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Hospital Construction and Management.

HOSPITAL

CONSTRUCTION AND MANAGEMENT

BY

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Preface to Second Edition.

THE first edition of this work was published in 1883. In it were explained the principles which should regulate and control the construction and management of hospitals, and typical examples were given of the principal institutions devoted to the care and treatment of the sick and injured, in all parts of the world.

A second edition has now been called for, and opportunity is thus afforded for giving in an Appendix, and elsewhere throughout the work, some additional information as to matters of interest pertaining to questions of Hospital Construction and Maintenance. The principles originally enunciated have nowhere, in all the discussions regarding hospitals which have since taken place, been proved to be unsound or erroneous, and therefore no material change in the form and arrangement of the work is deemed to be desirable or necessary, at present.

The great and important question of bringing the whole subject of the proper construction and regulation of such institutions into harmony with the rapidly advancing state of medical science, and the changes in the social condition of those who are compelled to seek for public aid in sickness, is daily becoming more urgent.

This question is no nearer solution now than it was in 1883, hence it may become imperative ere long to recast this work, and to expound in greater detail how hospitals can be made more fully to accomplish their proper uses for the relief of suffering, and for their adaptation as schools of instruction to the advancement of the art and science of medicine, both in its curative and preventive aspects.

F. J. Mouat,
Athenæum Club.

H. Saxon Snell,
22 Southampton Buildings, London.

July, 1889.

Preface to First Edition.

THERE is no systematic work in the English language on the arrangement, management, and construction of hospitals, in their hygienic, administrative, and structural relations.

The present is, we believe, the first attempt in any language to treat the whole question in a strictly logical manner, by considering primarily the principles necessary to be observed to fit them to fulfil their purpose; and then by applying those principles to practice, so far as they are accepted by the leading authorities on the subject.

All hospitals are intended for the relief of suffering, the cure of disease, and the repair of injuries—their *raison d'être* is, consequently, based on medical and hygienic grounds, which need medical knowledge and experience for their right understanding.

Hence, this portion of the work has been undertaken by a member of the medical profession, who has for many years, in his official and private capacity, devoted special attention to the question in each and all of its aspects.

For the architectural portion the responsibility rests with a member of that profession, who has had considerable personal experience in hospital construction and arrangements; who has made himself practically acquainted with the best recent types of hospitals in Europe; and who has thereby been enabled to form independent opinions as to what to do, and what to avoid, in the practical working of this great question.

The issues in the two sections of the work differ essentially in character.

In the medical relations of the matter, some of the principles involved must be more or less speculative in character, inasmuch as the problems of life and death, health and disease, the loss of the one and the recovery of the other, are still, and must probably for ever remain, beyond the

reach of rigorous solution by any means of investigation or instruments of research in our possession.

Not so mechanical and physical agencies, most of the relations of which can be determined with some approach to mathematical accuracy.

Hence, of necessity, greater precision in the practical application of the principles, than in the determination of the principles themselves, to be observed in hospital construction and arrangement. Not the less important, nevertheless, is it to indicate those principles so far as they are at present ascertained and accepted, and to subordinate the structural arrangements to their right interpretation.

The history of the efforts made in Paris for a century past, since the right path was indicated by Tenon in 1788, to reform the Maternities of that centre of civilisation, is an instructive example of the criminal folly of disregarding the counsels of those alone capable of guiding and directing public opinion in such matters, and of the lamentable as well as needless sacrifice of human life which has been, and still continues in some institutions to be, the result.

We believe that this attempt to submit the whole question in a strictly logical form to the consideration of the professions most immediately concerned, and to the public, which has so deep and abiding an interest in all that relates to the sick and suffering, is a step in the right direction.

We are not without hope that, however imperfect it may be in design and execution, it will prove useful to the numerous authorities engaged in the administration and direction of the public and private charities of the country, amongst which none demand or receive more earnest and devoted attention than those to which this work directly relates.

It was originally intended to make the work a complete representation of the hospital systems of the civilised world, with typical and illustrative examples of the best-known and most recent models in existence of such institutions. It has been found, however, that to collect the materials for this purpose would necessitate very considerable delay—a postponement of publication so considerable, in fact, as to be altogether unadvisable. We have, therefore, determined to publish at once so much of the materials as we have been able to digest regarding the principles to be

observed in the management and construction of such institutions, with descriptions and illustrations of the most advanced types to be found in Europe generally.

