volumes about the patients, who in consequence take the liberty of closing them. The arrangement of the other windows (figs. 4 and 5, Plate II..) is better. They are divided into compartments, and the entering air from the slanting position of the glass is directed upwards, and then falls gently downwards in cascades on the patients, and causes no inconvenience. The window arrangements of the Hertford British Hospital are well worthy of consideration. These are minutely referred to in the description of that institution.

5. *Nurse's room and scullery.*—Attached to each

ward there should be a nurse's room and scullery, the former commanding a view of the ward through a small window which has earned the name of a *Judas*.

6. *The water-closets and lavatories*, especially the former, should be separated if possible from the ward by a corridor, or any reliable contrivance that will insure that neither the stench of the closet nor those returning from the soil pipes, from whatever cause, will enter the ward. For every ten beds there should be at least one closet.

The position of the water-closets relative to the ward is of the greatest moment. After a study of many plans I am acquainted with no arrangement better and more conducive to the salubrity of the ward than that in use at the Baltimore Hospital and the Hertford British Hospital. In the latter the closets are so isolated from the ward as to preclude the possibility of a stench entering it. The "Administration Publique" in Paris have always reckoned the installation of a good system of latrines as essential to salubrity. The Commission of the Academy of Sciences, engaged in the whole question of construction, devoted much time to the consideration of the latrine arrangements. In their Transactions it is stated that "the water-closets and their position are an object of great importance in the erection of a hospital. It would be well that they were isolated and at a considerable distance from the ward, but convenience has been the reason of their location at the end of the ward."

. “Nearly all the hospitals in England have the closets placed at the end of the ward for the convenience of the sick. We are willing to propose for our hospitals this system, persuaded this arrangement requires great care in supervision” (*Rapport*, 22nd November, 1786, p. 114).

The closets should be well ventilated and divided from the wards by ventilated lobbies, and abundant provision made for the entrance of direct sunlight, the most powerful destroyer of organic matter.

Thorr, a German authority “on the construction and internal organization of a hospital similar to the *Maison de Santé* of Munich,” says, he would dispense with them altogether and recommend movable chairs. “They are,” he adds, “very convenient, and constructed at little cost.” This recommendation will not in the present day of good trapping and drainage find many supporters, because in spite of every care they become the means of diffusing a bad odour, and vitiating the air of the ward. In the event of patients being unable to go as far as the closet, bed-pans and movable commodes are supplied; but the general use of movable chairs will always be looked upon with disfavour. A possible objection, other than the inability of patients to go to them, is their distance from the wards, and their nearness to the corridors, as is the case in the Baltimore hospital, where some of them are directly on the verandahs. But when compared with the benefits of a closet-system that keeps a

ward immune from bad odours, this trifling objection disappears.

Other matters of detail with reference to beds, ward furniture, conveniences, &c., merely require mention. A matter of vital importance is the floor and cubic space per patient; and on this point, unfortunately, as on many others that deeply concern the inmates of hospitals, there has been no scarcity of opinions. Some authorities begin with the modest allowance of 500 cubic feet; others wisely finish with 3000 and 4000 cubic feet. The Army Sanitary Commission allowed 1200, the Barrack Commissioners 1500–2000. General Morin mentions 880 as sufficient. In Lariboisière the *cube d'air* per bed varies from 1800–2000 cubic feet; in the Boston Free Hospital it is 2200; in the Blackburn Infirmary it is 2200; in St. Louis (some wards), 2800; King's College, 2060; in the Edinburgh Royal Infirmary, from 2300 to 2500. According to the statistics of Leon de Fort the mean of the principal English hospitals will be 1800; of the Parisian, 1600. As far back as 1788 Tenon demanded that the mean of the French hospitals should be 51 cubic metres, or 1800 cubic feet. Sarazin gives the following dimensions of a ward to contain twenty-four beds:—Breadth, 9 metres; height, 5 metres; superficial area, 270 square metres. On the superficial area will depend the distance between the beds, which should never be less than 4 feet. Miss Nightingale maintains that the minimum area

should be 90 square feet, and Captain Galton is of the same opinion. An increase to this must be made in hospitals where clinical instruction is given. In St. George's, 69 square feet is allowed; in the Herbert (Woolwich), 99; Guy's, 138; St. Bartholomew's, 79; Netley, 103; St. Thomas, 112. A breadth of 25 feet is absolutely necessary to procure good ventilation, *e.g.*, Leeds, 27.6; St. Thomas's, 28; the Herbert, 26.

II. *The union of the wards to form a pavilion.*—In the present day two storeys of superimposed wards are considered the maximum; the lower flat, to avoid the humidity of the ground, being raised several feet, and supported by vaulted arches through which the air circulates freely. General Morin considers wards on the ground floor very advantageous. With only one flat the patients are able to go out and in, without the fatigue entailed by climbing several stairs. Lorain, Sarazin, Billings, and Miss Nightingale, give the preference to a hospital where the one-storied pavilion is elevated above the ground. The clinical hospitals of Paris have only one stage, and one row of wards; Charité, Cochin, and Vincennes have two, and two rows of wards. Lariboisière has three storeys of superimposed wards; as also has Tenon, which in most respects is the finest hospital in Paris, and a worthy memorial to the founder of hygiene in France. English hospitals recently constructed, *e.g.*, the Herbert at Woolwich, and the proposed military hospital at Malta, consist

of a basement, a ground floor, and one storey. Perhaps the factor which influences most of all the number of storeys is economy. The objections to three storeys and the consequent aggregation of the sick in a limited space, are founded upon sound data and experience, which has shown that the higher tiers of wards are less salubrious, and the mortality of hospitals with many storeys is greater than where only one exists. It has been satisfactorily demonstrated that the hospital miasm and other deleterious volatile substances produced by the sick, ascend in following the currents of heated air. This is one objection, not to speak of the difficulty and expense in carrying on the service. Another objection, no less strong, to lofty pavilions, is the necessity to establish lofty corridors, and by this means induce stagnation of the air. When the pavilions are of a great height, the sunlight is prevented from entering the lower wards, unless a greater space than is generally found exists between the blocks. Between each pavilion there should be a large open garden with walks, and those "*jets d'eau*" which the French value so highly. An important point with reference to the pavilions is their orientation. Dr. Oppert of Berlin says: "the façade of a hospital ought never to be turned to the north or north-east, because from these points come the coldest winds. And as the great rains come from the south-west, it is necessary to choose a south-east exposure. If the hospitals consists of parallel pavilions, the corridors should be

established at the right side of each pavilion, *i.e.*, to the north-west, thereby giving the wards the most desirable exposure." Thorr, another German authority, gives the programme of a model hospital, taking as the basis of his study the *Maison de Santé* of Munich. "It is," says he, "advantageous to dispose the block in such a way that the hospital never presents a court completely closed, although the closed in courts are in no way inconvenient, provided there be an extension of space."

III. *Arrangement of the pavilions to form an hospital.*—It would be a most desirable thing, if at all practicable, to limit the number of sick to 25 in one-storied pavilions, or to 50 where two wards are superimposed. But it is not intended to draw a hard and fast line in limiting the numbers to 50; for it is an ascertained fact that hospital salubrity is secured with as many as 80 or 100. It is equally true small hospitals possess a salubrity which leaves nothing to be desired. For an hospital of 100 beds, it would be necessary to have two pavilions and four wards, composed of a basement and a first storey, the pavilions being separated by a block destined for the administration. Such an arrangement is to be seen in the hospital at Swansea. In larger hospitals, where a greater number of sick has to be provided for, the difficulty of disposition increases in proportion.

The advantages claimed for the pavilion system are :—

1. It is made more certain that the sick are spread over a wide area.

2. The height of the walls does not interfere with ventilation and sunlight.

3. The chances of the hospital miasm migrating with the currents from one ward to another, or accumulating in the upper wards, are diminished.

4. Supervision is easier.

If pavilions, other than those destined for the medical and surgical cases, *e.g.*, lock, and casualty or ovariectomy wards are necessary to make an hospital complete, by all means let them be added; but do not mar their utility by planting small-pox depots in contiguity.

CHAPTER V.

DESCRIPTION OF HOSPITALS.

BEFORE reviewing the plans of the best hospitals that have been executed or proposed for execution, I would state that the disposition, the best and simplest, is that in which the pavilions are parallel and united to each other, and to the administration by a rectilinear corridor with terrace above. Such an arrangement is to be seen in the disposition of the Hôtel-Dieu, Lariboisière, the Herbert (Woolwich), and the Western Infirmary (Glasgow).

This plan is being now adopted in most countries; but to my mind, the disposition of the Hospital Tenon, differing somewhat from the former, is in many respects quite as good, if not superior. There are plans, however, more complicated in their arrangement, where the corridors are long and curved, *e.g.*, Boston Free Hospital; and where the pavilions radiate from a central building devoted to the administration. Among the circular plans the first designed, although not carried into execution, was that of Petit, in 1774, and he was followed in 1786 by Poyet, who was charged by the French authorities to draw out the plan of a hospital which was to replace the old and venerable Hôtel-Dieu. The Revolution soon came and hospitals were forgotten. It presents a project which, in spite of some defects,

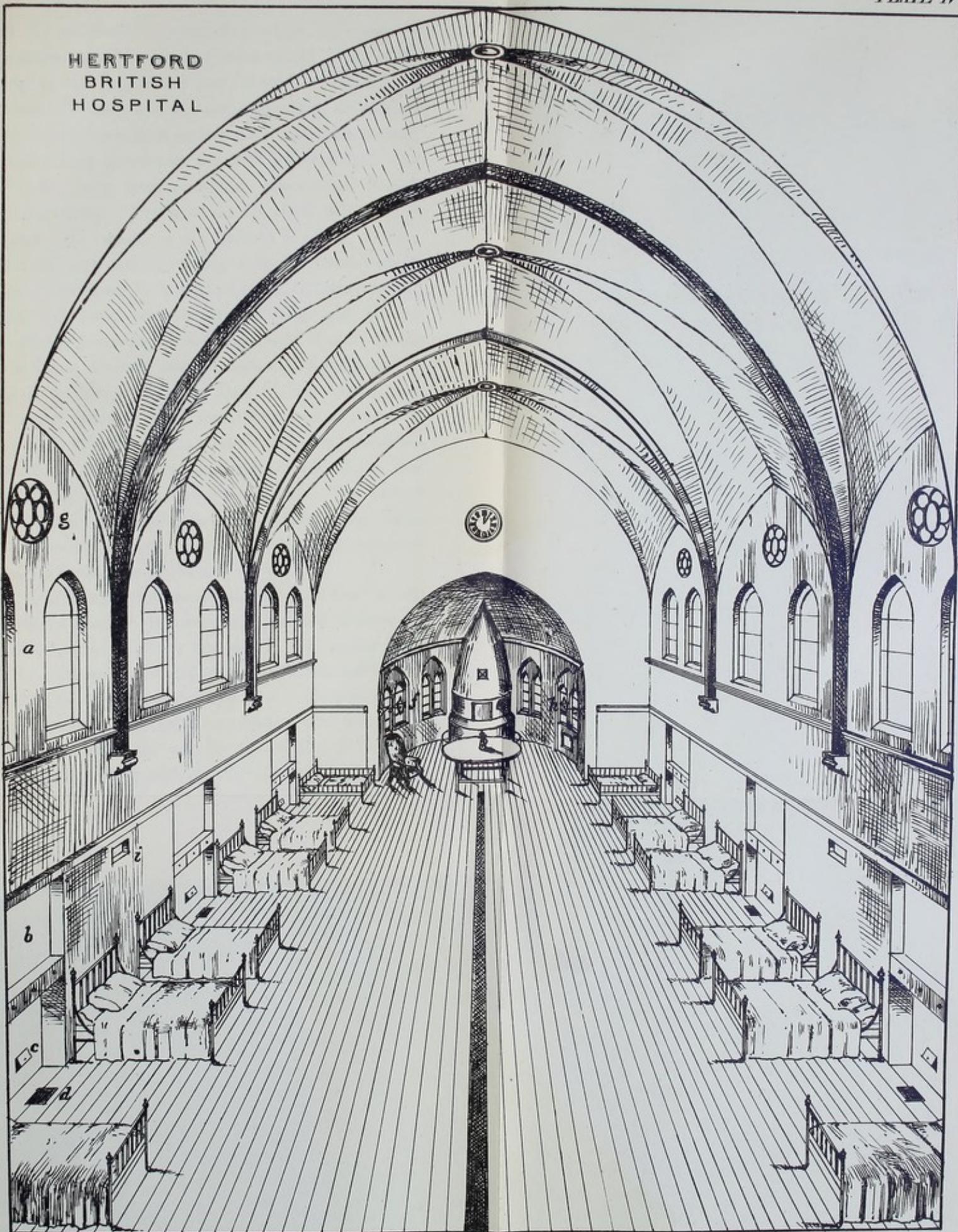
has justly remained celebrated, and considered worthy of imitation by the Americans, who have perpetuated this novel plan in the Hammond Hospital. The resemblance between the plans of Poyet and the American is made clear by the accompanying Plates. Poyet's proposed hospital consisted of isolated pavilions radiating from a central rotunda. It was to accommodate 5000 sick. The pavilions were to be 115 feet long, 24 broad, and 15 feet high. As each ward was to contain 35 patients, these dimensions would allow of 1180 cubic feet per bed.

Types of the best hospitals in England, Scotland, France, America, Italy, Spain, including those of small, medium, and large dimensions, are given with their accompanying plans, which will make a general study of them much easier. Details are avoided as superfluous. Those who may for special purposes desire them, will find them in the authorities quoted. It was my purpose to have begun with a description of the Edinburgh Royal Infirmary, which is the latest and probably the best addition to the hospital architecture of our country; but for many reasons I have selected the Hertford British Hospital, which is to all intents, as its name indicates, a British hospital, although standing on French soil.

HERTFORD BRITISH HOSPITAL, PARIS.

When in summer British tourists throng the gay capital of France, and visit the places of interest, it may be asked how many have seen, or are aware

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BRITISH
HOSPITAL



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of the existence of, a building which has made its appearance within the last three years? This building, to the English at least, should be reckoned a place of beauty and interest—affording, as it does, to their fellowmen in suffering a comfortable retreat, where they may have the best medical skill, and reflects, in a foreign capital, honour on British philanthropy. I refer to the Hertford British Hospital. Its founder is Sir Richard Wallace, who has for all time coming amply and fully endowed it, thus rendering it independent of extraneous aid. As has been truly remarked, this gift to our suffering humanity in a foreign land is truly of the kind that deserves remembrance in “triple brass,” as it is no less marked by that highest virtue that “never faileth,” when even faith waxes cold and hope itself grows dim. But this noble institution and its author have, in the gratitude of the sick and needy, a monument *ære perennius*. The history of this hospital, though brief, is interesting, being inseparably interwoven with the thrilling incidents of the two sieges of Paris.

In its origin it was an appendage to the “ambulance Anglaise,” organized and directed likewise by Sir Richard Wallace, and did, in conjunction with the ambulance, splendid service to British and French alike during that memorable time. Thus its foster-parent was the English ambulance. On the 2nd of October, 1871, the roar of cannon and the whiz of musketry being silenced, Sir Richard, as we learn

from a published report, "invited Sir John Rose Cormack, M.D., the Hon. Alan Herbert, M.D., and H. B. M. Consul, to meet him and receive from him a proposal to build and endow in Paris a hospital for the medical and surgical treatment of poor British subjects, to be called the HERTFORD BRITISH HOSPITAL, in memory of the late Marquis of Hertford."

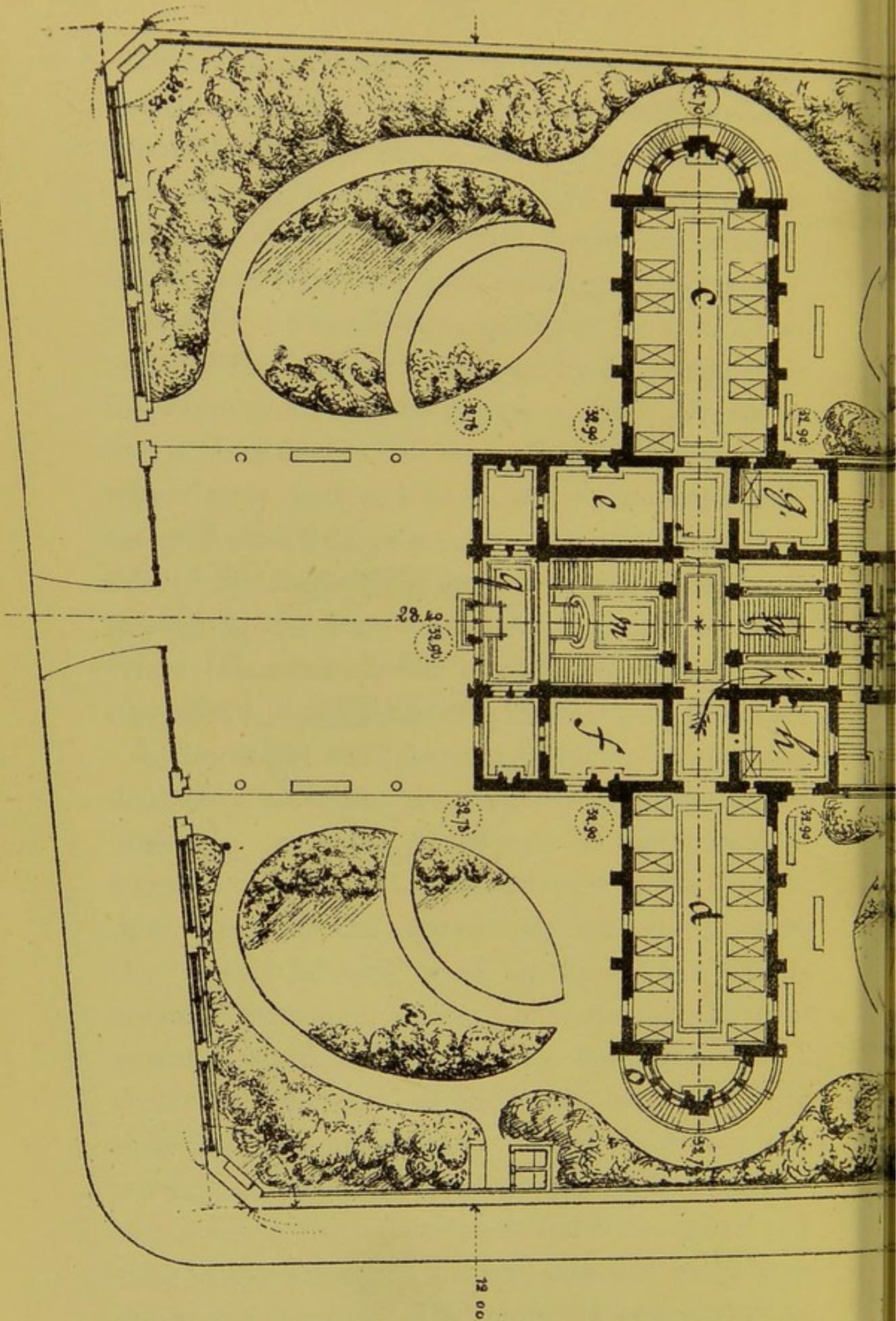
Definitely instituted on the 2nd of October, the temporary hospital in the Route de la Révolte was opened for the reception of patients on the 15th of November, 1871. At the same time arrangements were being made for a permanent hospital, on a basis worthy of its philanthropic founder. Although it was to do the work of a hospital, Sir Richard commissioned the architect to prepare the plans so that it "should not resemble a hospital." These instructions were carried out by the architect, who reared a handsome Gothic edifice, inspired by the architecture of the thirteenth century, when the Hôtels-Dieu were situated at the gates of the towns.

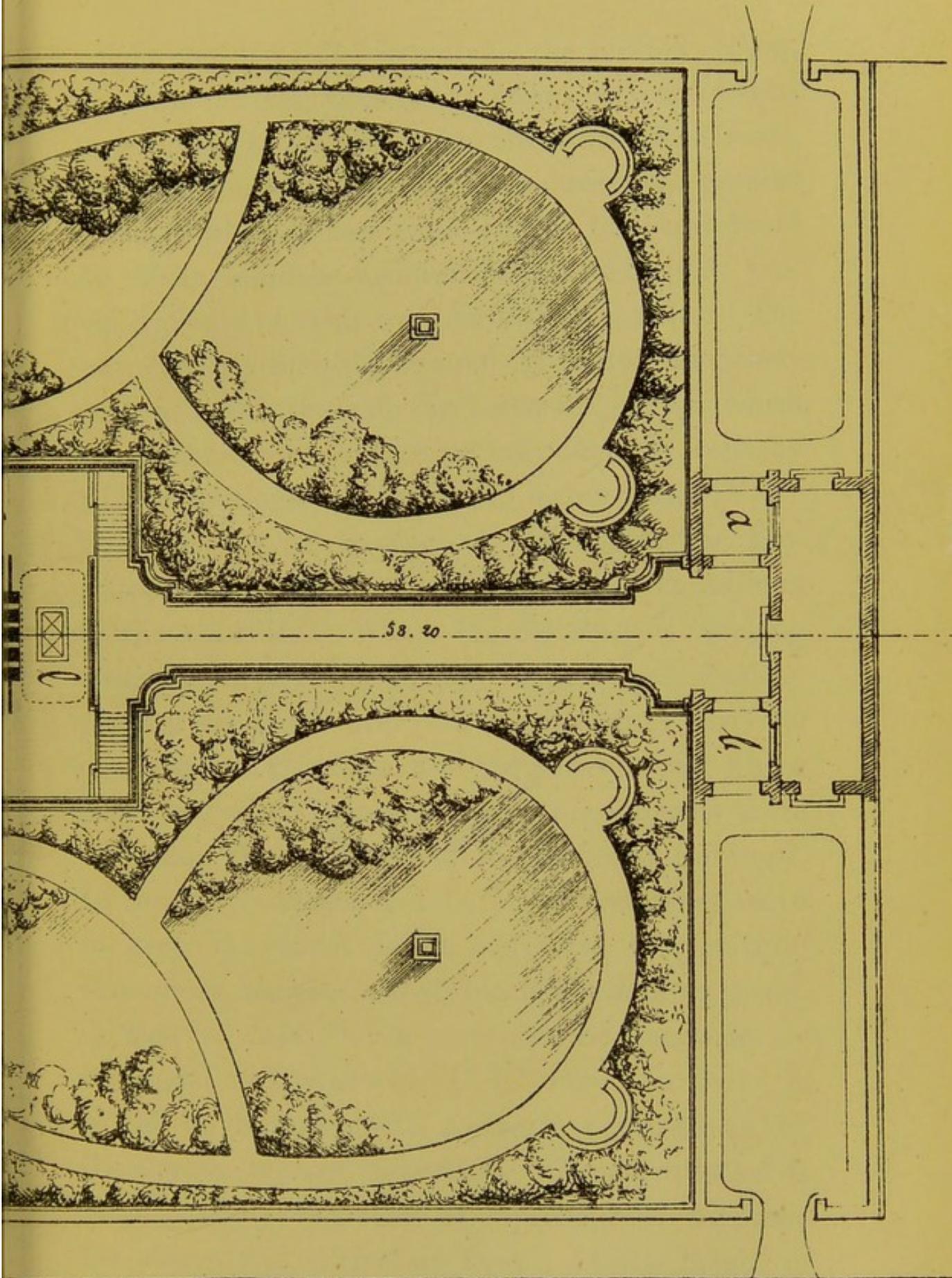
The foundation stone was duly laid on August 24, 1877, by Sir Richard and Lady Wallace. On the 16th of April, 1879, two years later, it was formally opened by Sir Richard and his lady, in the presence of the English ambassador (Lord Lyons) and a distinguished party. On the 4th of June, 1879, their Royal Highnesses the Prince and Princess of Wales and the Princess Victoria paid it a visit, the Prince naming the principal male ward "Albert Edward," and the principal female ward "Alexandra."