As regards the United States of America, we are promised plans of the Johns Hopkins' Hospital, of Baltimore, fast approaching completion, and shall content ourselves with this example of the most advanced views of our Transatlantic brethren, inasmuch as the general description of the hospitals of America, will, we understand, be undertaken by the most competent of all authorities on the subject, Dr. J. S. Billings, the learned and accomplished author of the Baltimore plans.

F. J. Mouat,
Athenæum Club.

H. Saxon Snell,
22 Southampton Buildings, London.

CONTENTS.

Sections I and III.

By F. J. MOUAT, M.D.

I.—The Principles of Hospital Construction and Management in Relation to the Successful Treatment of Disease. Illustrated by several Woodcuts.

III.—The Organization of Medical Relief in the Metropolis, shewing its Present Distribution. Illustrated by a Map.

Section II.

By H. SAXON SNELL, F.R.I.B.A.

Typical Examples of the General Hospitals of various Countries. Illustrated by upwards oe Fifty Lithographic Plates and numerous Woodcuts.

Appendix.

By H. SAXON SNELL, F.R.I.B.A.

Paper on "Circular Hospital Wards."

Account of Experiments to Test the Accuracy of Registering Anemometers.

Gas v. Electric Lighting for Infirmaries.

TABLE OF CONTENTS.

SECTION I.

	PAGE
PREFACE	iii to 5
GENERAL INTRODUCTION TO SECTIONS I. AND III.	1 to 7
I. THE CONTROL AND MANAGEMENT OF HOSPITALS	7
General Management	9
Special or Executive Control	11
Nursing	12
Hospital Records	15
II. THE PRINCIPLES OF THE CONSTRUCTION AND ARRANGEMENTS OF HOSPITALS	18
(*a.*) Site and Surroundings...	22
(*b.*) Ventilation and Warming	24
(*c.*) Water Supply and Drainage	31
(*d.*) Distribution and Dimensions of Buildings and Wards	32
(*f.*) Furniture and Fittings of Hospitals	37
TYPES OF THE MOST RECENT FORMS OF HOSPITAL CONSTRUCTION AND ARRANGEMENTS ...	38
The General Hospital of Friedrichshain in Berlin	40
Menilmontant	43
Hospital of St. Éloi at Montpellier	45
The Western Infirmary, Glasgow	49
The New York Hospital	51
The Civil Hospital of Antwerp	55
The Civil Hospital of Mons	57
CLASSIFICATION OF HOSPITALS	59
Clinical Hospitals...	60
General Hospitals...	62
Lying-in Hospitals	65
Fever and Small-pox Hospitals	70
Special Hospitals	75
Cottage Hospitals...	76
Convalescent Hospitals	77

SECTION II.

INTRODUCTION TO SECTION II.	i to ii
HERBERT MILITARY HOSPITAL, WOOLWICH, ENGLAND	3
Principal Sick Wards	7
BLACKBURN AND EAST LANCASHIRE INFIRMARY, ENGLAND	11
Principal Sick Wards	13
LEEDS GENERAL INFIRMARY, ENGLAND	16
Principal Sick Wards	18
ST. THOMAS'S HOSPITAL, LONDON	22
Principal Sick Wards	29

	PAGE
Royal Infirmary, Edinburgh, Scotland	33
Principal Sick Wards	37
Glasgow Western Infirmary, Scotland	42
Principal Sick Wards	46
Norfolk and Norwich Hospital, Norwich, England	49
Principal Sick Wards	55
St. Marylebone Infirmary, Notting Hill, London	58
Principal Sick Wards	61
Extracts from Official Documents as to the Construction of Workhouse Infirmaries	68
St. George's Union Infirmary, Fulham Road, London	220
Pavilions Generally	221
Administrative Offices	222
Principal Sick Wards	223
Hull General Infirmary, Yorkshire, England	256
Principal Sick Wards	260
Mons Civil Hospital, Belgium	77
Antwerp Civil Hospital, Belgium	79
Principal Sick Wards	84
Heidelberg University Hospital, Germany	88
Surgical One-storied Pavilions	94
Medical One-storied Pavilions	98
Medical Four-storied Pavilions	98
Surgical Four-storied Pavilions	99
Berlin Civil Hospital	100
Surgical Pavilions	104
Medical Pavilions	111
Infectious Wards	112
Berlin Military Hospital, Tempelhof, Germany	115
Principal Sick Wards	120
Isolation Sick Wards	124
Königsberg Military Hospital, Germany	125
Düsseldorf Military Hospital, Germany	126
Ehrenbreitstein Military Hospital, Germany	127
Cüstrin Military Hospital, Germany	128
Dresden Public Hospital, Germany	129
The Mutterhaus	130
The Pavilions	132
Strasburg University Hospital, Germany	137
Wards of Central Block	138
Pavilion Wings	139
The Moabite Barrack Hospital, Berlin, Germany	205
Principal Sick Wards	207
Halle University Hospital, Germany	210
Medical One-storied Pavilions	215
Surgical One-storied Pavilions	217
Isolation Pavilion	218
Lariboisiere Hospital, Paris, France	141
Principal Sick Wards	144
Puerperal Fever Wards	149
Hôtel Dieu, Paris, France	151
Principal Sick Wards	165