The external and internal beauty of this hospital has called forth the unqualified praise of all who have seen it. Mr. Ernest Hart, the editor of the *British Medical Journal*—no mean authority on the subject of hospital construction and hygiene—when going through the wards, remarked that he knew in England of only one hospital that approached it in elegance and completeness—the Radcliffe Infirmary, Oxford. The visit of the Prince and Princess of Wales to this hospital had the effect of giving greater publicity to the beauty of its exterior, and the excellence of its internal arrangements. Herr Stauss, the director of the Empress Augusta's Hospital in Berlin, was directed by that august lady to visit and closely examine it. After having done so most minutely, he considered it was unique and well worthy of imitation. The mayor of Neuilly says the "conception is meritorious and the execution excellent," and recommends it as a model "to the municipal authorities who wish to erect analogous establishments." The architecture and the general arrangements have received a fair share of attention in different journals; but I am not aware of any published account giving a complete statement of its peculiarities and outstanding features, with especial reference to the wards, their ventilation, lighting, and heating. This could not well be done until the arrangements were tested by the experience of twelve months.

This hospital is situated in an open space in the district of Levallois. How long it may continue so it would be difficult to say, as already there are signs of encroachment from two sides. It is surrounded by nicely-kept lawns, profuse with flowers in summer. It possesses everything man can suggest and money procure for the comfort and welfare of the sick. The centre of the building is occupied by the administrative department and the reserve wards. Up either side of the entrance hall runs a flight of stone stairs, scrupulously clean and white, and harmonizing with the pinewood fittings around. Abutting from each side of the main block are the two pavilions, containing on the first floor the two principal wards (Plate III. *c* and *d*), and beneath, on one side, the out-patient department and pharmacy; on the other a hydropathic establishment, wherein baths and douches of all kinds, hot, cold, vapour, medicated or otherwise, are given as adjuncts to therapeutics—a system of treatment largely adopted by the French. After ascending the staircase one finds on the right the “Albert Edward” ward, on the left the “Alexandra.” Strangers, among whom we include competent medical and engineering authorities, have, at the very threshold of the wards, been struck by their imposing appearance. Penetrating into the wards, and examining more closely, the first impression is not in the least altered, and the elegance and order of everything in no way interfere with their utility and purpose. The wards are two storeys in



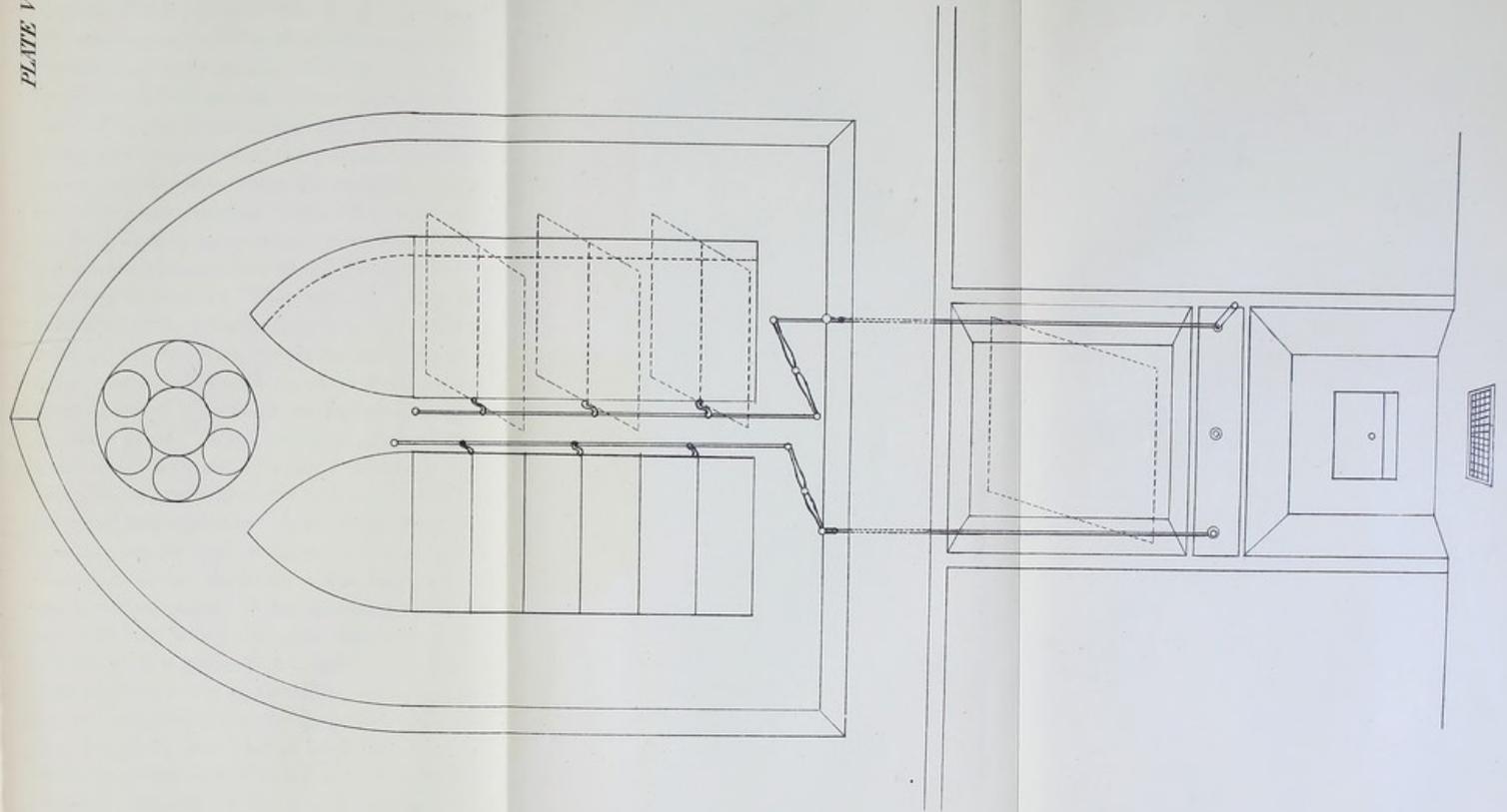


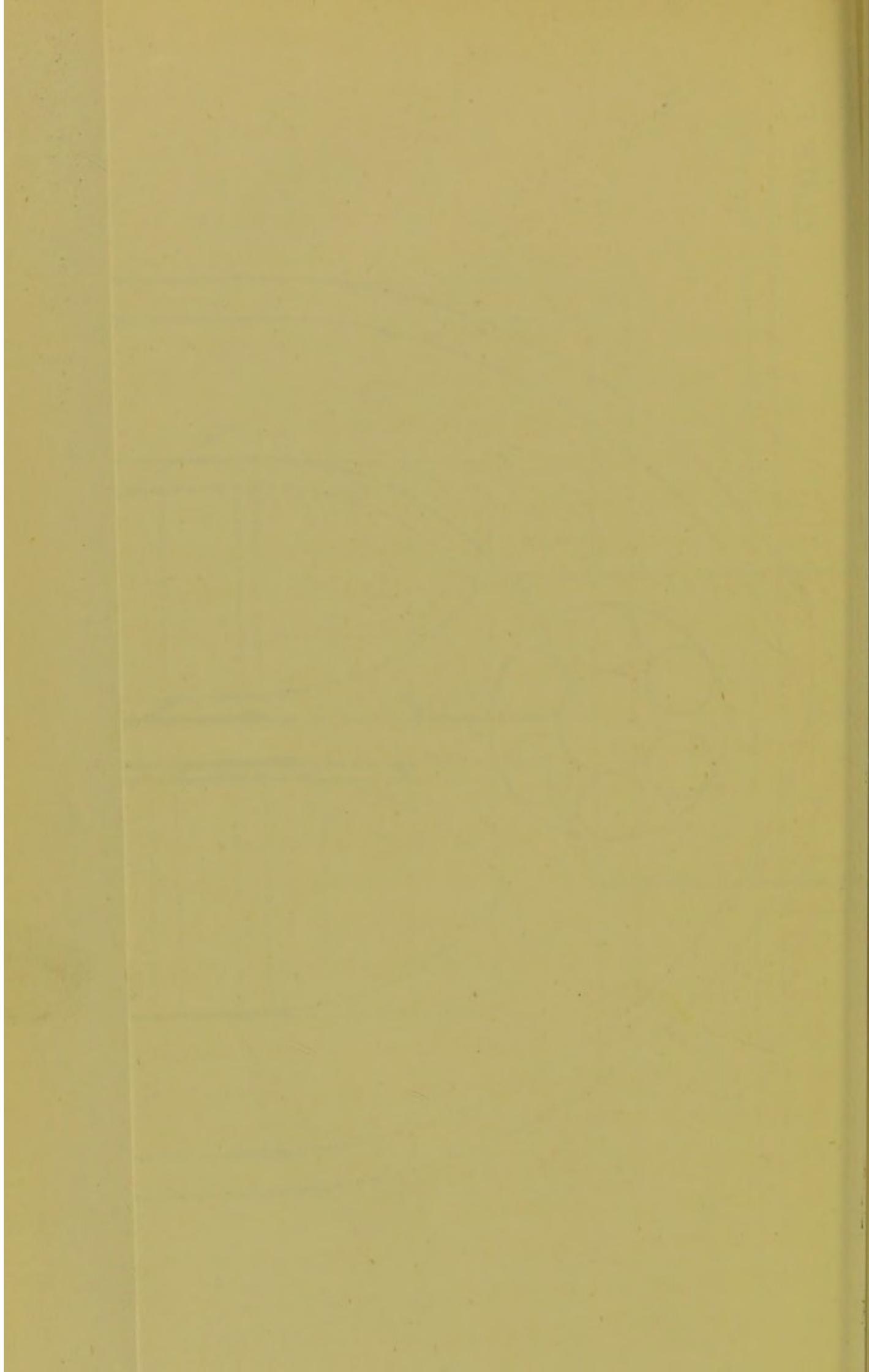




height, and bays of joists divide the vaulted ceiling. That the loftiness does not interfere with the warming, was put to the test during the winter of 1879-80, reckoned the most severe in Paris during the present century, when it was found that a temperature of 60° Fahr. could be maintained day and night, provided plenty of coals were heaped on the fire. The warming is principally secured by heated air generated in a calorifier on the basement storey, which enters the ward on the floor near the side walls by six iron gratings, 12 inches \times 12 inches (Plate IV. *d*). For purposes of heating or ventilation the fire-places may be put into requisition as an adjunct to the calorifier. When the calorifier is working well, the blasts of hot air may be easily perceived by placing the hand over the ward-inlets. They do not, however, inconvenience the patients near whose beds they exist. In addition to these means there are steam pipes running up the centre of the ward. In the early summer and closing autumn they serve to keep the wards in an agreeable temperature. Experience has shown that during a winter so severe as that of 1880, when at times the thermometer registered as low as -15° C. (5° Fahr.) in Paris, it would be impossible to secure proper warmth by the system of open fire-places. The ventilation is carried on by two rows of superimposed windows, fire-places, and extraction flues. At the height of the eye is the lower or smaller tier, *b*, composed of six quadragonal windows swung on a centre pivot,

through which the patients obtain a view of the garden and the surrounding country. They are opened every season of the year, save winter, to augment the supply of fresh air. The admission both of light and of fresh air is principally carried on by six coupled windows, about 9 feet above the floor. They are ogival in form, and crowned with a rosare (Plate V.). In each window there are six panes of glass. Each half is opened and shut independently of the other by a key which is solely intrusted to the nurse, who attends to the ventilation, being guided as to the requirements of the sick by the physician or house-surgeon. The opening and shutting of the windows are effected by means of the key which fits on to the end of a jointed rod of iron, the position of which is altered according as it is intended to shut or open the windows. They are a decided improvement on the style common in Parisian hospitals. This excellent arrangement, which has earned the special commendation of visitors, prevents the patients or anyone ignorant of the first principles of ventilation from interfering with them. It must be evident that the higher tier of windows, although not accessible to the hands of anyone, are, by means of the key, easily manipulated by the nurses. Unfortunately, among them there are not a few who believe that in winter every chink through which pure air might enter ought to be hermetically sealed. The compartments of the window when opened slant obliquely upwards in the





direction of the interior. The great advantage of this arrangement over that of all French, and many English hospitals, is obvious. The sloping panes give the current on both sides an upward direction towards the roof, against which it impinges, and afterwards falls gently in cascades on the patients through the heated and therefore lighter air ascending. In this way a thorough mingling of the different strata of the ward air is brought about. How different from the window arrangements of the French hospitals, described at page 44. The extremity of the ward is finished off by an arch, divided in the middle by a large open fire-place, having on each side three ogival windows (Plate IV. *f*). One of the windows forms the door, *h*, by which the patients gain access to the gardens. When necessity arises for large quantities of fresh air, as in the event of foul cases being in the wards, then the windows of this arch are called into requisition. Beneath the quadragonal windows are the fresh air inlets, *c*, situated on the floor, close to and behind the valves through which the heated air enters. When these inlets are opened the cold air at once mingles with the heated, conducing to a pleasant and equable temperature. Besides these means for ventilation another method has been adopted, which, though applied to factories, &c., has rarely been used in hospitals. It consists of an extraction shaft, 12 inches \times 12 inches, situated between each bay at the floor, appearing outside several feet above the roof, and louvred at the top.

The column of air in the extraction flues, if stagnant, or nearly so, is put in motion by a gas burner which is situated in the shaft about 7 feet above the floor, and is got at by a hinged pane of ground glass (Plate IV. *z*). It may also be used as a night light. In the event of the light being troublesome to a patient, a Bunsen burner is put on the gas-jet, and in this way a pale lambent flame is produced, which does not interfere with sleep, while it carries on at night the needed work of extraction. When lighted, the burning gas rapidly exhausts the air within the shaft, and consequently fresh supplies are constantly demanded to keep up the combustion, and these supplies are drawn through the square gratings at the foot of the side walls. The walls are lined with impermeable stucco. The floors of wood are frothed with a preparation of wax, oil, and paraffin, which prevents substances from sinking into the boards. Before leaving the wards, lofty and bright-walled, and complete in every detail save one, it may be stated that the difficulties encountered with the warming and ventilation at the beginning of winter were so great, that at the request of Dr. Herbert, I drew out a chart, on which the temperature was recorded every three hours, and on which were noted the windows, heat-valves, and inlets opened, and to what extent. An hygrometer was fixed on the wall near the entrance, so that any one would be able to see at a glance the temperature, and the humidity or dryness of the ward atmosphere. The ward

in my opinion has one defect, viz., the position of the entrance to the foul air flue close to the floor. Remembering that all gases—carbonic acid among the rest—expand by heat and ascend, carrying with them impurities, it must strike most people that the air sucked out by these shafts includes pure as well as impure air. Unquestionably these extraction shafts would fulfil every requirement, if the position of the entrance to the shaft was situated about 8 feet from the ward floor, as in that region air the most noxious would be got rid of. It has, however, been stated by persons well qualified to speak on this matter, that it is not so much the carbonic acid, oxide, and other gases, which it is desirable to have removed from the ward, as being the cause of septicæmia, pyæmia, erysipelas, and hospital insalubrity, as the heavier though imperceptible (except with the aid of the electric beam) and imponderable particles—the direct emanations from the body—which they allege fall to the ground. Is it, however, likely that this dust would find its way up an extraction shaft? This hospital has one other excellent feature—a feature which reflects much credit and shows great forethought on the part of those who drew out the plans—and it is the position of the water-closets (Plate III. *k*). They are in no way connected with the ward, not even by those highly lauded swing-doors. They are reached by a corridor 30 feet long, at right angles to the door of the ward. In the corridor there is a constant circulation of fresh air,

and also a cross ventilation. All the water-closets exist at the back of the building, in a part jutting out from the rest, and rise in tiers one above the other. Each closet has a special ventilating tube. It is quite possible when closets are planted in the corners of wards, that, in spite of spring-doors and abundant ventilation, stench and sewer-gases (if the trapping be impaired) may find their way into the ward. In this hospital such a contingency is remote. Out of doors, and at the foot of the garden, are the mortuary and autopsy-house, as well as a room in which the funeral service is read preparatory to burial.

It may be interesting to note that, in the course of the year, of more than 2000 persons receiving the benefits of this institution, nearly two-thirds were English, one-third Irish, and only a few Scotch.

EDINBURGH ROYAL INFIRMARY.

This handsome edifice, the latest and noblest addition to the magnificent hospital system of this country, was opened for the reception of patients in the autumn of 1879. This hospital is a building in every respect worthy of the public spirit of the descendants of the city and country that reared the old Edinburgh Royal Infirmary, which the Lord Provost of that day considered "the most necessary and most beneficial to the public of any one undertaking of this nature which has been at any time set on foot." And so it proved itself to be; for who can

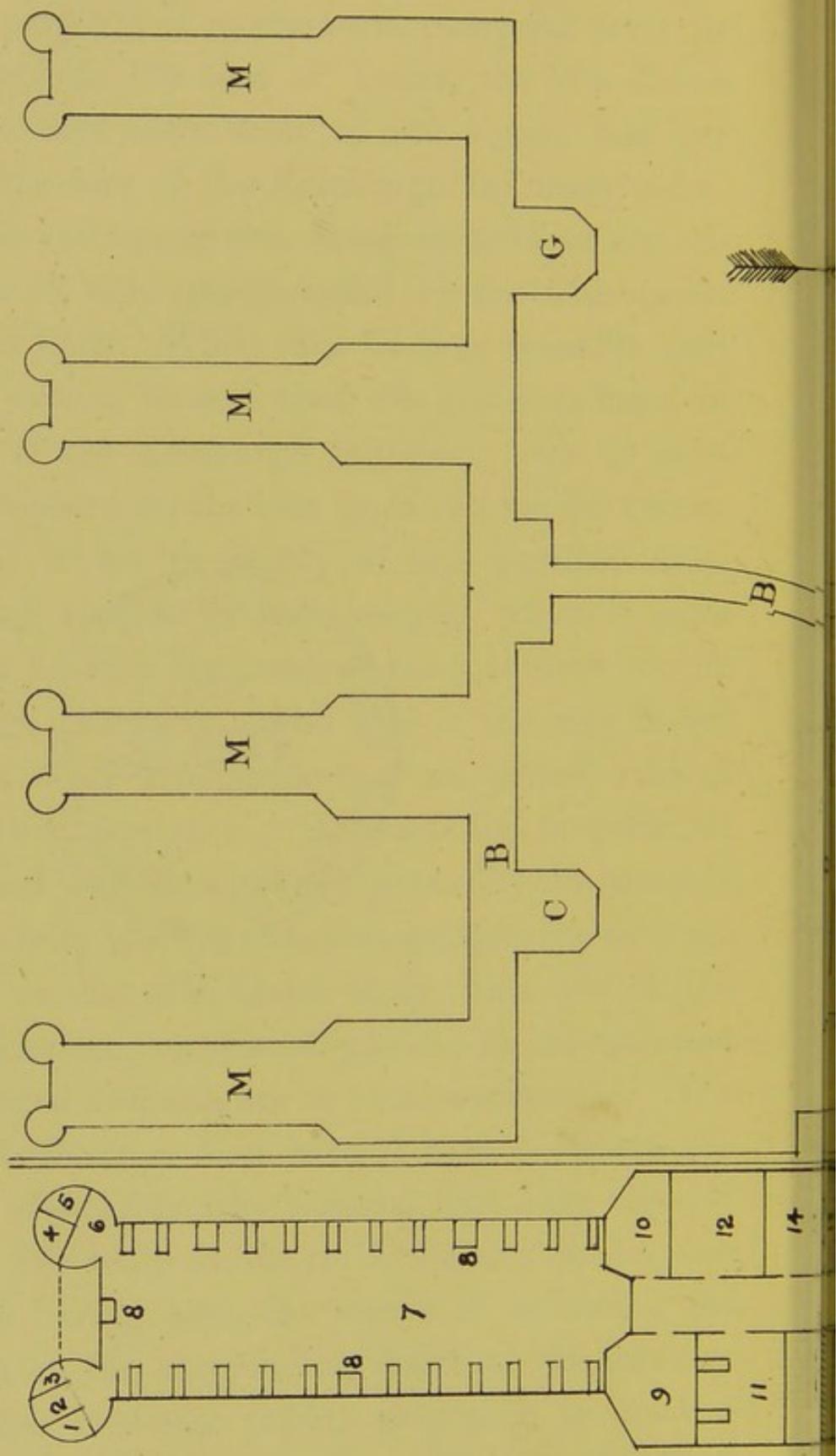
tell the good it has done on behalf of suffering humanity during the century and a half of its existence? The cost of the new infirmary falls little short of £350,000. Among the thousands who have freely given of their means for the support of both the old and new institutions, perhaps no name is more deserving of grateful remembrance than that of Mrs. Buchanan, of Moray Place, who has ever taken a deep interest in the welfare of those who seek hospital benefits. The New Infirmary stands on an elevated site sloping to the Meadows, in a large unoccupied space—so difficult to procure in large cities— $11\frac{2}{3}$ acres in extent, contiguous to the new medical school. At one time the idea of rebuilding on the old site was seriously entertained; but this idea was wisely abandoned, and the present site chosen, which is in every way superior to the old site. The front façade of the new, beautiful as it is, would be enhanced by affixing on each side of the clock the gold gilt letters which stood out on the old, *en bas-relief*, “Sick, and ye visited me; naked, and ye clothed me.” Although this noble baronial pile is admitted to be one of the best pavilion hospitals in this or perhaps any country, it cannot be pronounced free of faults internally or externally. After an extensive visitation of hospitals in the city of Paris, where so much has been done to ameliorate the hospital system, I know of only one that can compare with it—the Hospital Tenon at Menilmontant — Lariboisière, long the pride of Parisian sanitarians, having fallen

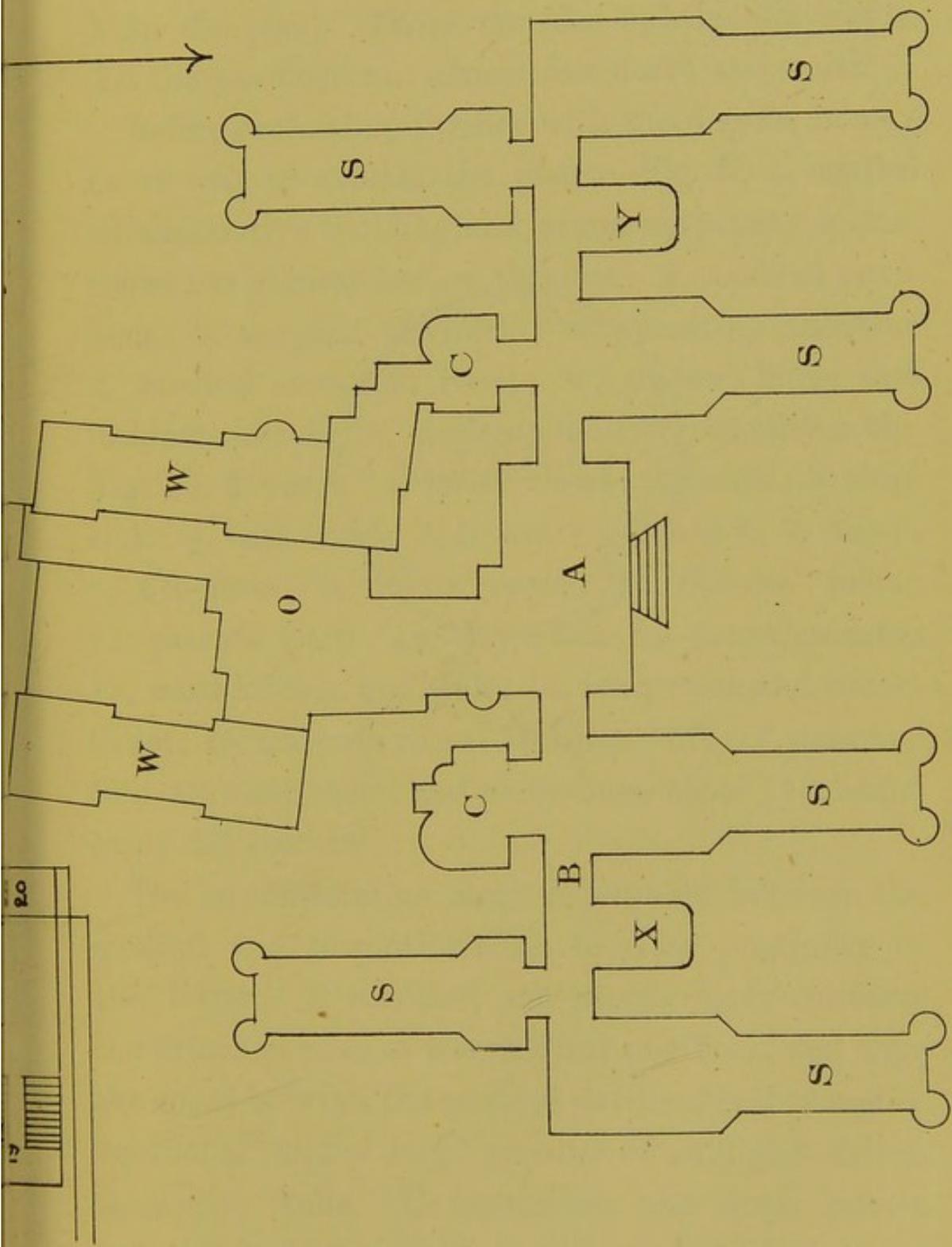
of late years into disrepute, owing to a high mortality and the presence of pyæmia and puerperal fever in the wards. In the case of Tenon, the site allows of surface area little short of 900 square feet per bed; in the case of the Edinburgh Infirmary something like 960 square feet, being an allowance much in excess of that recommended by the Chirurgical Society of Paris. While thus far they resemble each other, it cannot be said that the pavilions have, in the case of the Edinburgh Infirmary, been so judiciously disposed on the site as in the case of Tenon, for there is no possibility of one pavilion overshadowing another in that hospital, which is more than can be said for some of the pavilions of the Edinburgh Infirmary. And this is the only defect in the external arrangement of an edifice void of wasteful ornamentation. Unlike Tenon, however, its beauty and usefulness are not marred by the presence of a maternity block in close contiguity to the external pavilion on one side, and a small-pox depot on the other. The dangers of small-pox depots in connection with general hospitals are by no means fanciful. The French authorities have battled hard to lessen the ravages of small-pox by isolation, but have signally failed. The tents at the St. Louis and St. Antoine hospitals having been the means of spreading the infection to the surrounding districts, the sanitary authorities are now (1881) proposing to erect a small-pox hospital in the rural district of Alfort, 12 kilometres from Paris.



PLATE VI.

NEW ROYAL INFIRMARY, EDINBURGH.







General plan.—Built on the pavilion plan, it is divided into ten blocks, containing thirty-four wards. Of these the six surgical pavilions contain eighteen wards, the four medical twelve wards—the wards for special cases existing in the central building (marked A on the plan). There are also ophthalmic wards. All the pavilions run almost due north and south.

Before proceeding further with the details, it may be as well to explain the plan:—Fig. I., A, central administrative building and grand entrance; B, corridors; C, clinical lecture theatres; M, medical pavilions; S, surgical pavilions; O, operating theatre; R, medical reception room; W, nurses' home and resident doctors; X, students' hall; Y, casualty room. Fig. II., A ward. 1, water-closet; 2, urinal; 3, slop-sink; 4, bath room; 5, lavatory; 6, lobby; 7, ward; 8, fire-place; 9, nurses' room; 10, doctors' room; 11, private ward; 12, day room for convalescents; 13, ward kitchen and sink; 14, bath room and water-closet; 15, matron's room; 16, dinner lift; 17, patients' lift; 18, dust shoot, and dirty linen shoot; 19, staircase; 20, corridor.

The administrative block is situated between the medical and surgical blocks, in close proximity to the latter. A corridor, one storey high, connects the attached ends of the medical pavilions, and thus the space between the medical pavilions is thoroughly ventilated, and a large amount of sunlight strikes upon the walls. Unfortunately the same cannot be said for the surgical pavilions; but it must be

confessed that greater difficulties beset the architect in disposing them than the medical pavilions, owing to the central administrative block, the operating theatre, and the quarters for the resident doctors and nurses.

The result of the nearness of the pavilions, more especially the surgical, is the exclusion from the wards of a large amount of sunlight which is no small loss in a climate such as ours, where the sun is so often obscured. I took observations of this at mid-day, and two hours before and after. The rising sun naturally should strike upon the east sides of the pavilions. On the free external sides it does so, but the height of the walls, viz., 63 feet, and the contiguity of the pavilions, separated by a distance of 88 feet, leads to one pavilion overshadowing the other. In fact, the shadow of the first and third pavilions reached as high as the second storey of the east side of the second and fourth and the smaller surgical pavilions. The same thing happens to the west sides with the setting sun, the fourth overshadowing the west side of the third, and the second the west side of the first. And the exclusion of sunlight is made more certain in the surgical by the lofty corridor and the administrative block. This was not the case with the medical pavilions. At some period of the day the entire side, from basement to attic, received sunlight, although not the plot of ground between. Even when the sun reached the zenith, little light fell on

the plots separating the surgical pavilions already singled out. The sides of the pavilions bounding the large central court are more fortunate, and this benefit is owing to its great extent.

The remedy for this is one which the architect did not possess, viz., a larger site; and it must not be forgotten that the absorption of the "George Watson Hospital" was a great drawback. Perhaps the entire removal of this block further west might have been wise. One lesson to be learned from this is that the greatest amount of sunlight can only stream into blocks one storey high, with an increased distance intervening. If storey is added to storey, then of a necessity the space between must be increased, and in no case should it be less than twice the height. The system of rendering the glass of the windows of any of the pavilions opaque will be seen, after what has been said about the exclusion of sunlight from nearness, to be most objectionable. Nor is this opacity solely confined to the lower panes of the ward windows and the water-closets, but likewise exists in the upper compartment of the large windows. A more effectual attempt to shut out light could scarcely be made.

The corridors which branch off from the administrative building are two storeys high (30 feet), and thus the four large surgical pavilions are blocked to the south, which, for obvious reasons, is even more to be regretted than the blocking of the two small ones to the north. Space to the extent of 158 feet

intervenes between the two central surgical pavilions, and this space forms the central court. It is a pity that not more than 88 feet were allowed for the other two courts, because not only is the sunlight effectually excluded by the high corridor, but also the south winds. It is believed that the absorption of "George Watson's Hospital," and its utilization, must have to some extent hampered the architect.

The pavilions.—They have each three ward floors and an attic. The medical pavilions are 173 feet 6 inches long by 33 feet wide, and the surgical (running north) are 128 feet by 33. Their height, from the ground to the eaves, is 46 feet; to the ridges, 63 feet. The towers at the extremity of each ward are 12 feet in diameter. At the summit they are surmounted by conical tops, which are pierced with louvred openings for ventilating purposes. In the centre of the wide end of the pavilions are squared louvred turrets with conical top vanes, and they are likewise used for purposes of ventilation. In the broader end of the pavilions, reached from the corridor, is a passage 60 feet long and 9 feet wide, leading to the ward door. On one side of this passage is a bath-room, a *cabinet d'aisance*, the doctor's "side-room," and a private ward containing two beds; on the other, a ward kitchen, a nurse's sitting-room, looking into the ward, and a day-room for convalescents.

The ward.—Leaving the wider end of the pavilion,

we enter the ward by a swing door. The ward is 75 feet 8 inches long, 28 feet 6 inches wide, and 15 feet high. These dimensions allow of something like 2300 cubic feet of space and 153 feet of superficial area per bed—figures much in excess of those allowed in any other general hospital in this country. The floors are of soft deal, with a pathway of linoleum at each side, which renders movement in the ward noiseless. There can be no doubt that this kind of flooring is inferior to oak or dried wood, or the new style of flooring in the Maternity Hospital, Paris, which, although elegant, may have the disadvantage of being cold to the feet. A short experience has fully proved this inferiority. Two years had scarcely elapsed before the “dry-rot” took possession of the timber, rendering the floors and corridors unsafe for walking, and necessitating their replacement by better material. The walls are of Parian cement, and painted. They admit of cleansing. The ward has fourteen windows, running from within a few inches of the ceiling to within two feet of the floor. The lower three-quarters of the windows open sash-wise, but the upper segment consists of a pane revolving vertically on an axis, which is opened and shut by a jointed iron rod, which does not admit of interference by the patients. In addition to the windows are a number of fresh air inlets, situated on the floor level beneath the windows. At the external end of the shaft there is a grating, which is manipulated from the interior of the ward. The

ward has three open fire-places, one at each side, and the third at the free end under the central window. In two of them Galton's grates are placed, by which the fresh air is warmed before escaping into the ward. So many fire-places, while overcoming to a great extent the defects of partial radiation of the one fire, as was the case in the old infirmary, cannot be utilized without a great expenditure of fuel; and thus, it may be reasonably asked, is it worth while to secure complete radiation in this way in wards supplied with such an excellent means of heating by hot water? There is one great danger attached to too many fire-places, and that is, that foul air flues, even aided by artificial heating, may become inlets. The anemometer alone would accurately determine this; but there is, to say the least, strong presumption that the updraft in three chimneys might disarrange the outlet shafts, each measuring 6 inches by 9 inches, which are situated beneath the beds. At each of the four corners there are two large outlets—one near the floor, the other close to the ceiling. In all there are twenty-four outlets, exclusive of the fire-places. Each of them is connected with a brick flue, terminating in a wooden flue which runs to the louvred turret placed over the attached end of the pavilion. All the tubes surround a hot-water tank in this turret. This arrangement produces rarefaction of the air, and a constant escape of foul air. On the success of this complicated scheme of ventilation, we require precise

scientific data, before pronouncing a decided opinion. The same means of exhaustion are employed in the Hospital Tenon. No praise is too great for the ingenious contrivance which prevents the heated and fouled air of lighting from escaping into the ward. Each gas-jet has got a flue, which travels to the chimney.

A few remarks on the latrines and bath-rooms in the turrets at the free end of the ward, will conclude the description of the ward. One turret is devoted to a *cabinet d'aisance*, a urinal, and a slop-sink, while the other contains a bath-room and lavatory. These circular chambers are unequally divided by a wall, the inner space serving as a lobby with cross ventilation. There can be no question but that one water-closet is inadequate for fourteen patients, unless it be that the water-closet and bath in the ward approaches may be used by the patients, which, I understand, is not permitted. It is a pity that here, as in private dwellings, the closet pipes are concealed by woodwork. In every water-closet the siphon-trap should be visible and easy of detection. But a greater defect than this is met with in connection with the waste-pipes, which run direct into the sewer. Such a disposition of the waste-pipes will not meet with the approval of sanitary engineers, such as Baldwin Latham and Fleeming Jenkin, who, for obvious reasons, insist upon interposing a Somerset or Honeyman trap between the waste-pipes and the sewer.

The amount of space in the ward approach, covered by the private ward, nurses' rooms, &c., seems excessive. The nurse's room adjoins the ward, and an explanation of its large dimensions may possibly be found in a desire that every provision should be made to enable her to live in comfort close to the ward; which arrangement is less open to objection, when such provision is made.

Running beneath the pavilions is a subterranean passage, to which all the shoots and lifts descend. The hot-water pipes, after leaving the boilers, travel along the ceiling of these passages, and ascend into the corridors, which they heat, and then pass into the wards and turrets. The patients' lifts, the food lifts, the dust shoots, and the foul linen shoot, ascend from the corridor in the basement to the attics. The danger of frustrating isolation, which is the *raison d'être* of the pavilion system, has led to the non-usage of the latter shoot; since through it, as through the dust shoot, impure air has every chance of ascending to the different storeys. The clinical and operating theatres are well lighted and well arranged. In spite of defects that might have been avoided, there can be no doubt that the Edinburgh Royal Infirmary is an excellent example of a pavilion hospital.

GLASGOW WESTERN INFIRMARY.

Like similar institutions, proposals to build this hospital were made many years before they were

carried into execution. For situation, construction, and internal arrangement, it has few equals. In some respects it possesses advantages over the only other pavilion hospital in Scotland—the Edinburgh Royal Infirmary, which was built several years later. In it one sees a judicious combination of the corridor and pavilion system. The hospital was designed for 400 patients, but I understand there are seldom more than 350 in it at a time. The blocks stand on $11\frac{1}{4}$ acres of land, being almost exactly the ground area of the Edinburgh Infirmary, and yet in the latter there are nearly twice as many beds. The situation of the former is more favourable, there being less chance of encroachment by buildings, and the ground being much more open beyond. The sanitary zone, advocated by Tollet, has been amply secured here.

The hospital consists of nine pavilions, with a central portion containing the operation and lecture theatre. The stairs, lifts, and shoots are placed where the blocks intersect one another. The large wards, 15 feet high, 26 feet broad, have from fourteen to eighteen beds, each of which has a cubic space of 1650 feet. The internal arrangements are excellent. Seldom does a stranger enter a ward rendered so cheerful by the care and finish bestowed upon it. The wall-paper, frequently coated with varnish, will readily admit of periodical cleansing by disinfecting liquids. Equal care has been bestowed upon the wood work of the floors and corridors. The latrine arrangements at the corners of the

extreme ends of the wards leave little to be desired. It is the only hospital in Scotland where there is a hydropathic establishment for the treatment of skin diseases. A douche or two for the treatment of nervous maladies might be added with benefit, and in this way the thin end of the wedge would be inserted for the attachment to our hospitals of baths of every description, as is the case in France.

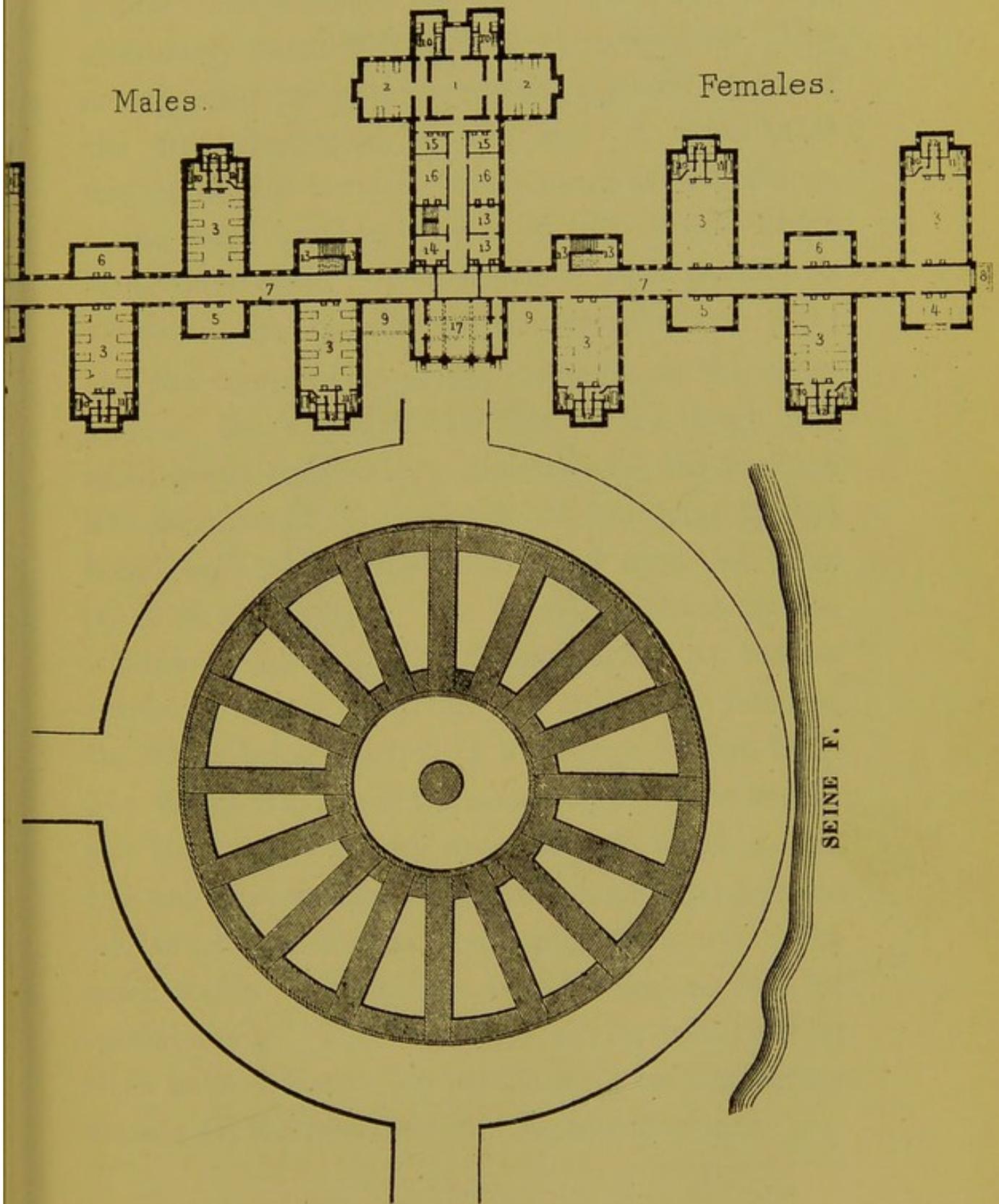
The heating is effected by open fire-places and warm water coils. The ventilation is excellent, and is principally carried on by natural means. The windows, in respect of size, position, form, and method of manipulation, are well worthy of imitation.

BLACKBURN INFIRMARY.

There can be no question that the disposition of the blocks of this infirmary is a fortunate application of the system of isolated pavilions. The entire cost of the building was £23,270, or £170 per bed—a small figure when contrasted with the enormous sums spent on Lariboisière and the Hôtel-Dieu. There is accommodation for 140 patients. The site, which is on a rising ground, covers more than 8 acres. Here all the essentials to salubrity exist.

The central block, which is larger than the others, is for the most part destined for the administration. It is in the form of a cross, the narrow arms of which contain wards of four beds each (2 on Plate), abutting from the operating theatre (1), and in which those who

BLACKBURN INFIRMARY.



SEINE F.



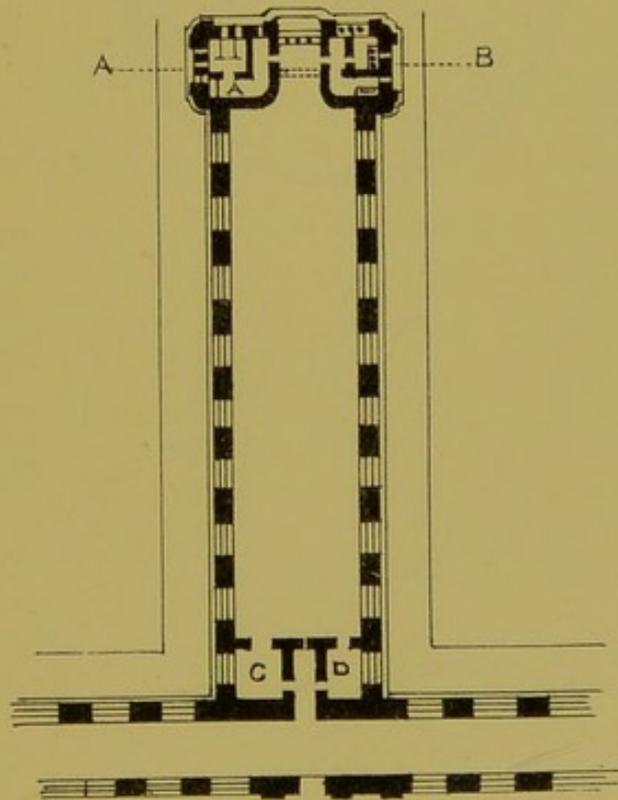
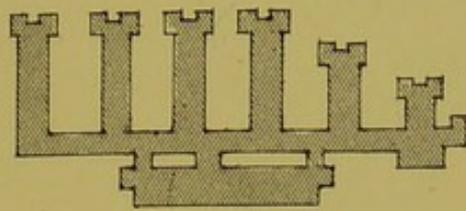
have undergone operations are placed. From the foot of the cross two long corridors (7) branch off. Altogether there are eight two-storied pavilions running alternately from each side of the corridors. This arrangement prevents overshadowing, and admits of the free circulation of the air. A remarkable feature of this hospital, which seems to be faultless, is the small number of beds in each ward—there being only eight. The length of each pavilion is 47 feet; the breadth of the corridor, 10 feet; and the continuation of the rectangle on the other side of the corridors, 14 feet. The large and small wards communicate directly with the corridor. The large ward (3) measures 39 feet long, 23 feet broad, and 16 feet high. Thus for each bed there is 1800 cubic feet. The ward is lighted by ten windows, 3 feet broad by 9 feet high. At the far extremity of the ward are the baths and latrines, the latter being reached by a passage 13 feet long. The closets (12) are of the same height as the wards, and have two windows opposite each another. In this way cross ventilation is secured, and disagreeable odours have no chance of entering the ward. The small wards (4) across the corridor are reserved for special cases. The volume of air for each bed in them is 2570 feet. The pavilions (6) are the lecture rooms; (5) the refectories for the convalescents.