PAGE

TENON HOSPITAL, MENILMONTANT, PARIS, FRANCE ... 168
Principal Sick Wards ... 171
The Maternity ... 173
ST. DENIS HOSPITAL, FRANCE ... 175
Principal Sick Wards ... 178
BICHÂT HOSPITAL, PARIS, FRANCE... 181
Principal Sick Wards ... 183
BOURGES MILITARY HOSPITAL ... 186
Principal Sick Wards ... 189
SAINT ÉLOI HOSPITAL, MONTPELLIER, FRANCE ... 191
Principal Sick Wards ... 193
UTRECHT HOSPITAL, HOLLAND ... 198
AMERSFOORT MILITARY HOSPITAL, HOLLAND ... 200
Summer Sick Pavilions ... 201
Winter Sick Pavilions ... 204
HOSPITAL OF ST. ANDREW THE APOSTLE, GENOA, ITALY ... 228
Principal Sick Wards ... 233
RIGA TOWN HOSPITAL, RUSSIA ... 236
List of Riga Hospitals ... 237
Principal Sick Wards ... 238
NATIVITY HOSPITAL, ST. PETERSBURG, RUSSIA ... 241
Principal Sick Wards ... 242
JOHNS HOPKINS' HOSPITAL, BALTIMORE, UNITED STATES ... 244
Principal Sick Wards ... 250
M. TENON'S PROPOSED HOSPITAL ... 264
TAKHTSINGJI HOSPITAL, BHAVNAGAR, INDIA ... 271
Principal Sick Wards ... 272
BURDON SANDERSON'S PROPOSED HOSPITAL WARD ... 274
SUMMARIES ... 278, 279 and 280

SECTION III.

ORGANIZATION OF MEDICAL RELIEF IN THE METROPOLIS ... 3
Finance of Hospitals ... 22
Out-Patient System ... 24
The Mortality of London Hospitals ... 28
London Hospitals ... 31
Suggestions ... 37
Hospital London ... 39
INDEX TO MAP ... 42
MAP ... 45
GENERAL INDEX ... 49

APPENDIX.

PAPER ON CIRCULAR HOSPITAL WARDS ... 1
Discussion ... 8
ACCOUNT OF EXPERIMENTS TO TEST THE ACCURACY OF REGISTERING ANEMOMETERS ... 10
RESULT OF AN ENQUIRY INTO THE RESPECTIVE COST OF LIGHTING A LONDON INFIRMARY BY ELECTRICITY AND BY GAS ... 18

ILLUSTRATIONS.

Section I.

PAGE

Berlin Civil (Friedrichshain) Hospital—Plan 42
Tenon (Menilmontant) Hospital—Plan 44
St. Éloi Hospital—View 46
New York Hospital—View 52

Section II.

Herbert Military Hospital—View 3
" " " Plans and Section 4
Blackburn and East Lancashire Infirmary—View 11
" " " " Plans ... ... 12 and 14
Leeds General Infirmary—Elevations 16
" " " Plans and Section 18
St. Thomas's Hospital—View and Plan 22
" " Plans and Section 26
Edinburgh Royal Infirmary—View 33
" " " Plans and Section 34
Glasgow Western Infirmary—View 42
" " " Plans and Section... 44
Norfolk and Norwich Hospital—View 49
" " " Plans and Section 54
St. Marylebone Infirmary—View 58
" " " Plans and Section 60
" " " Thermhydric Stoves 62, 64, 65
St. George's Union Infirmary—Plans, Elevation, and Section 220
" " " Construction of w.c.'s ... ... 225 and 226
Hull General Infirmary—Plans and Elevation 256
" " " Plans and Details 260
Johns Hopkins' Hospital—Plans and Sections 244
Dr. Burdon Sanderson's Proposed Annular Hospital Ward—Plan and Section 274
Heidelberg University Hospital—View 88
" " " Plans and Section 92
" " " Plans of Pavilions ... ... 98 and 99
Berlin Civil (Friedrichshain) Hospital—View 100
" " " " Plans and Sections 102
" " " " Plan of Isolation Pavilion 113
Berlin Military Hospital—Elevation, Sections, and Plans 115
" " " Plan of Proposed Staircase 123
" " " Details of Ice House 128
Cüstrin Military Hospital—Block Plan 128
Ehrenbreitstein Military Hospital—Block Plan 128
Düsseldorf Military Hospital—Block Plan 128