PROPOSED GENERAL HOSPITAL FOR THE ISLAND OF
MALTA AT VALETTA.

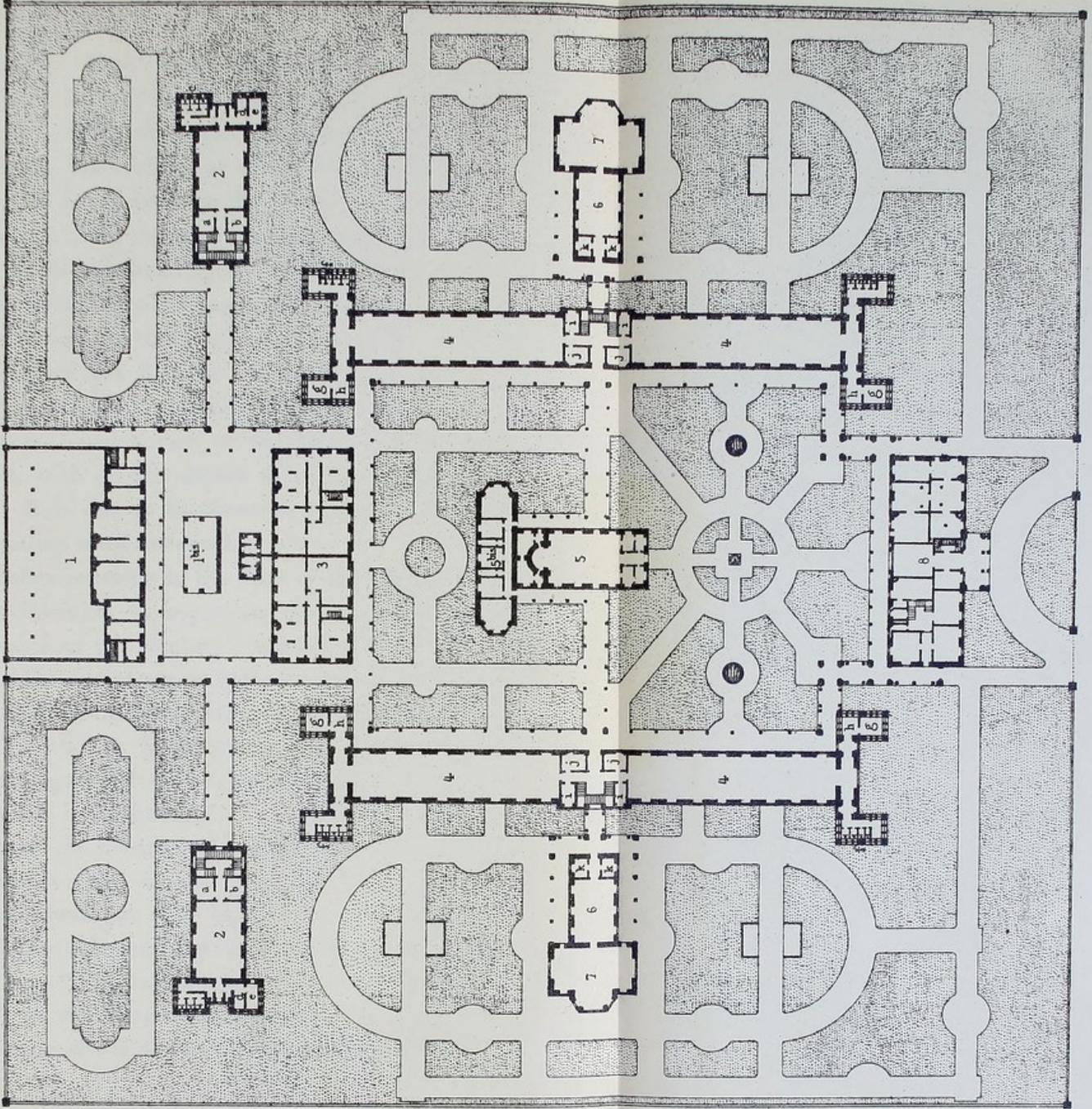
The fact that the plans of this hospital were not carried into execution in no way detracts from their excellence, or prevents them from being serviceable to those in authority, if at any future time a new hospital for Malta, which is sadly needed, be decided upon. The plan (Plate IX.) is the work of Mr. Wyatt, the architect of St. Thomas's Hospital, and the Brompton Consumptive Hospital; and it has received the unqualified praise of Miss Nightingale, Captain Galton, and Dr. John Sutherland, members of the Commission of Hygiene, and Husson, the eminent French authority. Miss Nightingale considered the plans faultless. Captain Galton and Dr. Sutherland knew of no hospital which would unite so completely all that is necessary for the well-being of the sick and the facility of the service. Husson says, "It is without doubt one of the most complete establishments which up to this time we have examined. The blocks are well arranged relatively to one another, and their distribution from the double point of view of hygiene and supervision leaves nothing to be desired" (Paris, August, 1862). This plan does not coincide with that (Plate VIII.) given in the Report of the Barrack and Hospital Improvement Commission on the Sanitary Conditions of the Mediterranean Station, 1863 (Malta and Gozo). Neither of these plans having been adopted, the old hospitium of the Knights of St. John still

VALETTA HOSPITAL
MALTA.

PLATE VIII.









remains. That there was necessity for a new hospital is fully borne out by this report. No amount of alteration on the venerable pile of the Knights, the erection of which dates as far back as A.D. 1575, can remedy the defects stated therein; and such being the case, it would be a pity rudely to lay hands on a building of so much historic interest, when even the site upon which it stands has been condemned by those best able to judge. In the *Statuta* of the Knights of St. John of Jerusalem (issued in Latin by the Grand-Master Verdala) there is to be found a view of the interior of the great ward, with all the details of administration going on. It is also to be observed that the beds of the hospitium were curtained.

Before referring to the plans of the hospital which was intended to supersede the hospitium, a few extracts on the sanitary condition of the latter will show the urgent necessity for something on the lines of the former. Commenting on the General Hospital at Valetta the report states that "it is the most ill-arranged and unsuitable place for the sick of a garrison in existence;" . . . "it is mostly cut off from the influence of healthy winds, and exposed chiefly to the sirocco." . . . "The outlets of three sewers are close to it." . . . "The air in and about the wards is always more or less impure." . . . "The latrines are of Maltese construction (porous stone), and very offensive." . . . "One of the courts is 34 feet below the level of the other,

and both courts are closed in at the angles." The site of the hospital proposed by the Commission, 1863, is on the highest ground within the fortress lines, and what is of much significance now-a-days, cannot from its position be encroached on and surrounded by buildings. In this instance the pavilion construction is so flexible that "it has readily adapted itself to the necessities of the ground, without any essential sacrifice of its special advantages." The sick wards were on two floors only. The wards were to be in six pavilions (*vide* general plan, Plate VIII.), 50 feet apart. Thus the extent of intervening ground between the pavilions is much greater than the height, which is 35 feet. In such a climate as that of Malta, and in so exposed a situation as the building is intended to occupy, it will be sufficient for health.

The larger wards, exclusive of the space at the extreme end, were intended to be 110 feet long by 28 feet broad, which would allow for thirty-two beds a superficial area of $96\frac{1}{4}$ square feet, and of 1548 cubic feet. All the pavilions were to be connected on both floors by an open arched corridor sufficient to give shelter from sun and rain, while it would not interfere with the free circulation of air about the pavilions. The position of the water-closets is indicated at *a*; of the lavatory, bath, and urinals at *b*; of the nurses' room at *c*; of the ward scullery at *d*, on Plate VIII.

As stated, the plan of Mr. Wyatt, given in

Husson's admirable work, which I have reproduced, differs very materially from the plan proposed by the Commission (Plate VIII.). Sir J. Gaspard Le Marchant, the governor of the island, proposed to unite all the different establishments, as indicated in this plan (*vide* Plate IX.). It was to be at one and the same time an "hospice" for the aged, an hospital for the sick and incurable, an orphanage, a house of refuge and of repression for prostitutes, and an asylum for the insane. It was to accommodate 1000 persons—500 males and 500 females. The latrines, urinals, and the baths are placed at the extremity of the ward in an isolated pavilion, oblong in form, and attached to the sides of the ward pavilion by an arcade 10 feet in length. The latrines are indicated by the letter *f*, the baths and lavatory by *g* and *h* respectively. The dimensions of the wards would allow 1500 cubic feet to each bed. The figures indicate 1, the kitchen; 2, the special diseases; 4, the ordinary wards; 5, the chapel; 8, offices, pharmacy, library, operating rooms, &c.

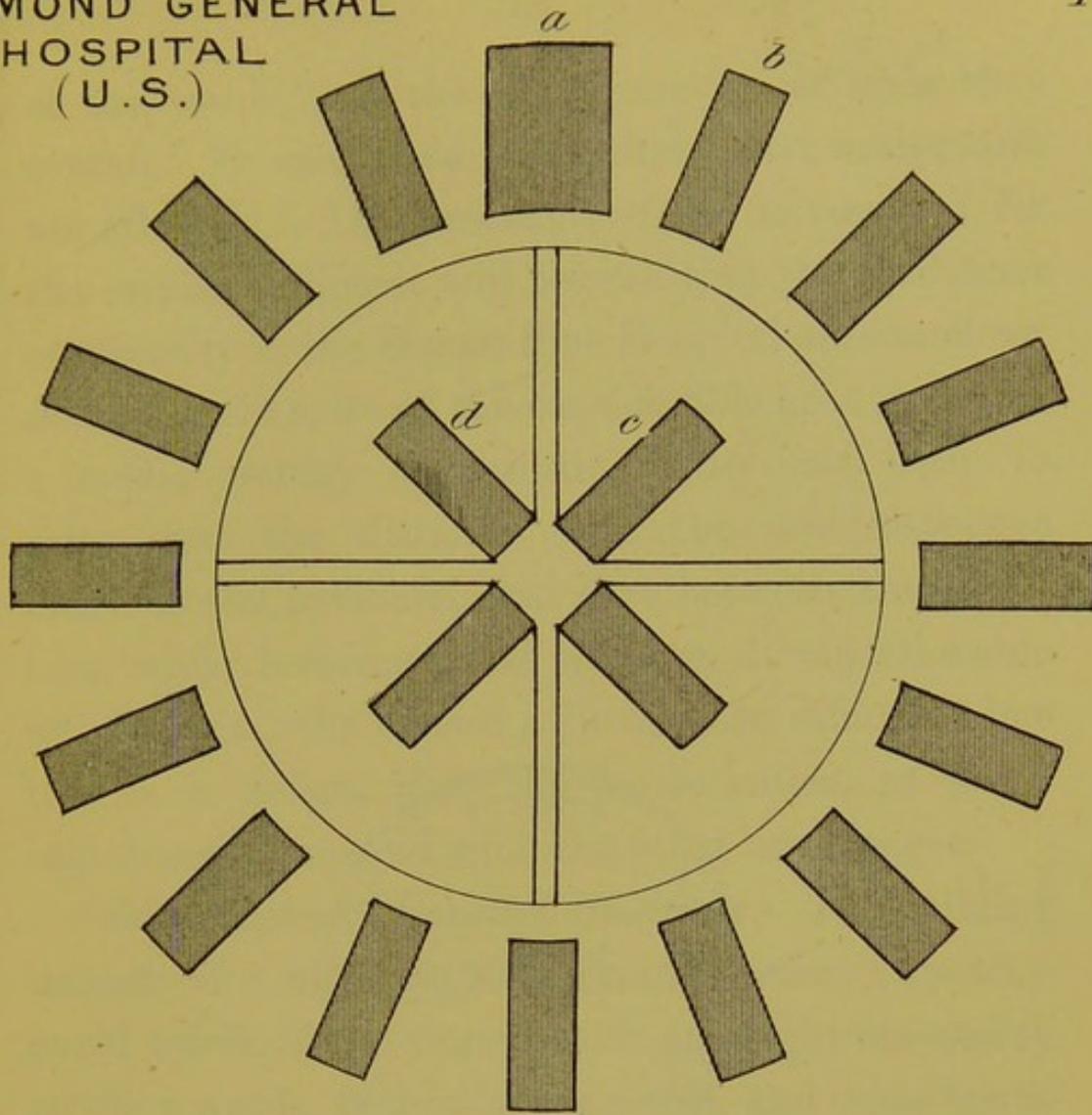
AMERICAN HOSPITALS.

Hammond Hospital.—Here the two circular corridors envelop in a double circle the ground on which the structure stands. The pavilions stretch from one corridor to the other in a radiating fashion. They are equi-distant from one another, the distance between the blocks at the centre being 40 feet, and at the

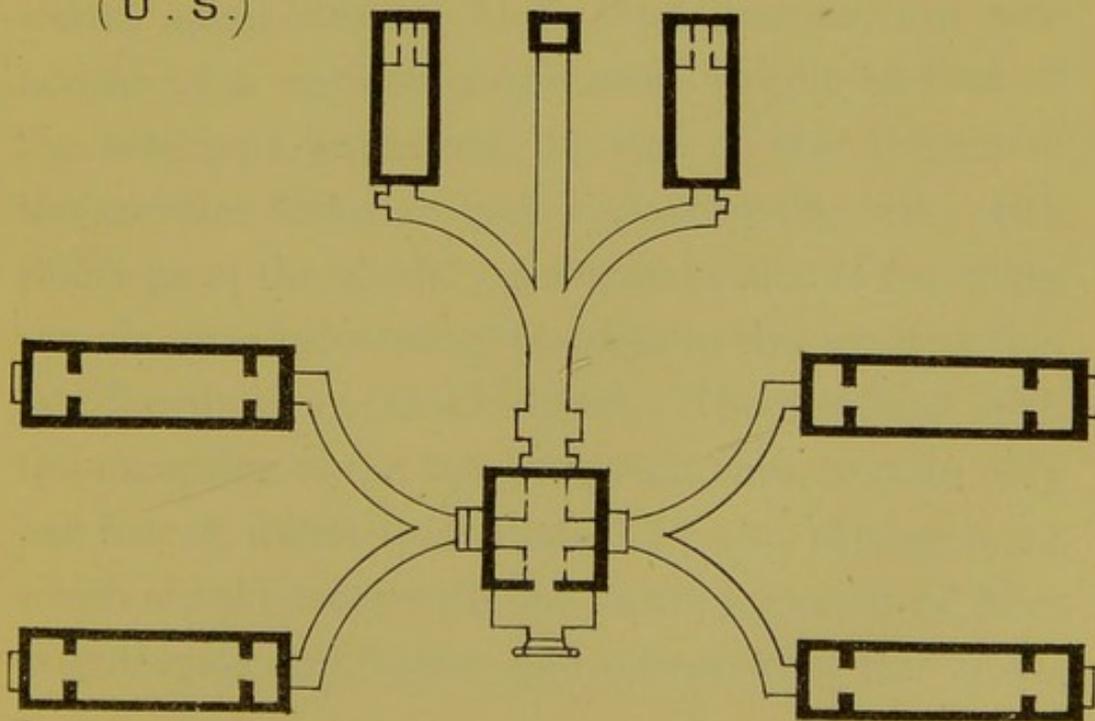
peripheral extremity 83 feet. In an arrangement such as this, which has not met with general acceptance, there is, on the whole, a saving of ground ; but, with a space of only 40 feet intervening between the central ends of the blocks, there must be overshadowing. Of the sixteen pavilions, fifteen are destined for the sick (Plate X. *b*), and the sixteenth, the largest, for the administration (*a*). In each pavilion there are fifty-two beds. The entire hospital accommodates 780. The kitchen is indicated at *c*, and the linen room at *d*.

Boston Free Hospital.—The plan of this edifice is, if anything, more remarkable than the previous. Its model has not as yet been copied, although the plan is worthy of being repeated elsewhere. In the centre there is a large square block destined for the administration. From the middle of three sides of this block, three corridors strike out at right angles, afterwards bifurcating, and thereby creating six crescent-shaped corridors, at the extremities of which are the pavilions. The distance between the pavilions in this instance is 110 feet—a space that allows of the free admission of air and light, and affords no chance of stagnation. The four largest blocks, 110 feet long, and nearly 32 feet broad, consist of a basement and two storeys, occupied by wards containing twenty-five beds. Each ward has sixteen windows. Each man is allowed 127 of superficial, and from 1900 to 2000 feet of cubic space. This hospital is remarkable for the large size

AMMOND GENERAL
HOSPITAL
(U.S.)



BOSTON FREE
HOSPITAL
(U.S.)





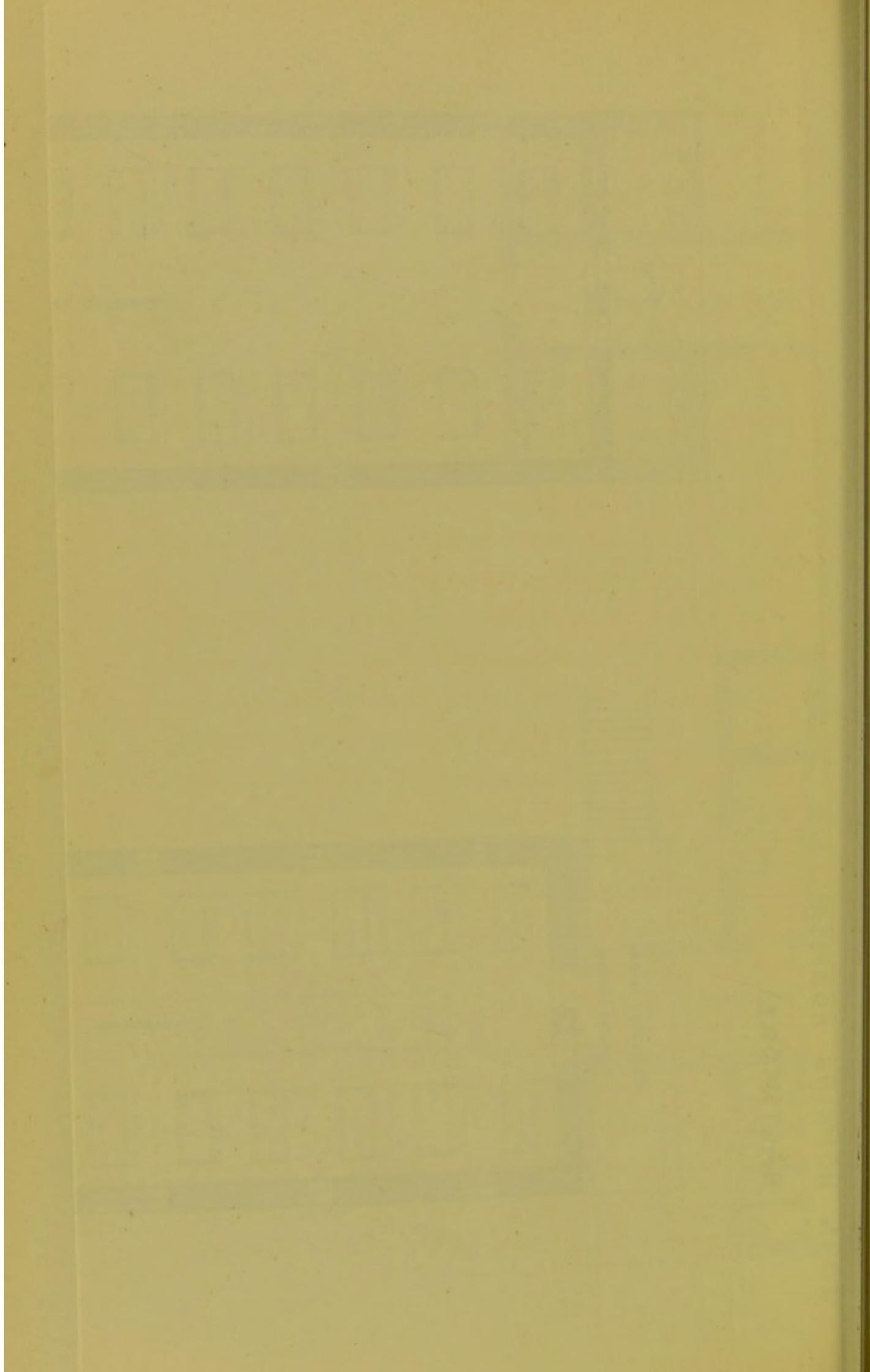
of the wards, and the small number of beds they contain. To each ward water-closets and bath-rooms are attached. The basement storey is reserved for the service. Thus it will be seen that the conditions of salubrity in the Boston Free Hospital are excellent, making it, in spite of the considerable area it covers, a model worthy of imitation. It may seem to some that the distance from the administrative block to the pavilions, and that between the pavilions, while insuring good hygiene, is objectionable by rendering the service a little more difficult; but this is a defect, if it can be so called, of small importance compared with the other advantages.

“*John Hopkins*” Hospital, Baltimore.—The building consists of a block for the administration, two octagonal wards of two storeys each, and eight one-storey pavilion wards, two isolating wards, and some tents. The wards are arranged round a central garden, and freely exposed on all sides to air and light. The wards, administration block, and kitchen, are connected by a corridor of the same height as that of the basement wards, viz., 10 feet, so that the top of the corridor forms an open terrace walk, level with the floors of the wards. An examination of the plans reveals some interesting features in the construction and distribution of this hospital. The pavilions, with the exception of the two octagonal ones, contain only one flat of wards (*vide* Plate XI.)—an arrangement which should meet with the entire approval of Miss Nightingale and Tollet, and others who, like them,

have a decided aversion to those with two storeys. When this hospital is completed, the accomplishment of which will occupy some years, the United States will be able to boast of one that equals, if not excels, the finest structures in Britain, France, or Germany. Perhaps the nearest approach to it is the St. Eloï Hospital at Montpellier. A gift such as this, coming rarely as it does, stands out in a nation's history, and is worthy of all commemoration. The name of its philanthropic founder will be enrolled in the same page with that of John Howard, Peabody, and Sir Richard Wallace.

HÔTEL-DIEU, PARIS.

It will not be out of place here, before describing the present Hôtel-Dieu, finished in 1876, to refer to the historic edifices of which it is the successor, more especially to the parent edifice, reared in the seventh century, which is a landmark in French history, and whose historic interest transcends that of all similar establishments, not excepting those of Rome itself. Its early existence is to some extent shrouded in mystery. Documents, however, have been found in the cartulary of the Notre-Dame adjoining, which establish beyond doubt its early origin. All the wards, at the commencement of the twelfth century, were purely ecclesiastical in their architecture. Like the Hôtels-Dieu of Angers and Chartres, the wards had three or four naves, separated by rows of columns, in which were placed three or four rows of beds, and



like them the Hôtel-Dieu of Paris is one of the most interesting monuments of the century. It will always stand out *en bas-relief* in the annals of medicine as a time-honoured institution, round which a tissue of medical history might be woven. Century after century saw new wings added by the kings and queens of France, until at length there were beds for 2800, and these were always occupied. Reverence for this ancient pile—a large part of which succumbed to fire in 1772—cannot blind one to the palpable defects everywhere apparent. There can be no mistake that wards, monastic in their character, were too dark and sombre to have a cheerful effect upon the sick. Probably the best thing that could have happened them was the effect of a cleansing fire, since this hospital became unsuitable as a place of cure, if one may judge from the appalling mortalities recorded—mortalities clearly traceable to overcrowding and deficient space. And these defects have led to dangers no less terrible than even epidemics themselves.

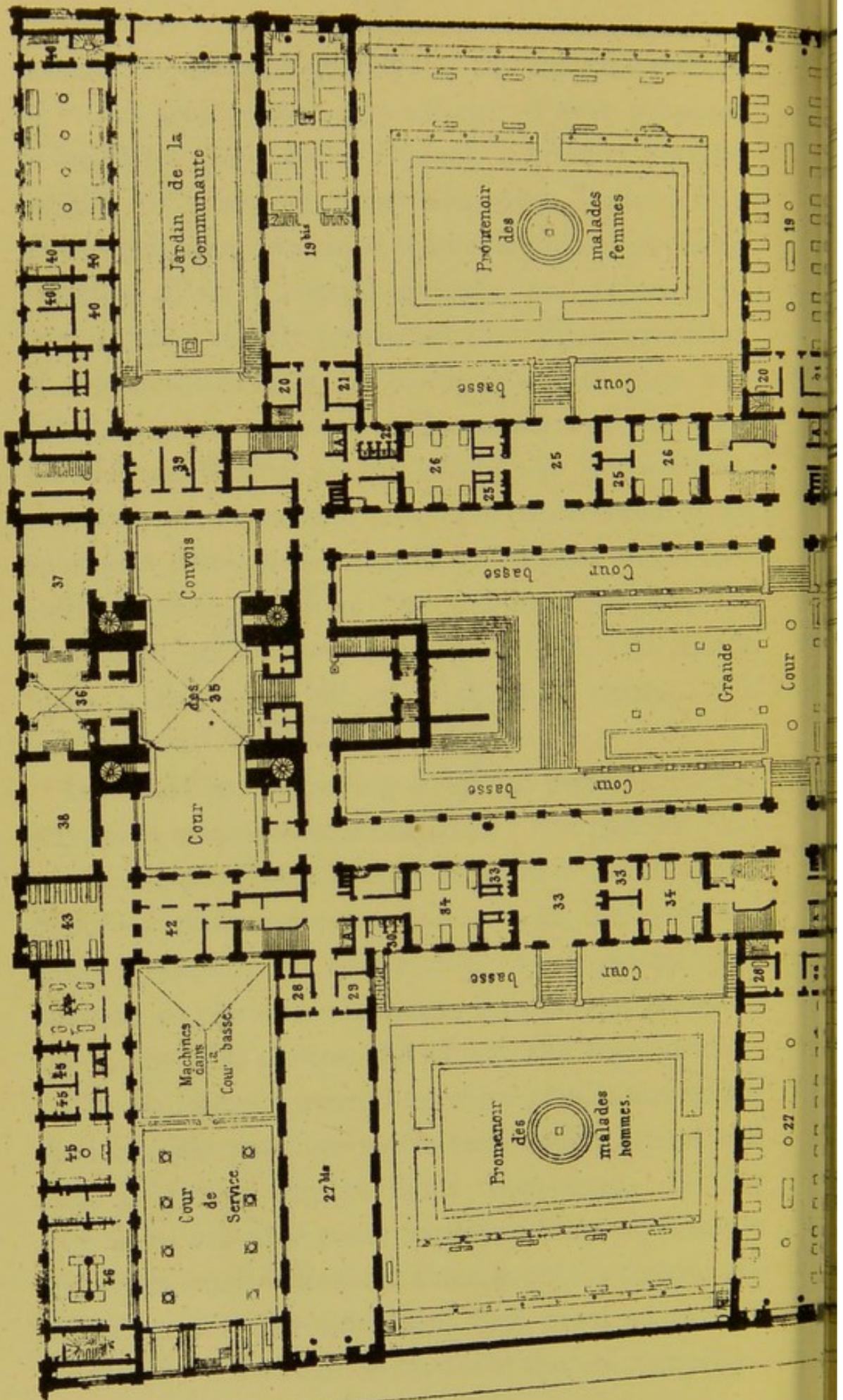
The ruins were still reeking when proposals were made for a successor. The last and ablest statement was presented in a memorial by Tenon to the king. The contents of that memorial need not be recapitulated here. Suffice it to say that it has formed the basis of almost every work on hospital construction. At a later date (1838) two proposals were made—one to change the site, the other to break up the Hôtel-Dieu into several hospitals,

situated in different quarters of the capital—neither of which was carried into effect. Poyet proposed to build, on the island of Cygnes, a circular hospital capable of receiving 5000 sick (*vide* Plate VII.). The Commission examined the novel plan of pavilions radiating from a central rotunda, and rejected it, because they rightly concluded that the aggregation of thousands of sick in contiguous buildings was sure to lead to disaster. Hence we find the new Hôtel-Dieu, flanked on the left by the Notre Dame, standing on its ancient site, and constructed at an enormous cost—something like a million and a half sterling—defrayed from the public exchequer. It is situated on the famous Ile de la Cité, and stands upon a flat space, about 5 acres in extent. It contains 840 beds.

Its situation, occupying a central position in the city, is in some respects excellent. The general plan of the hospital is the same as that of Lariboisière. From a rectangular court, 160 m. \times 35, five pavilions extend laterally on either side. Of these two are devoted to the administration, four to the patients, one to the laboratories, and two to the sisterhoods.

The buildings surrounding the central court which connects the pavilions with each other, are of the same height as the pavilions themselves. In this way there are nine court yards—a large central one and eight small. Each of these courts is completely closed in on three sides, and to a great extent on the fourth. There can be no doubt that this arrange-





Jardin de la
Communauté

Promenoir
des
malades
femmes

Convois

Cour
des

Cour

Machines
dans
Cour basse

Cour
de
Service

basse

Cour

basse

Cour

Grande

basse

Cour

basse

Cour

Promenoir
des
malades
hommes

19 bis

20

21

25

25

26

20

37

35

35

38

42

28

45

46

27 bis

29

33

33

34

26

27

19

20

Cour

26

27

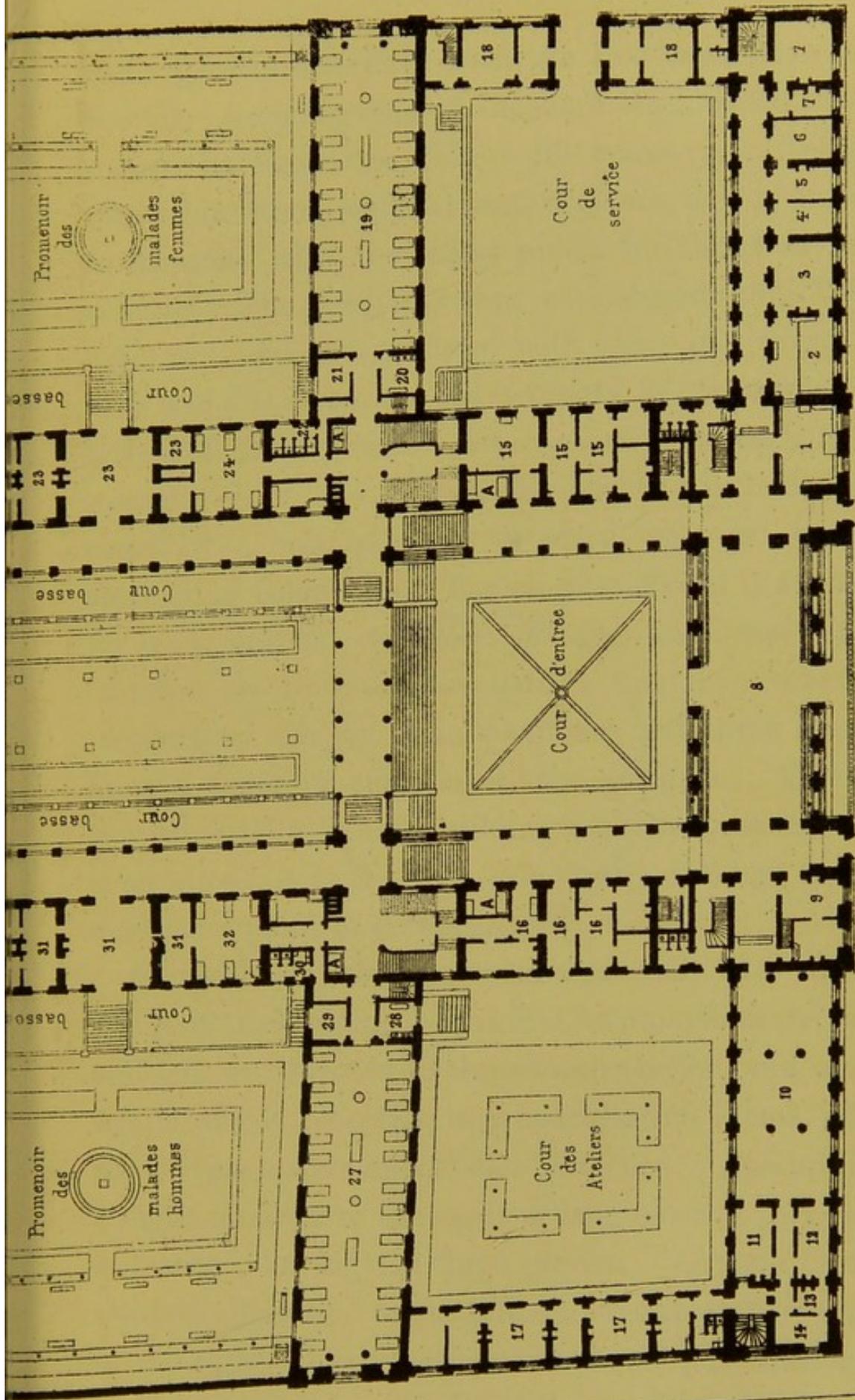
19

20

Cour

26

27



Place du Parvis Notre-Dame

HÔTEL DIEU, PARIS.

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ment greatly interferes with the free circulation of the air, reminding one of the high wall which surrounds La Roquette. The solid masonry, of beautiful white stone, strikes one at a glance, and is quite in harmony with the many public buildings in its vicinity. The interior is even more elegant than the exterior; and the gardens, with their gay flower-beds and *jets d'eau*, are characteristic of the æsthetic tastes of the Parisian. After passing through the entrance door, one reaches the beautifully laid out court by a palatial flight of steps, crowned by a connecting colonnade. The elegant chapel is at the far end, and on each side are the pavilions. In addition to this central garden are four others, inclosed by the six main pavilions, and these must have a cheering effect upon the patients. While the superiority of this building over its predecessor is admitted, it is far from being void of faults from a sanitary point of view.

A spacious vestibule connects the two main wings of the building. The first two pavilions, right and left, are devoted to the administration, and consist of offices, reception and consultation rooms, and the private apartments of the "internes." Ascending a flight of steps to the right, a long covered corridor is reached, having the large garden, "Grande Cour Centrale Plantée," to the left, and the range of wards to the right. Leaving the corridor, we pass through a door into the vestibule of the pavilion, in which is the staircase which leads to the different storeys.

To the right are the passages leading to the wards, the dirty linen shoot, and a lift. Before reaching the ward we have to pass, on the right, the entrance to the passages leading to the *cabinets d'aisance*, which are situated in the longitudinal building, and the room of the sister in charge, and, on the left, the bath room. These rooms are not nearly the same height as the ward; but above them there is, I believe, a store-room. We are now inside the ward, which is 90 feet long, 17 feet high, and 28 feet wide. The floors are of oak, the walls of Parian cement. There are windows on each side and at the extremity. The windows are rounded at the top, and reach nearly to the summit of the ward. They are a great improvement on the old French style, opening valve-like, and are divided into two pieces, the lower being rectangular, and the upper semi-circular. Above the skirting board, on each side, there are seven openings for fresh air, which are covered by gratings. In the vaulted ceiling there are exit apertures. Provision is made for carrying off the products of combustion produced by the two gas lamps which give light. The heating is mainly effected by three hot water coils, which appear at intervals in the centre of the ward. Beneath the end window, at the far extremity, there is an open fire-place. The beds have curtains.

One of the most striking features of this hospital, put up regardless of expense, are the *salons de conversation*. The floors are made of polished oak,

and so are the doors, which on one side face the garden, and on the other open on the corridors of the large central court. These salons are decorated in Pompeian colours, and the ceiling is deeply pannelled, and picked out in red and blue. The convalescent patients can desire nothing better. The grandeur of these rooms will enable them to forget some of their misery. There are four amphitheatres for operation—two on each side of the building; they are in the longitudinal block, and occupy space which elsewhere is taken up by small wards. The two end pavilions on the right hand are occupied by the sisterhood, and they inclose a garden. The ground floor of one of the two end pavilions on the left is devoted to a mortuary and mortisection room, and the first floor to a lecture room and laboratories.

On the right of the basement floor are the wine-cellars, the larder, provision store, kitchen and servants' dining-hall, womens' baths, dirty linen room; and on the left are the boilers for heating the building, and the steam-engine for ventilating it; also workshops, mens' baths, a dispensary and *ptisannerie* (a kitchen for making decoctions, in which the French have great belief), a drug store, and a range of cellars.

The heating of the building is entirely effected by steam and hot-water pipes and a few open fire-places; but these latter are intended to convey to the patient a feeling of cheerfulness. The heating apparatus is of a costly kind, there being no less than twenty-four miles of copper piping. Unfortunately the heating

apparatus does not assist in ventilation, and consequently the fresh air has to be supplied by artificial means, being propelled by a steam-engine into the wards. Air for some of the wards is drawn by means of a screw from the top of the building; for others from the banks of the Seine, through an underground tunnel, filtering through wadding before being sent into the shafts leading to the wards. The foul air escapes by special ducts from the wards, and travels to the roof. This hospital is not without defects, and among these are—

- (1.) The contiguity of one pavilion to the mortuary.
- (2.) The use of curtains.
- (3.) The height of the walls connecting the outer end of the pavilion.
- (4.) Inefficiency of outlet shafts.
- (5.) The water-closets (Plate XII. 30). They are not situated in the pavilions, but in the longitudinal building, and are approached by two passages, so that the same closets serve for the large and small wards. In the angle formed by these two passages is the lift, A (Plate XII.). Windows exist only on one side, and thus there is no possibility of a thorough draught, unless one of the passages be utilized for the exit or entrance of the air, which would be objectionable.

HOSPITAL LARIBOISIÈRE.

Before discussing the plan of this celebrated hospital, the first methodically constructed on the

pavilion system, it would be advisable to refer to the Report (9th November, 1839), of the Medical Commission over which Orfila, the Dean of the Faculty of Medicine, presided, and which included among its members Guéneau de Mussy. The first report to the Council General is remarkable for two suggestions, viz. :—

1. To reduce the number of flats.
2. To enlarge the opening of the windows.

The second report says—“Your Commission has, in the interests of the sick, consulted the plans of the hospitals of Europe considered the most perfect, specially those of the beautiful hospital at Bordeaux, which is so justly admired.”

The Commission further took into consideration “the result of the recent writings which have been published in different countries, on the better condition which the construction and distribution of hospitals demand;” and in proposing “to give Paris and France a model hospital, which up to this hour it stands in need of,” they remark that “we are far from proposing an ostentatious monument—a model of architectural beauty. On the contrary, we think the interests of the sick have been too often sacrificed to that perfection purely external.”

The plans contained in the second proposal, although unanimously adopted by the Council, were fortunately never executed. Resembling in great measure those of the Frankfort hospital, there was

to be a vast quadrilateral composed of a series of small wards, having between them a corridor for the service. The wards were all to open into a large corridor, and to take light from the side opposite to their principal entrance, and consequently receive it from one side only. This disposition, so contrary to the laws of hygiene, was none other than a reproduction on a small scale of the ancient wards of the Hôtel-Dieu, or King's College, London. This arrangement offered an insurmountable obstacle to the renewal of air by natural ventilation, and the corridor became the common receptacle and the permanent conductor of morbid emanations. And, moreover, the advantage gained by those central corridors was more imaginary than real. According to this same Commission, between each bed there was to be a door through which the soiled linen and dead bodies would be removed, and thus a disagreeable spectacle concealed from the living.

The Lariboisière of to-day is none other than a fulfilment of the programme of the Academy of Sciences. It received the unqualified praise of Miss Nightingale and Mr. Robertson. The latter says, "I have myself seen the application of several ingenious plans, which have been crowned with success, and which should not fail to incite sentiments of pleasure and admiration. I will mention more particularly the hospital at Bordeaux, and that of St. Jean, Brussels, and Lariboisière, Paris." Oppert of Berlin, in his splendid work on a com-

parison of the hospitals of Germany, England, and France (1859), speaks of it as "the model hospital of Europe, and one of the most beautiful monuments to humanity."

It can no longer, however, claim the first place; many hospitals having sprung up since 1854, which far surpass it. Some years ago it had an unenviable notoriety for a high mortality.

Its erection was undertaken by Gauthier, who was requested to embody in his plans the ideas of Tenon and the Academy of Sciences.

On each side of an oblong central court are five pavilions, three of which are devoted to the sick. Each pavilion contains three superimposed wards of thirty-two beds, and two additional beds in a small room at the far extremity where persons excited or suffering from contagious affections are put. The accouchement ward contains only twenty-eight beds. A covered-in corridor, with balcony above, surrounds the court. The parallel blocks for the sick run at right angles from the corridor, and are separated by gardens which are only sixty-three feet wide. Remembering that the height is fifty-nine feet, it will be seen that this interval is too small to admit sunlight and the free circulation of the air. In short, the only remedy for and justification of tiers of superimposed wards—a considerable interspace—is wanting here. The cubic space per bed varies from 2072 feet on the ground floor to 1840 feet on the second storey. The cost of the building

was £400,000, or nearly £700 per bed, there being 600 beds in all—a sum which, while much in excess of the Edinburgh Royal Infirmary, was considerably under the figure of the Hôtel-Dieu.

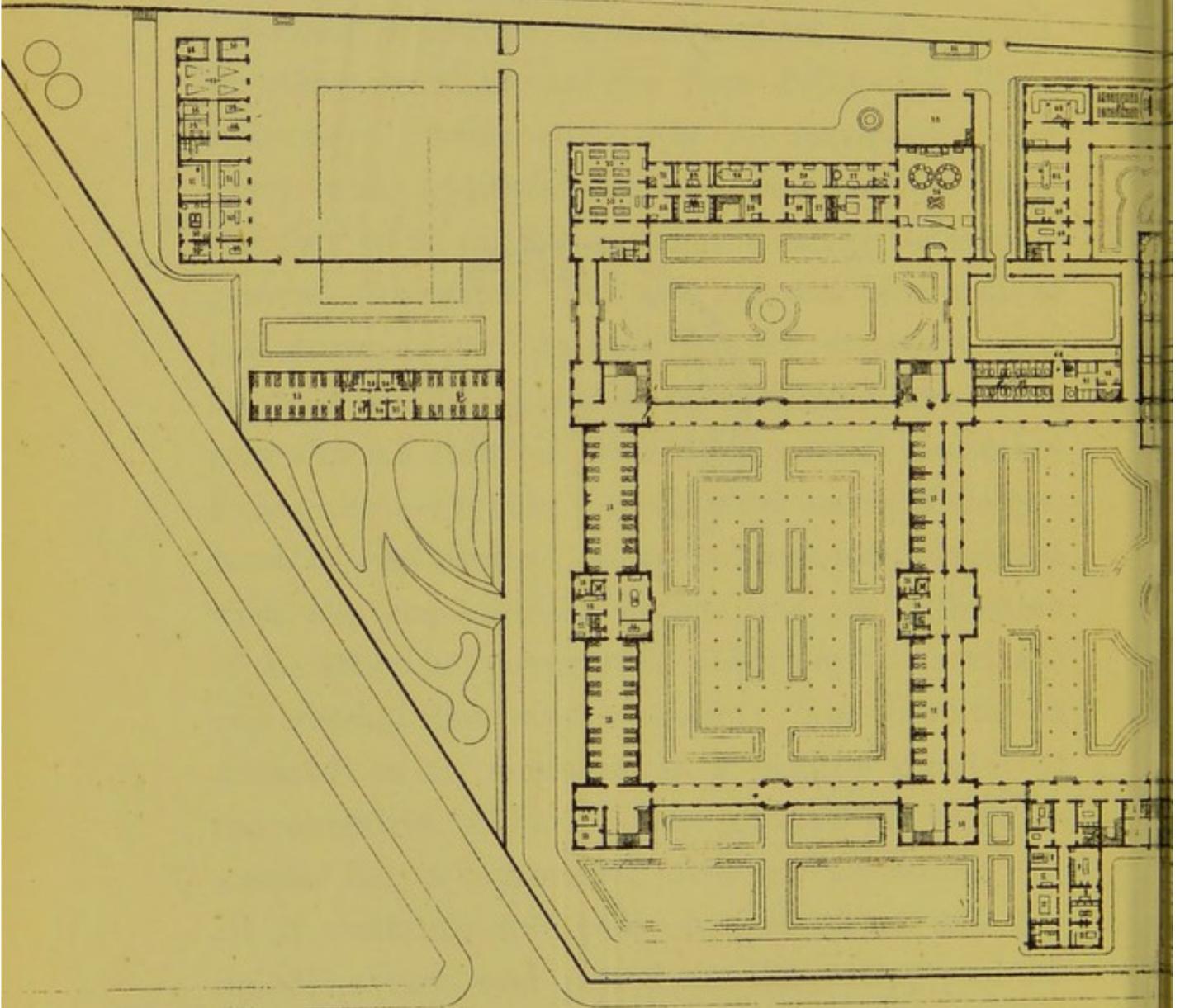
HOSPITAL TENON, MENILMONTANT, PARIS.

In many respects this hospital, named in honour of the French hygienist of last century, is one of the finest in Europe; in some respects it is equalled, in others excelled, by the New Edinburgh Royal Infirmary. After admitting its superiority over every other institution of the same kind in Paris, the fact of a small-pox depot existing between a general store-room and the external side-wall of the external pavilion calls for the strongest condemnation. Its situation, as seen from the block plan which I obtained from Bureau de l' Assistance Publique must render it a continual source of danger. Another bad feature, of no consequence compared with the one already stated, was the utilization of the attics in emergencies, which are by no means rare during the winter season. The hospital is situated on an eminence in a healthy quarter of the outskirts of Paris. The ground on which it stands has a superficial area of 13 acres. In all it contains 800 beds, but of these 200 are supplementary and placed in the attics, and 32 are reserved for small-pox. It consists of four detached pavilions parallel to one another, and connected by corridors on the ground floor running



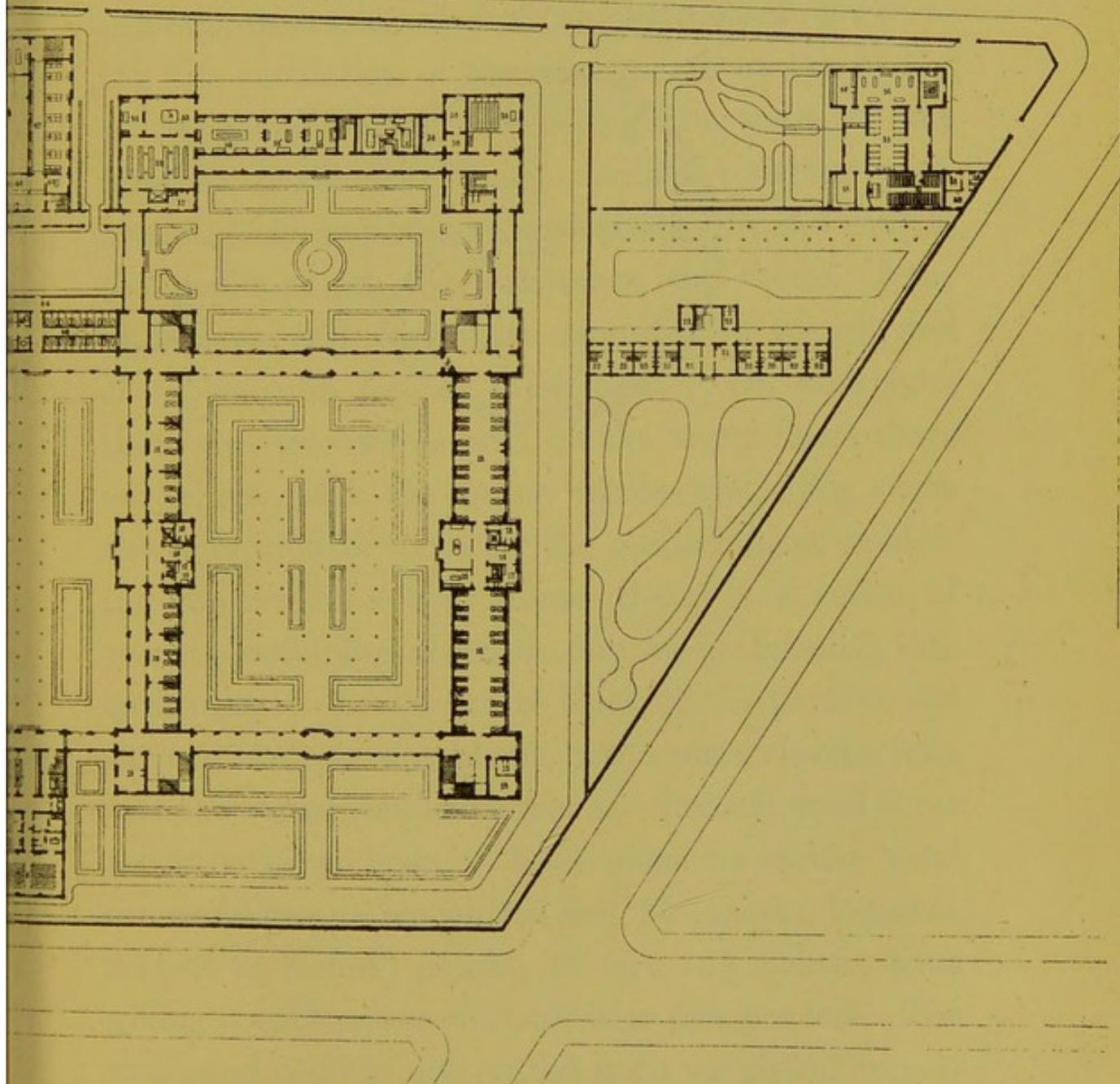
HÔPITAL

PLAN G



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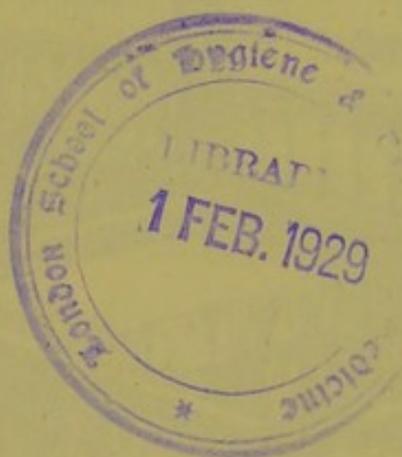
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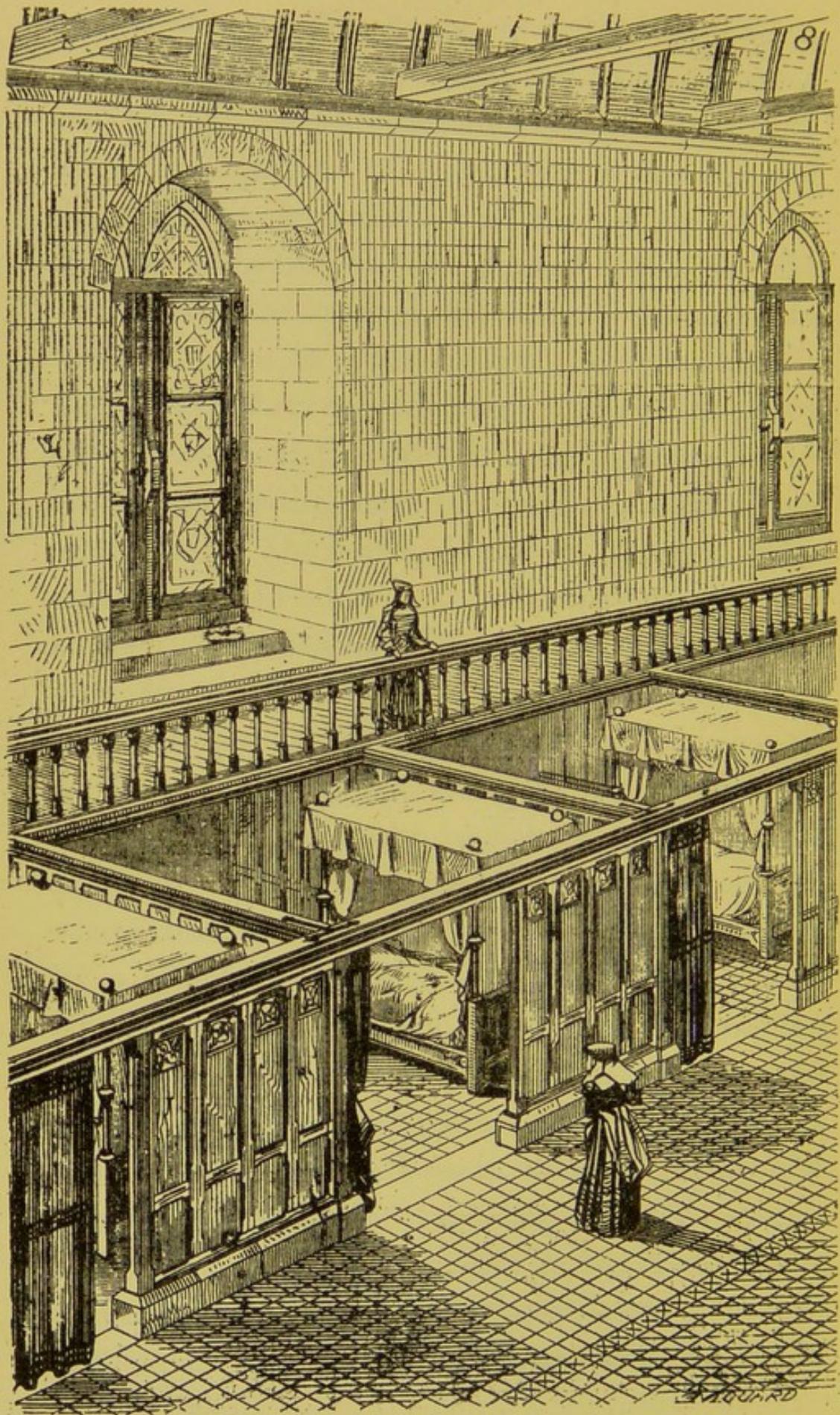


round the principal court, and along the two ends of the oblong courts, uniting the two internal and the two external pavilions. The garden between the inner blocks measures 254×210 feet; those between the inner and external blocks 162×210 feet. The difference in extent of the three gardens separating the four pavilions is easily explained. A greater space was necessary between the two internal pavilions than between the external and internal, in consequence of the obstruction offered to the free circulation of the atmosphere by the blocks in front and behind connecting the ends of the internal pavilions. Each pavilion consists of a ground floor, two storeys, and attics. In the ends of the pavilions are the stair-cases, the rooms of the physicians and surgeons, examination rooms, and chambers with two or three beds. On each floor there are two wards, and on the upper floors there are three. All the other wards are alike, with the exception of those on the ground floor, bordering the central court, where there is a series of rooms, containing three or four beds, opening into each other. In the centre block of the pavilion are the convalescent day rooms, bath rooms, closets, lifts, and the superintendent's rooms. In each ward there are twenty-two beds. The dimensions of the ward are as follows:—length, 84 feet $7\frac{1}{2}$ inches; breadth, 28 feet $2\frac{1}{2}$ inches; height, 17 feet $10\frac{1}{2}$ inches; thus giving a cubic space of 2040 cubic feet per bed. The walls and ceilings are coated with varnished imper-

meable stucco. The wards are lighted by twelve windows reaching to the ceiling, and opening in three sections. In front are the administration buildings, the central portion of which is four storied, and the wings single storied. At the far end of the rectangular court are the general baths for the treatment of the internal and external diseases. In addition there is a vapour bath, a hydrotherapeutic room, and other dependencies. Like Lariboisière and Hôtel-Dieu, the provisions for lighting, ventilating, and heating have been made on a grand and costly scale. The heating is effected by warm water and steam. In addition to natural ventilation, the air in the ward is removed by the propulsion of pure air, which is drawn through a stalk higher than the hospital, and by mechanical contrivances for the extraction of the foul. By this combination 3500 cubic feet of air can be secured to each patient per hour. The waste product resulting from the combustion of the gas used in lighting escapes by a simple contrivance into the foul air shafts. The erection of this hospital has given Lariboisière, not long ago the model hospital for France and the world, a secondary place. Owing to the short time this hospital has been in existence, no definite opinion can be formed regarding it. The magnificence of this edifice redounds to the credit of the 'Assistance Publique.' Its usefulness, however, will be marred by the small-pox pavilion already referred to.



HOPITAL DE TONNERRE
(Vue perspective d'une des travées de la salle).



HOTEL-DIEU DE TONNERRE.

This ancient edifice traces its origin to the eleventh century. It was a magnificent hospital for those days, perhaps the best in France. A perspective view of the interior is added to show the great contrast between it and the first hospital in France at the present day—the Hospital Tenon. Like all similar institutions in those days, it was under the management of the church, and following the custom was situated near the *eglise Notre-Dame* of that town. In the ward, as will be seen from the perspective (Plate XIV.), there were chambers (alcoves) in which the beds, forty in number, were placed. Above these recesses ran a gallery, from which possibly the windows were manipulated, and supervision exercised over the sick. It will be seen that the windows of the present hospitals in France are identical with those of the eleventh century. The ventilation was carried on by the windows and ventilators fixed in the timber work of the roof. On the whole, it must be admitted that the conditions of salubrity were good. Although the large dimensions of the ward allowed nearly 4000 cubic feet to each patient, yet in those inclosed spaces the circulation of air was bound to be imperfect, and, from the altitude of the windows, the amount of sunlight admitted must have been small. A comparison of the interior of this hospital, or that of the Knights or San

Spirito, with one of recent date, will serve to show the reader the evolution of the hospital system from the crudity of the early and middle ages to the perfection of the nineteenth century.

OSPEDALE SAN SPIRITO, ROME.

After England and France there is no country which offers so much material for investigation as Italy. The famous San Spirito Hospital, in the city of Rome, was founded as far back as 1198 A.D. Having been richly endowed by the Popes its revenues are very considerable. It is situated in a most unhealthy locality on the bank of the Tiber. From an architectural point of view it presents some remarkable features. The glaring defects of this hospital are common to all such institutions in Rome. It has accommodation for 2000 sick (Husson). When I visited this ancient and historic building I was at once struck with its palpable defects. The wards were long, broad, and high; and although there was no want of cubic space, there was unmistakable evidence of the absence of air and light. On each side of the ward two rows of beds were placed—those of the outer row alternating with the inner. On reaching the far end I counted the beds, which numbered 150. The atmosphere was most offensive. How could it be otherwise? The windows, situated at the top of the side walls, were about 30 feet high and close to the eaves, and were next to useless,

giving little light and less ventilation. Nay, more, it was hardly possible for the sick to see the cloudless Italian sky overhead. Passing in between the small spaces separating the beds, I found the state of matters no better. I looked to see the diseases marked on the bed tickets, but they were not recorded. Whatever diseases they were afflicted with when they came in, which the Italian student did not seem to have taken cognizance of, if one may judge from the clean card-ticket above the beds, unquestionably after a short stay in this curing resort, bad air and want of light either supplanted the original disease or materially aggravated it. Here, indeed, "the triumphant art of nourishing disease by that on which it is fed" seems to be verified. There were strong presumptions for believing that the one hundred and fifty cases included a great variety of diseases—a combination such as one would not meet with in an English ward. The infectious ward was on a line with the general ward, separated merely by two doors with a small corridor between. The appearance of the sick was but the reflection of the gloom and insalubrity of the ward. So far as I could learn there was no change upon this structure from the days of its first construction. Such an institution is far from being the public benefit it ought to be; and until the Italians are roused from their lethargy and indifference to hygiene, no improvement will be effected. The absence of curtains, so

common to French hospitals, was the one redeeming feature to be seen in this remarkable and historic building of the Middle Ages. The other numerous hospitals in Rome are constructed on the same principle, and have the same defects.

GRAND HOSPITAL OF MILAN.

At the head of the hospitals of Italy the Grand Hospital of Milan takes its place. For magnitude of proportion it has no equal anywhere. It contains something like 3400 beds, which are spread over fifty-six wards, each ward containing sixty beds. The cubic space per bed is enormous—the allowance being 3400. It might be interesting to give an account of this gigantic edifice ; but as such colossal structures are discountenanced in the present day, to do so would serve no purpose.

Moreover, the verdict of modern science has gone forth against such, and the very idea of confining so great a multitude of human beings suffering from different diseases within four walls has been justly looked upon as one of the “lunacies of science.” The eight pavilions are arranged in the form of a cross with four square courts, two sides of which are formed by the right angles of the cross. No one is better qualified to speak of this hospital than M. le docteur Larrey. In a discussion which took place in the Academy of Sciences, Paris, he said, “The Grand Hospital of Milan, remarkable for its enormous proportions, furnishes neither by its situation nor

by its contiguity to the canal the sanitary conditions justly ascribed to buildings with a less imposing exterior."

THE HOSPITALS OF SPAIN.

This country possesses few hospitals of much consequence. Probably when the eagerness of the Spaniard for amphitheatres for the bull-fight has diminished, and the necessity for the development of charity dawns upon him, he may see how little progress he has made in paths of benevolence and reform compared with his neighbour across the Pyrenees. It is an undeniable fact, and one that may well cause the Spaniard to meditate, that the budget for the maintenance of the Parisian hospitals is alone equal in amount to that allowed by the Spanish Administration for all the hospitals and reunions throughout Spain. First in importance comes the Princess's Hospital, Madrid, which was constructed after the plan of Lariboisière, and gives the aspect of a quadrilateral. It is composed of eight pavilions, four at each side, which are completely isolated by six lateral courts communicating by a covered gallery. Each pavilion consists of a ground floor and one storey, both of which are destined for the sick. It contains sixteen wards with twenty beds, and one ward with twenty-four. The dimensions of a ward are $35\frac{1}{2}$ feet long, 21 feet broad, and $14\frac{1}{2}$ feet high. Thus each patient is allowed the small amount of 500 cubic feet, which

is utterly insufficient. In all there are between 300 and 350 beds. It is in many respects much superior to the older building, the General Hospital of Madrid, which was reared in 1788 to contain 1800 beds. It is a striking contrast to the former. It is a vast quadrilateral, formed of lofty blocks five storeys high, and grouped round a central court. As might be expected, the hygienic conditions are far from satisfactory. This is the kind of tenement of which Sir James Simpson had a horror.

The plans of two hospitals, for Huelva and Rio Tinto, one to contain twenty beds, and the other forty, have been drawn out and, I believe, approved of by the Board of Directors in London of the Tinto Copper Mining Company. In summer, the heat being intense and the light very powerful, precautions had to be taken which would insure that the sick should not suffer from either. I drew out a ground plan and front façade of an hospital, which I thought would meet the necessities of the climate. To modify the light and heat the verandah, which surrounds nearly three sides of the ward, as shown in the plans, may at times be converted into a corridor by lowering screens made of grass or wicker-work. In this corridor the patients may walk about and amuse themselves during the hottest hours of the day. Damp and heat may be effectually avoided by constructing the walls and roofs double, with a free passage for air between them. When these hospitals are constructed, it is to be hoped that

the Spanish authorities will take a lesson from them. It was Dr. Mackay, the medical officer of the Tinto Company, who made known the necessity for these hospitals to meet the wants of the town and mining district. Here, as in every hot climate, the hospital will be built on raised arches, and thus free ventilation will be secured in the basement.

THE HOSPITALS OF RUSSIA.

Russian hospitals are on a par with those of Spain. With reference to those in existence little is known, and that little is not worthy of much attention. The want of cohesion and good feeling is a barrier to the erection of such charities. In this country the stagnation of sanitary science is painfully evident, from the havoc which epidemics of plague and pest bring about in their not unfrequent visitations to provinces where hygiene is all but unknown. In reading a description of St. Mary's Hospital in the Russian capital, I was so much amused with the following strangely mysterious and superstitious paragraph that I reproduce it. "When there is any uncertainty about the death of a patient, the cadaver of the unfortunate is put into a chamber comfortably heated and provided with all the appliances necessary in cases of asphyxia. To the digits (fingers and toes) of the dead twenty threads of silk are attached, and to these again a string communicates with a lever in such a way that the slightest

motion of the body (the *rigor mortis*) or extremities of the patient reputed dead will be sufficient, by this arrangement, to put in play a chime of bells destined to awaken and warn those who are watching to do the work of resuscitation."

CHAPTER VI.

AERATION — VENTILATION.

THE subject of ventilation is one which I approach with much diffidence. After having carefully examined the different systems, some of them complicated enough, and seen them in operation, I obtained little satisfaction. Opinions, for which no precise data can be given, are abundant; but when one comes to ask how much fresh air is introduced into the ward in an hour, how well it is distributed, and what is the cost and what the mortality, positive and reliable information is not forthcoming. In the city of Paris valuable experiments have been made with the view of settling with scientific precision some of those debatable questions about the ventilation of hospital wards. These experiments were made, not by adopting one uniform system for the entire range of pavilions, but by the employment of different methods in different wards, and by a comparison of results and cost until an approximate value of each method was obtained. The aeration and natural ventilation of the wards depend in a great measure on the plan after which the blocks have been constructed. It is to give abundance of light and air that in our day the pavilion system has been adopted. It is absolutely necessary that the wards be surrounded by an atmosphere pure and free. It is equally necessary

that the rays of the sun find easy access—a condition indispensable to the salubrity of hospitals. Intensity of sunlight may in warm climes become intolerable unless modified by blinds ; in ours there is no chance of suffering from excess of light. That patients bear light and heat much better than cold was strikingly exemplified by the brilliant success of Dr. Larrey in Egypt under a tropical sun.

Taking the case of a ward of standard dimensions, in which each patient is allowed 1500-2500 cubic feet space, in which the windows are opposite and relatively large, and in which the outlets, and inlets, and fire-places are properly situated—the question may be asked. by what best means is the atmosphere of this ward, which is rendered impure by carbonic acid and the emanations from the sick, to be kept sweet, the temperature uniform, and the index of the hygrometer midway between dryness and moisture ? On a satisfactory solution of this intricate question depend, says Miss Nightingale, “the purity of the ward, the recovery or death of the sick, the usefulness or injury arising from the hospitals, the duration of cases ; whether, in short, an hospital planned, erected, and supported by voluntary contribution, is to be a blessing or a curse to civilization.”

Is natural ventilation sufficient ? or are we forced to call in the assistance of artificial means ? Were I to state my own opinion, as formed from my experience in the Hertford Hospital and other Parisian hospitals, it would be given in favour of a

combination of natural and artificial, although at the same time I am conscious that until recently the mere mention of the latter in Britain would have been considered almost criminal.

The principle which should regulate the ventilation of hospitals was propounded in 1785 by Lavoisier, who estimated that a man consumed five cubic feet of air per hour. (*Vide* Lavoisier "*Memoires de la Société Royale de Médecine*," p. 572.) The principles he then enunciated, although adopted by the Academy of Sciences, were not at the time acted upon: for we find that some of the members of this body, among others Tenon and Bailly, while deploring the insalubrity of the French hospitals, made reference to the English hospitals which they visited, where it was the custom to renew the air by simple ventilation. After their visit to England the question of ventilation was taken up in France.

I have inclined towards a combination of natural and artificial after the experiences of a trying winter, at the commencement of which it was impossible to bring the temperature of the wards above 9° C. (Fahr. 48·2°) by means of fireplaces. When the calorifier on the basement story was put into requisition unseen difficulties arose. The blasts of heated air entering the wards near the patients' beds (*vide d*, Plate IV.) became inconvenient, and produced an offensive and overheated atmosphere, the temperature at times mounting as high as 21° C. (Fahr. 70°). The system was not, however, to be

condemned without giving it a fair trial, and ascertaining the reason of the close and impure state of the ward atmosphere, which produced erysipelas in the only surgical case then in the female ward. Dr. Herbert, the physician on duty, was much annoyed that erysipelas should have broken out *de novo* in wards so elegantly constructed, and with such an excellent ventilation. The cause was not far to seek. The system of ventilation and heating was new to those who were intrusted with its management, and little or no attention was paid to the windows, and the heated air was permitted to enter the wards *ad libitum*. The question of the ventilation was gone into, and at the suggestion of Dr. Herbert I drew up a ventilation chart, on which was recorded every three hours, by the night and day nurses, the temperature, the windows and heat-valves opened, and indications of the hygrometer with which each ward was supplied. This proceeding had the effect of causing due attention to be paid to the windows, the heat-valves being closed or opened according to necessity — the necessity being indicated by the temperature, which varied from 15-17° C. (60-64 Fahr.). The windows were opened daily, and a cross ventilation always went on. The impure air was principally removed by this cross ventilation, and to a less degree by the extraction shafts situated in the lateral walls. (*Vide* i., Plate IV.) The position of the entrance to the shaft seemed to me an objection, and this leads me to speak of carbonic

acid, which some authorities do not consider the dangerous impurity to be got rid of by ventilation. Were the truth of this established, I can readily see why the inlets to the extraction shaft should be so near the ward floor; but believing that where there is much carbonic acid there are other impurities of a deadly character, whose quantity it is difficult to estimate, and whose weight is so slightly heavier than the air that the feeblest current carries them upwards, there can be no question that the point of discharge of the foul-air shafts should be above the patients, not only on account of the rapid ascent of the heated respired air, but also because patients lying in bed propel it upwards. While agreeing with those who believe that the most dangerous impurity is a particulate or dust, which settles upon wounds and produces erysipelas, &c., I am not blind to the dangers of the gas, which in a short time produces malaise, headache, lassitude, and a stifling sensation. Like the imponderable dust, this carbonic acid is to be found everywhere, but especially in the higher strata; and this I ascertained by exhausting a bottle and allowing it to fill with the air collected in the higher regions, the temperature of which was also taken. I used the simple lime-water test, and the milkiness was decidedly more marked in the air taken from near the ceiling, than that taken from the floor. The examination of the air, I may state, was made at midnight with every window, door, and orifice closed. The index of the hygrometer varied

little. That carbonic acid passed up the extraction shaft in considerable quantities there was no doubt; for on placing in the centre of the shaft a piece of litmus paper dipped in distilled water, the blue colour had assumed a distinct red. The air is set in motion at night by a Bunsen burner. It is a pity that this particulate or dust cannot be handled more effectually. Of its danger there can be no exaggeration. It can only be rendered harmless by the free admission of pure air, in quantities of not less than 3000 cubic feet per head per hour, and by flooding the ward with sunlight. Dr. John Sutherland believes that 4500 cubic feet per head per hour must be allowed when there are many bad cases, and especially surgical cases with open wounds. We can only satisfy ourselves regarding these points by a careful observation with the anemometer and thermometer, and by an air analysis. An accurate record of the results would be of much more value than any number of assertions that an hospital is ill or well ventilated. Until recently, the gas consumed in hospitals for the purposes of lighting was no small factor in rendering the air impure, by using up the oxygen and producing carbonic acid and oxide, and raising the temperature. This is obviated now-a-days by the ventilating globe-lights, from which ventilating tubes lead into the foul air flues or chimney.

By natural ventilation, I mean the continual action of natural forces purifying the atmosphere

from the pulmonary and cutaneous exhalations of men, from the products of combustion, and from the effluvia which proceed from the person and discharges of the sick. Little requires to be said concerning this excellent method of ventilation, as it is free from all the complexities and intricacies that surround artificial ventilation. This system has been put on fair trial in Britain, but in some cases has not been found sufficient; and hence the application of artificial means in some of our city hospitals, in all cases, however, as an auxiliary. In temperate climates natural ventilation, with the powers of extraction available by utilizing the sources of warming and lighting, is the best for hospitals. In warm climates these means do not suffice.

The natural forces which I have referred to are:—

1. *Diffusion of gases.*—As a purifying agency its power is insufficient.

2. *Movements of the air produced by inequalities in temperature.*—Bearing in mind that air undergoes a certain expansion or contraction according as it is heated or cooled, and as the warm internal air is lighter than the cold external air, a constant interchange takes place through every chink of window or door, and through the special inlets or outlets. The amount of fresh air entering in this way is not inconsiderable, for experiment has shown that by placing anemometers in the open windows to measure the quantity entering, and in the chimney and flues the quantity making its egress, it was found that six

times as much air passed by the anemometers in the flues as entered by those in the windows. These means will alone suffice to ventilate wards, the air of which is hotter than the external air, but they will not answer when the air requiring renewal is equal to, or colder than, the internal air. Hence it is inapplicable and unreliable in hot climates.

3. *Perflating and aspirating action of the wind.*—*Perflation* takes place by opposite windows, and this is the best means that can be adopted for the speedy and efficient removal of impurities. In calm still weather this agency is almost *nil*, and in gales it becomes unbearable in consequence of the drafts produced. *The aspirating action of the wind* is further seen in the exhaustion of the air contained in shafts and chimneys, thus creating a vacuum, which is replenished by air from below. The mechanical arrangements invented to permit of the wind causing an up current and preventing down draughts are numerous. Of these I may mention the use of movable cowls turning from the wind, and special forms of covering. The best illustration of perflation and aspiration would be when the wind blows down a shaft to the basement, where, if necessary it is heated by a cockle stove, passes into the wards, and escapes by openings in the ceiling leading to shafts covered by cowls turning from the wind. This method, however, would only be applicable to pavilions of one storey.

The size and position of special inlets and outlets

are matters of detail. The entering air may be warmed when necessary in different ways, in the inlet shafts. Perhaps the most simple of all is the following. There are openings made in the floor or in the wall close to the floor, communicating with the outside by the direct conductors which traverse the wall. Similar openings exist near the ceiling. The cold air enters, heated only in winter by hot water, circulating in pipes under the sill, afterwards ascending and escaping by the superior outlets. This is the system generally applied in pavilion barracks. Another equally simple method, different from the preceding, gives good results in winter. The air enters by canals into a chamber which surrounds the "poêles" or Böhm stoves of Germany, where it is heated and escapes into the ward by openings in the sheath, after which it mounts in virtue of its higher temperature, falls down as it cools, and disperses itself all over the wards. This system has been installed in the hospital barracks of the United States and France.

The quantity of fresh air introduced by the windows is out of all proportion to the amount obtained by the most powerful ventilating apparatus. Sarazin illustrates the truth of this by assuming that 10 metres of air enter per minute by a window 1.5 metres broad, and 3 metres high. The amount of cubic air which enters is equal to $1.5 \times 3 \times 4 = 45$. In one hour this amount would swell to 2700 metres, and if six windows were

opened 16,200 cubic metres of air—a quantity much in excess of that obtained by any ventilating apparatus. But natural ventilation has its drawbacks, and one of the most serious is the rapid lowering of the temperature in winter. Natural ventilation, if it has its admirers in England, is not without its detractors in France, where a mania may be said to exist for artificial methods. In the latter country physicians and surgeons, confident in the system of artificial ventilation, dazzled by the figures 50, 80, 100 cubic metres per head per hour, have not only neglected natural ventilation, but considered the system productive of many evils. In natural ventilation the position and size of the windows, and the method of opening and shutting them are of great importance. Sarazin recommends windows 13 feet high, and reaching to within 2 feet of the ground, and divided into two or three compartments—a suggestion which the French have not adopted. The old system of having the windows 9 feet from the ground, to prevent currents from establishing themselves at the level of the beds, was a useless and hurtful precaution on the part of those who knew no better. Sarazin has truly said regarding this system, “Nothing is so sad as hospitals where the windows are elevated above the height of a man. The sick, like the prisoner, who can only see his cell wall and the sky (sometimes not even the latter), feel separated from the world and brood over the miseries which surround them.”

Artificial ventilation may be said to have its birth and stronghold in France. Desaguliers, in 1734, was the first to propose ventilation by propulsion. English authorities look upon the system as a "*pis aller*," and consider it only necessary in badly constructed hospitals.

In France the systems in use at the large hospitals are the following:—(a) *System of Duvoir*—that of extraction. (b) *System Thomas et Laurens*—that of propulsion. (c) *System Van Hecke*—also that of propulsion. The first system was first employed in France in 1846 at the Beaujon Hospital. As soon as it became known, the administration came to terms with the inventor, and in the same year his double apparatus of heating and ventilation was applied to this hospital, where it soon became an object of study for the Parisian *savants*. The erection of Lariboisière later on gave the administration an opportunity of renewing their experiments, and they decided on the simultaneous application of the first and second systems, which gave the best guarantees of success. This was done with the following results:—

System First.—30 cubic metres per head per hour.

System Second.—90 cubic metres per head per hour.

In 1860 one or other of the systems was in operation in all the Parisian hospitals. In each the vitiated air leaves by flues arranged at the height of the lateral walls and leading above the roof, whilst the

pure air enters by the horizontal shafts placed in the centre of the floor. In the Duvoir system the vitiated air is removed by the vertical canals, united in a flue in which is placed pipes of hot water. The pure air enters by the horizontal shafts. In the systems Thomas et Laurens and Van Hecke the pure air, introduced by propulsion, forces the impure air to ascend and escape by the vertical flues.

In the Duvoir system the heat necessary for the wards and extraction flues is obtained by a continuous circulation of hot water through pipes. The water heated on the basements mounts through two spiral tubes in a shaft to the reservoirs of each storey, and after circulating in the wards through coils of piping returns to its source—the boiler. The warming, as well as the ventilation, is accomplished by this method, which is in use in Lariboisière (one-half) and the Palais de Justice. It is also employed in the Circuit Court-house in Glasgow; but those who have occasion to sit there as medical witnesses for a whole day, can scarcely consider it a success if purity of the atmosphere is to be considered the test of its efficiency. But perhaps it is hardly fair to speak disparagingly of this system while the windows and the inlets may be, and very possibly are, neglected.

In the Thomas et Laurens system the propelling fan, which is of much greater dimensions than the Van Hecke one, is worked by powerful engines

capable of supplying more than 4000 cubic feet per head per hour.

In the Van Hecke system a fan, worked by an engine, forces the air into small chambers in the basement, where it is warmed by cockle stoves, and then ascends into the wards. It is in use at the Hôpital Necker.

The above three systems give the following comparative figures (Sarazin, p. 738):—

Systems.	Quantity of air renewed per hour per bed.		Cost of 1st installation per bed.	Annual cost per bed.
	Cub. met.	Cub. ft.		
Duvoir,	30	= 1000	£15	£2 0
Thomas et Laurens, ...	90	= 3000	£32	£4 0
Van Hecke,	97	= 3300	£9	£0 19

General Morin gave his testimony in favour of the first system. The opinions of two other distinguished French authorities, Pécelet and Grassi, were given in favour of the second system. The second and third systems differ as to the level from which fresh air is taken. Angiboust, in his *Memoire sur le Chauffage et la Ventilation des Hôpitaux*, pp. 312 and 315, says:—"A point discussed but not decided in spite of its fundamental importance is the situation from which the fresh air is drawn." In the Duvoir system the fresh air inlets are placed at the level of the ward floors; in the Thomas et Laurens system the air for the wards is taken from a considerable height by means of an engine; in the Van Hecke system it is taken from beneath the ground floor. Angiboust set himself to ascertain whether the air

became purer as we ascend, and he came to the conclusion that more carbonic acid existed in the air near the ground than higher up. He says, "The miasms floating in the air comport themselves like carbonic acid," and he adds that "the ozone is more abundant in higher regions than near the ground." The fact that the air is purer in the higher regions is an argument in favour of propulsion. Other *savants* took up the question in favour of natural ventilation. The opinion of Dr. Larrey will be found in his work *Notice sur l'Hygiène des Hôpitaux Militaires*, 1862, pp. 26, 27. He says, "Ingenious as the different systems are, they do not seem up to the present to have produced a sensible influence in the mortality. The system of aeration, presumed to be one of the best, that employed at Lariboisière, does not remove from that beautiful hospital erysipelas, diphtheria, and puerperal fever." . . . "The aeration natural by opposite windows is the most simple and the most easy to employ, and the heat obtained by fireplaces."

Ventilation by Propulsion and Ventilation by Extraction are thus the two systems at present in operation in Paris. I examined carefully that in operation at the Hôtel-Dieu and Hôpital Tenon. In the former the air was sucked through an underground tunnel by a powerful engine from the banks of the Seine, a distance of 60 yards. Before being forced up the shaft by which it reached the wards,

it was drawn through a wire gate lined with a thick sheet of moistened wadding. When I examined this sheet there was a thick coating of filth attached, showing that air supposed to be pure carries with it impurities requiring filtration. The air forced up came in contact with pipes heated by vapour, and in this way it was warmed in winter before entering the wards, which it did by three large circular pillars situated at equal distances in the centre of the ward floor, and perforated on their upper surface. The heated air could easily be perceived by placing the hand on the upper surface, or laying a light object there. The foul-air outlets were scattered near the floor and ceiling, and the exhaustion went on by means of hot pipes in the extracting chimney, which was situated in the middle above the roof of each pavilion. So far as I know, this system seems to have worked satisfactorily. It is in use in some of the large English prisons. The heating of the air was found to be necessary in winter to maintain a uniform temperature; but this should not prevent the employment of the valuable ventilation obtained by opposite windows.

Two systems of ventilation by extraction will be found in Figs. 1 and 2, Plate II., after Morin. Fig. 1, the source of heat is in a chimney or tower above, and the velocity of the current in the ascending tubes is in proportion to the heat developed. The air leaves the wards by the openings at the floor level. With the same quantity of heat the amount

of air aspired augments with the height and with the surface of section of the chimney (*vide* Russell's "Sanitary Houses," p. 55). Fig. 2, into a tube which has the form of a siphon reversed, the source of heat being placed as low as possible, the air first descends into the short branch and finally ascends into the larger, which has at its base a heat-generating apparatus. The ventilation of the General Prison at Perth is carried on in this way. Morin names the two systems, *Ventilation par appel en contre haut*, and *en contre bas*. In the Hôpital Vincennes the two systems of aspiration are in use, and furnish nearly equal results. By these methods, while the heat is sufficient, 70 cubic metres, or over 2000 cubic feet, are supplied to each bed per hour. The heated air enters the ward by openings in the ceiling, and then descends. It is aspired by the chimney after it has done its work. Sarazin, comparing the results of the system of Morin with the ventilators of Watson, Arnott, Muir, and Mackinnell, believes they are superior, though at the same time they are much more costly.

The following objections to extraction by fire and hot-air shafts occur to me:—1. The danger under certain conditions of wind and temperature, of the draught in the chimney being checked, and regurgitation taking place. 2. The impossibility of properly controlling the places where fresh air enters. 3. The inequality of the draught.—As to the cost and

success of aspirating chimneys, positive data is not obtainable at present. One essential point in all these systems is to have the flues large and numerous, and especially those for ingress of fresh air. Air moving at the rate of 1·2 feet per second causes no perceptible current (*vide* Parkes' Table).

The advantages of propulsion appear to me to be—1. The air is taken from the most favourable situation, and far from the openings of the foul-air shafts; 2. In summer, when the heat is overwhelming, this system permits of a sensible diminution of the heat, at times intolerable, and thus ameliorates to a great extent the impure state of the atmosphere. In the hospitals of Necker, Beaujon, and Lariboisière it has given good results—though perhaps not altogether what were anticipated, which is generally the case when too much is expected. One thing is certain, that it can do in summer in warm climates what no amount of windows can do—viz., introduce air having a temperature much lower than that in the ward. This refrigeration is not to be underestimated. The lowering of the air in warm climates is produced by the following methods:—

1. The air by a mechanical action is compressed and expands at the moment of entrance, but this would require a horse power of ·8 per bed.

2. The air is cooled in summer by making it pass over water, and take up moisture.

3. The air is made to circulate in conductors cooled by ice. This system would require so much

ice as to render it undesirable from an economical point of view.

4. The air is made to pass through subterranean channels in which the temperature is almost constantly equal to the mean temperature of the surface of the earth.

The expense has been a strong objection to the introduction of this system into English hospitals. In France the objections are the costliness of the system, and the want of appreciable diminution in the mortalities since its adoption. The latter is not a fair objection, as the system of overcrowding prevalent there, would undo the effects of the best ventilation. So far as the propulsion of fresh air is concerned it will always remain costly, but the satisfactory results obtained should make the question of cost a matter of secondary importance. As regards the aspirating chimney, which works day and night, the waste heat from the furnaces is utilized as the motor power. A uniform system for each country is out of the question. What is suitable in France, Italy, Spain, &c.—viz., the propulsion of cooled air in summer—is unnecessary in our insular climate.

HEATING.

After the discussion and examination of the question of ventilation, the heating of the wards is simplified, as the apparatus just reviewed is destined for that as well as for the ventilation. In England

and the United States heat is principally obtained by the direct radiation from fires, which method is considered by its partisans as very much superior to the indirect radiation obtained by passing fresh air over coils of pipe containing hot water. They must be reminded when desirous to heat economically that 88 per cent. of the heat generated by fire-places is lost, and that the temperature varies considerably in different parts of a ward of ordinary dimensions. In Germany the heating is obtained by *grand poêles de faience*. They are objectionable because they use up the ward air, and diminish its respiratory quality, and produce carbonic acid and oxide. The calorifère of Duvoir-Leblanc (combining heat and ventilation) is composed of a powerful engine, a complete circuit of tubing, and reservoirs at each storey. By this means there is no chance of overheating, or communicating any noxious property to the air. Equal volumes of vapour contain 288 times less heat than water elevated to the same temperature, and thus the method of heating by vapour permits of a sudden falling of the temperature. This drawback is obviated by combining the water and vapour in the following manner:—The vapour tubes terminate, like a worm, in a tank of water, which is heated, and is afterwards conducted by pipes to a reservoir, where it condenses (Apparatus of Grouvelle at Vincennes). The calorifère used in the Hertford Hospital has given complete satisfaction as to its capacity for giving warmth during a severe and

trying winter. The air is heated in a furnace on the basement, and passes by shafts into the wards. The danger of this system is, and there is some truth in it, that the air is rendered too dry, and deprived of its ozone, while carbonic acid and oxide pass through the furnace uneffected.

LIGHT.

It may be taken for granted that persons of intelligence are fully alive to the importance of this element, whose hygienic value it is scarcely possible to overestimate. But it is certain that by not a few human beings it is not held in high esteem, if one may judge from the dwellings and *personnel* of the lower orders. I have witnessed, as who among medical men has not? the terrible effects of the want of it in dispensary practice among the "great unwashed," and in the ophthalmic clinics, where cases of phlyctenular and interstitial keratitis abounded, and where in many instances sight was lost, or the imprints of disease left for a lifetime. The Italian proverb only spoke the truth when it told us that "where the sun does not come in the doctor will." The free admission of light is always beneficial to health and cheerful to the sick. Without it and pure air, and they always go hand in hand, people may drag on a feeble existence when they work or sleep in a tainted atmosphere; but they die much earlier, and have no real enjoyment of their shortened lives. What medical man on his errand of mercy has

traversed the crowded streets and alleys of our large cities, and burrowed his way into the dark places where disease is carrying everything its own way, and has not experienced a feeling of sadness in thinking that the occupants are living in tenements from which the essentials to life, in abundance overhead, and striving to gain admission through chinks blocked up with filth, are excluded. It is not to be wondered at that such localities, with their labyrinth-like tenements, are the fertile springs of crime, disease, and death. Everything around is depressing; mind and body suffer alike. It is a well-known fact that light is a powerful antagonist of organic matter. Every ward, every lavatory, and every closet should be flooded with sunlight, if in our new and better hospitals we do not wish to be visited by diseases that executed havoc in former days in badly constructed barracks, prisons, and hospitals. The influence which this element exercises in the material universe is wonderful. Without it all life would die. Without it no plant can thrive, and surely man, the highest and most complex organism created, can ill spare that which is so absolutely necessary for his physical and mental development. The pale, blanched, sickly visages of those who live in the dark, obscure dwellings of our cities tell their own tale. There are good grounds for thinking that the want of sufficient light is one of the main causes of the deviation in the spine and limbs of children predisposed to scrofula, for which

there is no better therapeutic remedy than plenty of fresh air and exposure to the sunlight. It is therefore the bounden duty of those intrusted with hospital architecture, to dispose their plans so that this life-giving element, coming from the fountain of all life, will find its way into every corner and recess from which it alone can chase away every form of corruption and filth, which have a vested interest in darkness. Illustration upon illustration might be given of the disastrous effects traceable to the want of this element. It is recorded that the continuous and intense darkness of an Arctic winter cast a gloom over the brilliant expedition of Dr. Kane. The want of sunlight caused great depression to the members of the expedition. The amount of disease, misery, and destitution bred in those labyrinth-like tenements still to be found in most cities is incalculable. It is to be feared that much reform need not be expected until the Public Health Act is amended, and more stringent rules laid down.

Naturalists tell us that in the depths of the ocean, where everlasting darkness reigns, the forms of life found there are destitute of the colouring which may be seen in those near the surface, whose life and growth are influenced by light. Every medical man knows the cause of the anæmia and accompanying enfeebled vitality common among miners, who spend so much of their time in the bowels of the earth.

The scientific inquiries of Tyndall and Pasteur,

the eminent Parisian investigator, have fully established the value of this element. Than these, no living scientists know more about the air and its contents, normal and abnormal. The results of the experiments of Pasteur on the rapid production of bacteria in the dark, are well worthy of reproduction, if they did but serve to remind the hospital architects that hospitals should be so planned and constructed as to admit abundance of light, especially when it is remembered that we live in a region where the sun is often obscured, and pass through seasons, when there only remains to us a short-lived twilight. He showed very clearly that these minute organisms—the enemies of life and health—might be absolutely killed by sunlight; and further, that this hygienic influence was in proportion to its duration and intensity, being most powerful in direct, but still distinct in diffused or indirect sunlight.

Professor Tyndall has made even more of the "dust" than Pasteur. He has shown by a series of brilliant experiments that the air is loaded with impalpable particles, which are composed of a heterogeneous mixture of dead matter and living germs. In a darkened room, ward, or closet these disease germs are pushed into the virulent energy of reproduction. How important, then, must be the hygienic value of sunlight.

CHAPTER VII.

HOSPITAL HYGIENE.

WHEN it is remembered that hospital hygiene can only be secured in structures planned and executed in accordance with the most modern views of engineering skill, expressed in the preceding chapters, it follows that hospitals badly constructed, badly ventilated and lighted, must be more or less unhealthy. There can be no denial of the fact that bad hospitals increase the mortality, prolong the residence of the patient, delay the recovery, and thus waste the resources of the charity. No stronger indictment than this can be served upon those who participate in the perpetuation of buildings insalubrious from their situation or internal arrangement. To a hospital with a high death-rate a stigma always attaches. An attenuating fund is a serious outlook for governors or managers, who are finding by yearly experience that, while the cost per bed is increasing, the public subscriptions necessary to meet it are diminishing. Hence it will be found that a good hospital, though of costly construction, is cheaper in the long run. I regret that I am not in a position to support these statements by truthful and reliable figures, because positive data as to the effects of different plans upon the health of the inmates cannot be obtained, except in special and

aggravated cases. The absence of figures will not, however, alter a fact known to every one, that if bad hygienic surroundings are prejudicial to good health—how much more so to lives enfeebled by disease. As a rule, those who claim to speak with the voice of authority consider the systems with which they are most familiar the best. The mortality statistics of hospitals are in the meantime not of the immense value which some people attach to them, since the character of cases varies so much, and since, in the hands of not a few, figures are capable of manipulation amounting to positive distortion, and the whole truth is sometimes withheld in consequence of failure to record many facts which have a bearing on the cases. If any value is to be attached to statistics as an evidence of hospital salubrity, we must look to surgical rather than medical results. Even surgical figures are so fenced round by extenuating circumstances to account for death, that they cannot be absolutely relied on. In either class of cases many difficulties prevent one from arriving at a safe conclusion; but for obvious reasons, in medical cases much more than in surgical. Were I to take the unsupported testimony of Miss Nightingale, who has known of hospitals the atmosphere of which was so foul that she believed “the sick were suffering from something quite other than the disease inscribed on their bed-ticket,” the problem would be solved. Doubtless there were hospitals in existence at that time, where the invisible inhabitants of

their foul atmospheres did a thriving trade among afflicted humanity. I have seen one such myself at Versailles, presenting all the defects of a collapsed French hospital. Since the science of hygiene has forced itself on the minds of physicians, and attracted public attention, such institutions no longer remain to cumber the ground, but are replaced by edifices worthy of the science that razed their predecessors, and worthy of the best sanitary skill. The hygiene of hospitals can only be secured by obtaining a good site and construction, by attention to ventilation, water supply, and drainage; in short, attention to all those well-known measures necessary for the prevention of disease. The science of hygiene, although not so ancient as that of therapeutics, has in its short life accomplished much lasting good on behalf of humanity, and nowhere more than in the capital of France, where it has been highly appreciated. Were it a science venerable with years, we would not have to record the fearful havoc which diseases, to a great extent preventible, engendered and fostered by filth, have produced in Britain, France, Spain, and Russia from centuries back to within a very short period—diseases which were as truly the product of a blind negligence of sanitary laws as effects are of their causes. Happily for those countries which have taken up the question of hospital hygiene, we are not appalled by the visits of those terrible scourges that at times have almost swept clean our wards. Their complete

extinction is now well-nigh an accomplished fact. To procure this desirable victory over a concealed enemy, architects and sanitary authorities have performed their duty ; but in many instances those who are intrusted to keep the wards pure and wholesome fail to carry out the instructions given them, and this negligence may probably account for a higher mortality in the new Lariboisière than in the old hospital of St. Louis, and the prevalence of pyæmia and erysipelas in good hospitals, in which, if properly managed, they should never gain a footing.

It is my belief that ward hygiene can only be obtained where the wards are of dimensions that will permit of a superficial area of not less than ninety feet, and a cubic space of not less than 2000 cubic feet per bed when the distance between the beds (which should on no account be enveloped in curtains) is not less than four feet, and when the windows are large enough and in their proper places, and the means for renewing the atmosphere of the ward satisfactorily tested. The position of the water closets is of much significance, and should, if possible, have no direct communication with the ward, but should be separated by a corridor, as is the case in the Baltimore Hospital, the Hertford British Hospital, and Blackburn Infirmary. When they are situated in the angles at the remote end of a ward, as in the new Edinburgh Royal Infirmary, the chamber in which the closet and urinal is situated should be so thoroughly ventilated as to

prevent the possibility of the return of foul stenches or insidious germs.

I come now to inquire what are, and what have been the principal causes of hospital insalubrity—in short, of the impurities in the ward air. The most important, because the most dangerous, are the impurities of respiration, the exhalations from the bodies, and the effluvia from discharged excretions when these are passed in the bedding or movable chair. From these sources a large quantity of organic matter passes into the ward atmosphere, and it is beyond question the main cause of the *sui generis* ward odour, one perceives on passing into it from the fresh air. This odour, which must always to a slight extent remain, can only be appreciably diminished by having the sick in wards whose walls and floor admit of periodical cleansing. In this way all fermentative processes in those situations are checked. One authority makes light of the danger of carbonic acid, and considers it as nothing more than the “bogey” or bugbear of popular lectures on ventilation, and not the dangerous impurity most people rightly believe it to be. If it is not the specific danger of hospitals, this much may be said that it does not exist in any inclosed space without leaving its mark upon the inmates, who are inspiring it in quantities above the normal. Enfeebled health, paleness, and anæmia are the sure sequelae of an atmosphere charged with it. There can be no doubt that the solid particles suspended

in the air are the real source of danger; although, as a rule, it may be taken for granted that the solid and gaseous go hand in hand, and where you find the one there you find the other. The transmission of a ray of light through a dark room, or an electric beam through a tube, leaves no doubt as to the composition of the air. Those minute solid particles consist of skin epidermis, nucleated epithelium from the mouth and air passages, pus cells from the discharges of wounds and abscesses, and from the expectoration of phthisical patients and minute bodies (*sphæro bacteria*), which originate from and thrive upon the organic matter. To these must be added the specific germs that are the cause of pyæmia, &c., and the *contagia* of specific diseases—*e.g.*, small-pox, scarlet fever, measles, and typhus; and there are strong reasons for believing that there is a direct transference from body to body of cells undergoing special vital and chemical changes. For a time doubt existed as to the possibility of pus cells taking a share in the impurity, until Broca, the distinguished physiologist and anthropologist, dispelled such doubts by his discovery of pus on the grimy walls of a Parisian hospital. We have abundant evidence that in wards with pustular and granular ophthalmia, these diseases are propagated by the passage into the atmosphere of disintegrating pus and putrifying matter. Thus these molecular particles—living or dead organisms—are considered to be true infecting agents, conveyed to the surface of

wounds or inhaled by the breath. Tyndall has, by his beautiful experiment, conclusively shown that a great portion of the suspended matter is organic. The amount is so great under a powerful beam of electric light that the air appears a semi-solid rather than a gas. Just as the epithelium or skin drift of desquamative scarlatina or the scab of small-pox pustules is infectious, so are the emanations from erysipelas, pyæmia, and hospital gangrene. From these latter originate the germs which were the scourges of our hospitals—alike the evidence and measure of their insalubrity—scourges which continued to spread their malignant shadow over the patients like a upas tree, until better hospitals and an abundant supply of fresh air had banished them from our midst, so that they no longer were a source of anxiety to the surgeon. In addition, the air is contaminated by carbonic oxide, sulphuretted hydrogen, and the impurities resulting from the combustion of gas. The latter danger does not now exist, as the impurities generated in this way are removed by a special ventilating tube, which runs into a foul-air shaft. If in every ward in our more recent hospitals where there is an aggregation of sick all these impurities—save the specific germs of pyæmia which are induced by the former—exist to some extent; surely in badly ventilated and over-crowded wards they must be multiplied tenfold. How great is the necessity for ventilation to remove or dilute and oxidize the poison, and to effect

this "4000 cubic feet per hour will not be found to be far below the proper amount for the acute and febrile diseases" (Parkes, p. 353). Erichsen, with all the authority that attaches to his name and utterances, states that "the ratio of wounded to the size of a given ward may be calculated, and if it exceed a certain proportion, infection of wounds will be induced, and their occurrence may with absolute certainty be predicted." The same authority gives, by extracts taken from the reports of four Metropolitan hospitals up to 1871, an idea of the influence which bad hygienic surroundings had on the rate of mortality. In 187 primary amputations 90 or 48·6 per cent. died, and of these deaths 21 occurred from shock and 30 from pyæmia. In 84 secondary amputations 50 or 59·5 per cent. died, and of these only 3 perished from shock, whilst 22 were the victims of pyæmia. In 350 amputations for disease 98 or 27·4 per cent. died, and of these none were destroyed by shock, but 34 by pyæmia. Moreover, in the Crimea the rate of mortality after primary was 15 per cent. against 41 per cent. after secondary amputations. In the large city hospitals of Great Britain the rate of mortality after amputation of all limbs up to a recent period was 1 in 3. In Paris matters were even worse. Out of 1656 amputations, the statistics of which were collected by Malgaigne and Trelát, and recorded by Sir James Simpson, 803 died, or nearly 1 in 2. The Government statistics collected by Bristowe and Holmes

show that in 1861 the amputation death-rate in Parisian hospitals was 3 in 5. Germany could produce no more encouraging statistics, the death-rate sometimes mounting as high. Figures like these require no further comment; they are painfully clear proofs of the necessity for those sweeping changes in our hospital system that have not come about a day too soon. Taking into consideration their absolute accuracy, they prove incontestably that the secondary operations were not fatal from shock and hæmorrhage like the primary, but from that scourge which still lurks in badly constructed and ill ventilated hospitals—pyæmia with visceral complication. Erichsen came to the conclusion that the mortality after amputations is influenced more directly than that of any other operation, except perhaps ovariectomy, by the hygienic conditions to which the patient is subjected after the operation. A mortality of 40 per cent. was what might be reasonably expected in any circumstances, but recent experience in improved hospitals has produced much better results, and considerably lowered the death-rate. As a proof that the hospital miasm, which has produced at times so much consternation and anxiety among surgeons, is no chimera, but a living, formidable enemy, capable of multiplying his forces more rapidly than any nation, and executing more havoc than modern engines of warfare, I cite the statistics collected by Sir James Simpson (*Edinburgh Medical Journal*, June, 1869), of 2098 amputations of all

kinds in country and private practice in towns where 1 in 9 died, whilst of an equal number performed in large city hospitals of Great Britain 1 in 2 died. These suggestive figures require no comment. It is subject for congratulation that mortalities such as those cited are only to be found in the records of the past, as by the adoption of good hospitals, with airy and well-ventilated wards, this insidious enemy has been forced to surrender, and now we know for a fact that these high mortalities greatly depended upon preventible causes. Hospital hygiene is by no means a thing of yesterday. Alanson of last century knew that the success of his operation depended upon other things as well as the knife, and on the subject he enunciated sound ideas. He says, "The air in which the case is to be conducted is a point worthy of your greatest attention. If possible, the room should be spacious, and in an open, wholesome situation. It is well known that in hospitals which are situated in populous towns, and are much crowded, the salutary influence of the air is so altered that compound fractures and other important surgical cases prove peculiarly fatal." Unquestionably therefore the prevalence of pyæmia, erysipelas, and hospital gangrene, may be considered as a sure sign of inferior hospitals, while the rapid healing of wounds and sores, the speedy recovery of serious operations, point to the existence of better institutions. The former, fortunately becoming fewer, are alike a cruelty to the patient and an injustice

to the physician and surgeon. No stronger condemnation of any hospital ward can be given than the simple fact of any zymotic attacking others than those who brought the disease with them. And yet cases of erysipelas or pyæmia may occasionally present themselves in good hospitals, although it must be understood they seldom or never spread. These statements are strikingly borne out by illustrations from the Hertford hospital. A case of erysipelas appeared, which had originated to the best of my belief *de novo*, and assuredly from no defect in the hospital or ward; but, without casting reflection upon any one, I considered its presence attributable to indifference to ventilation and the regular admission of fresh air, on the part of those intrusted with the ventilation. I have seen nurses who might be supposed to know better, exhibit a strange and strong liking to have the windows hermetically sealed, especially in winter, on the assumption that pure air is not so necessary for the sick at that season as in summer, the consequence being that the patients existed for hours in a foul, oppressive atmosphere, which hindered the elimination of their own waste, and thus delayed recovery. In the same hospital four cases of small-pox were detected two days after admission. On the eruption appearing, their immediate removal to the Annexe of the Hôtel-Dieu was carried out, the wards were freely ventilated, and no further cases occurred. Thus the hospital was not at fault. But where the hygienic sur-

roundings are bad, patients have but a poor chance. The truth of this is exemplified by the experience of a French hospital towards the close of last century, where of 20,000 who passed through the wards 5000 were carried to their graves; or later, by the sad experiences in the Crimean hospital at Scutari, where the wounded who were treated in the open tents fared well, while the less fortunate, who were cooped up in misnamed hospitals, were decimated by pyæmia and hospital gangrene. To surgery more than to medicine is due the credit of having been the means of stirring up hospital authorities to provide better accommodation for the treatment of disease. Were it not for the remedies suggested to avert the frightful mortalities following upon operations we should, even yet, be content to work away in the miserable pest-houses of centuries ago. But surgery is not entirely free from blame or indifference in this matter. Why this science should have made so much progress within this century, and hospitals received so little consideration, is easily explained. Surgeons frequently troubled themselves about the best method of doing this or that operation; but how few of our best surgeons have combined and taken counsel against their common enemy—the hospital miasm—which has at times defied the most dexterously performed operation. I have already stated that medical statistics are much less reliable as to the sanitary condition of a hospital

than surgical statistics, because various causes are at work to increase or diminish the mortality. To the laborious and by no means congenial work of compiling statistics, I have devoted some attention; but the results are far from gratifying, as they prove little or nothing. After analysing the statistics of the Hertford British Hospital for two years, I realized how difficult it would be to put much value upon them, as there were no two cases alike—the age, constitution, and habits of life, the season of the year, and many other circumstances, exercising an influence upon the condition of the patient. As regards the admission to this Hospital, there were special influences at work. Some entered in the last stage of their malady; others were compelled to seek admission from poverty and the inclemency of the season, and I have heard it stated that the provision of funerals at the expense of the hospital often constituted an attraction to the friends of the patients. As the following compilation shows, many entered only to die. Admissions from 1876–1879 were 855. The death rate of each year varied very little. Of the admissions in the year 1879, which were 258, twenty-four died, or one in 10·75. Of the deaths phthisis produced twelve, or one-half of this number. Forty per cent. of the deaths occurred within a week of admission. Another curious fact in connection with the mortality was, that fifty per cent. of the deaths occurred among stablemen, chiefly from phthisis. These figures, too

limited perhaps for making deductions, show that there were special causes in operation to account for the high death-rate. A legitimate interpretation of the laudations of antiseptic surgery by many surgeons in the present day, would seem to mean that it has taken the place of good hospitals. No doubt antiseptic surgery has accomplished much; but even its existence in inferior hospitals will not prevent the aggravation of disease, constitutionally or locally, nor will it tend to hasten recovery. What is of prime importance in every hospital is such management as will insure cleanliness in every direction. The absence of this would soon lead to the deterioration of the most perfect structures that can be devised, and give rise to second-rate results. Not long ago, in the miserable pest-houses of Munich, hospital gangrene, hospital gastritis, and erysipelas were rife for ten years, and the mortality statistics something appalling. Operation after operation failed or was followed by a slow recovery in consequence of these, and the patients with compound fractures invariably died. In 1871 Volkman's clinique was so full, and the deaths from pyæmia and erysipelas were so numerous, that at one time he was on the eve of closing his wards. We are informed, by those who approved of his introduction of antiseptic surgery into his wards, that without any alteration in the hospital he banished these scourges. If this statement were allowed to pass unchallenged, it might seem as conceded that there was no necessity for reforming

our hospital system, no necessity for large airy wards, no necessity for the untold benefits of abundance of air and light, which were denied to the Munich patients. The surgeon who presided over the Munich clinique seemed calmly to submit to the state of things that existed there, and proceeded under the protection of antiseptics to perform various operations, while he allowed those hospital scourges to do their deadly work unchecked. It is impossible that the antiseptic spray can remedy the evils of unhealthy hospitals. Nussbaun is, however, more candid than some of his admirers, for he says, when referring to the great *Allgemeines Krankenhaus*, "that he made immense improvements on the previous condition of the hospital." Hospital salubrity can never be adequately attained by antiseptics, which nevertheless has done much and lasting good for surgery.

The high mortality in German hospitals induced Germany to take up the question of antiseptics. France sneered at them, and went on improving in the construction of her hospitals. In England there are many hospitals where antiseptics are not employed, and still good results are obtained, admitted to be due in a large measure to excellent hygienic conditions. In proof of this I may state that Professor Spence, a strong advocate of hospital hygiene, has published the results of a series of the most formidable operations, which results compare favourably with those of antiseptic treatment. Tar-

dieu has said with truth that "mortality does not always signify insalubrity," and cites as an example the case of Lariboisière, which owes its high mortality, when compared with other hospitals of inferior design, to its situation in the worst and most populous quarter of Paris. Holmes, an authority on the subject of mortality statistics, holds that a low death-rate may (*cæteris paribus*) indicate comparative inefficiency. Much may be gained by comparing the mortality statistics of a good hospital in London or Paris with those of the hospitals of Munich, Lyons, or Versailles, to prove the absolute superiority of the former. Between good hospitals, on the other hand, the difference of the mortality rate is so small that the explanations will be found in causes entirely apart from hospital salubrity. The value of water, as conducive to hospital hygiene, has ranked high in France since the year 1750. Every hospital is fitted out with a complete hydrotherapeutic establishment. Apropos of this Husson says, "by a happy application of the best principles of hospital architecture, all the elements of hydrotherapy, the most varied and perfect, are to be found in a relatively small space." Its entire absence from the great majority of English hospitals is, I think, a mistake, and the result of bias on the part of physicians, who appear to consider that they would be allied to quackery, if they showed faith in the therapeutic as well as cleansing properties of pure water. Were their existence more common in England, less would be

heard of the men who develop the "pathies" and degenerate into "quacks" pure and simple. Hydro-
 pathy and other fashionable nostrums of the day
 require to be checked, and relegated to the oblivion
 of exploded theories; and a right appreciation of
 the hygienic and therapeutic properties of a copious
 water supply will go far to accomplish this object.

Perhaps one of the greatest factors in hospital
 salubrity is cubic space; and yet a glance at the
 accompanying figures will show that while the
 Italian hospitals offered in this respect exceptional
 conditions of salubrity, the results of treatment
 told another and disastrous tale, attributable to bad
 construction and defective ventilation:—

FRANCE.		GREAT BRITAIN.	
Vincennes,	1200	King's College,	1800-2060
Bayonne,	1000	Blackburn,	1800-2200
Rochefort,	1450	Guy's,	1650
Tenon,	2040	Edinburgh Infirmary,	2300-2500
Lariboisiere,	1700-1860	Glasw. W. Infirmary,	1650-1700
GERMANY.		ITALY.	
Wieden (Vienna),	2900	Turin,	3420
Bethanie—Berlin,	1760	Milan,	3390
Frankfort,	1270	Florence,	2440

CHAPTER VIII.

CONCLUSION.

ALTHOUGH abler pens than mine have taken up this question, and given to it that many-sided interest with which it is now invested—an interest that has led to the erection of hospitals in the city, and also in the country, where our less fortunate fellow-men may have all that medical skill and nursing can accomplish, and which they could with difficulty obtain at their homes—yet, I venture to hope, that these pages may not be unacceptable to the reader.

While it is gratifying to notice that there is no symptom of any falling-off of the public sympathy and spirit of those who contribute towards the erection and maintenance of hospitals, and while we are bound to admire the grand and diffuse display of national charity, it must be confessed that there is a tendency in some quarters to allow benevolence to rush heedlessly, and to establish charities where they are not required, with the result that hospitals with open portals are often taken advantage of by individuals not by any means the most needy, and a spirit of dependence is thus fostered among the community. That there are occasions when individuals might honourably, and without loss of self-respect, accept the benefits of charitable institutions, when their own resources are inadequate, there can be no doubt;

but there is no mistaking the tendency in the present day to abuse hospital privileges, and thus to deprive the most needy of a retreat in their hour of necessity.

Moreover, it is an exceedingly difficult matter to settle the number of beds that should be allowed to every 1000 of the population. This much, however, may be said with safety, that proposals to erect hospitals in cities, where the public generosity is taxed to the utmost to maintain the present hospitals, are unwise. Oppert has endeavoured to settle this difficult matter by fixing four to every 1000 of the population, but this will not always hold good; special circumstances being in operation in different cases. A comparison of the hospital accommodation relative to the populations of London, Paris, Edinburgh, Glasgow, Manchester, and Liverpool, shows great disparity, and this disparity can only be explained by exceptional circumstances.

The following is a summary of the hospital accommodation of the above mentioned cities:—

	Population in 1881.	Total Num- ber of Beds.	Ratio of Beds to Population.	Beds per 1000 of Population.
London,	3,839,500	21,475*	1 to 177	5·6
Paris,	2,225,000	9,500	" 230	4·4
Glasgow,	704,000	1,673	" 420	2·8
Liverpool,	681,000	1,100	" 619	1·6
Manchester,	574,000	1,200	" 478	2·0
Edinburgh,	228,000	1,020	" 223	4·4

* The figures in this column do not include the beds of asylums, workhouse-infirmaries, *hospices*, &c.

These figures, making allowance for their absolute accuracy, would seem to indicate that, in dealing

with the question of hospital accommodation, other factors as well as population, which ranks first, must be taken into account. They show that cities with the largest medical schools have the greatest number of beds. It may seem strange that Edinburgh should have more beds in proportion than Glasgow, where there is a larger population to take advantage of the hospitals; but it must not be forgotten that applicants for the Edinburgh come from a wider area of the country than those for Glasgow hospitals. If the ratio of four to a thousand were accepted as a minimum, then, it follows that in the case of Manchester and Liverpool there is a striking deficiency. And yet it can scarcely be believed that these cities need double, or even treble, their present hospital accommodation. It cannot, however, be said that in all cases there has been a judicious disposal of the accommodation we at present possess. Were relative urgency of ailments the title of admission, there would be less chance of the abuse referred to being carried to any extent. Perhaps the proposal of Government supervision, suggested by so eminent an authority as Dr. F. J. Mowat, would go far to check this evil, as well as the no less serious one of attempts on the part of matrons and treasurers to supplant or undermine the authority of the medical staff, whose voice should be supreme in all matters relating to the sick. Doubtless had this proposed system of supervision been in force, we should not have been witnesses of the unseemly

squabbles which have occurred of late years in some of the metropolitan hospitals. In fact, this interference on the part of the nursing staff has assumed an ugly shape. It is to be feared that some nursing superintendents are not acquainted with the instructions laid down for them by the eminent military surgeon Rollo in 1801. He says—"Nurses ought to be entirely under the direction of the surgeon, and to be answerable to him alone for their conduct."

These remarks are not intended to reflect upon nurses in the performance of their hospital duties, but they are made in view of the many scandals which have been caused by the attitude of interference which they, or rather their superiors, encouraged by an indirect representation, have assumed towards the medical and surgical staff. Too much stress cannot be laid upon good management; and whatever share the representatives of trust estates, public bodies, or even the public, may take in the general government, there can be no question that in the immediate government the professional element should be all-powerful. In Edinburgh this theory has never been questioned, nor is it a power at all likely to be abused. A repetition of the scenes that have taken place, more especially in England, between doctors on the one hand, and treasurers and matrons on the other, must unmistakably lead to Government interference to prevent their recurrence. These occurrences furnish arguments as to the desirability of having the central control in the hands of a

governmental administrative agency, such as is to be found in Paris. There the Government is represented by the director of the "*Assistance Publique*," whose actions are controlled by a council, which includes members of the medical profession and of the municipal council, and over which the Prefect of the Seine presides. Government interference has ere now been directed towards endowed institutions, when it was supposed that things were not going right. And the same thing may happen to endowed and non-endowed hospitals. Government inspection would do good service, did it but serve to prevent irresponsible officials from insulting a class of men who have done so much in hospitals, and so cheerfully, and in many instances without hope of reward, except that which came to them from the consciousness of having performed a public duty—men of whom Lord Derby said recently that they did more unremunerative labour than any other class he knew of.



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