	PAGE
Königsberg Military Hospital—Block Plan	128
Dresden Public Hospital—Block Plan of Additions	130
,, ,, ,, Mutterhaus, Basement and Ground Plans	131
,, ,, ,, Basement and Ground Plans of Pavilions	133
,, ,, ,, Elevation and Section of Pavilions	134 and 135
Strasburg University Hospital—Plans and Sections	137
Moabite Hospital, Berlin—Plans, Elevations and Section	205
Halle University Hospital—Bird's Eye View and Block Plan	210
,, ,, ,, Plans and Sections of Pavilions, &c.	216
Mons Civil Hospital—View and Plan	77
Antwerp Civil Hospital—Elevations	79
,, ,, ,, Plans and Section	82
Lariboisière Hospital—Elevation and Sections	141
,, ,, Plan and Section of Pavilion	144
,, ,, Plan and Section, Puerperal Fever Wards	148
Hôtel Dieu—View	151
,, Plans and Section	162
Tenon Hospital (Menilmontant)—Bird's Eye View	168
,, ,, ,, Plans and Section	170
,, ,, ,, Plan and Section of Maternity	148
St. Denis Hospital—Plans and Sections	175
Bichât Hospital—Plans, Elevations, and Sections	181
Bourges Military Hospital—Plans, Elevations and Section	186
St. Éloi Hospital—Plans, Elevations and Section	191
M. Tenon's Proposed Hospital—Plan	264
Utrecht Hospital—Plan and Elevation	198
Amersfoort Military Hospital—Front Elevation...	200
,, ,, ,, Plans and Sections	202
St. Andrew the Apostle, Hospital of, Genoa—View	228
,, ,, ,, ,, ,, Plans and Section	233
Riga Town Hospital—Plans, Elevation and Sections	239
Nativity Hospital, St. Petersburg—Elevation, Plan and Section	241
Takhtsingji Hospital—View	271
,, ,, Plans	272
Map of Hospital London	45

Hospital Construction and Management.

Section I.

By Frederic J. Mouat, M.D., F.R.C.S.

Introduction.

Since the institutions devoted to the relief of the suffering from disease and accidents have ceased to possess an ecclesiastical character, and become what they now are, and long have been, part and parcel of the general practice of charity and benevolence in their purest forms, Hospitals, with special reference to the successful treatment of those admitted within their walls, have scarcely kept pace in their construction and management, with the advance of civilisation in other branches of social economy.

The present system of treatment of disease in public institutions in this country has not yet been two centuries in existence, as the following table, taken from Dr. Steele's Essay on the Mortality in Hospitals,* shows, viz. :—

Hospitals.	Date of Foundation.	Hospitals.	Date of Foundation.	Hospitals.	Date of Foundation.
London :—		Bristol	1735	Nottingham	1782
Westminster	1719	Edinburgh	1736	Canterbury	1793
Guy's	1723	Windsor	1736	Dundee	1795
St. George's	1733	Aberdeen	1739	Stafford	1795
London	1740	Northampton	1743		
Middlesex	1745	Exeter	1745	Irish :—	
		Manchester	1753	Jervis Street	1726
Special Hospitals.		Chester	1755	Steevens'	1733
British Lying-in	1749	Newcastle	1757	Meners'	1734
City of London Lying-in	1750	Glasgow	1794	The Meath	1756
Queen Charlotte's Lying-in ...	1752	Norwich	1771	House of Industry ...	1774
		Stafford	1769		
Small-Pox	1746	Worcester	1745	*Special, in Dublin.*	
Lock (Female)	1745	Leeds	1767	The Rotunda	1745
„ (Male)	1747	Oxford	1770	The Lock	1754
		Leicester	1771	The Westmoreland Lock ...	1755
Provincial :—		Dumfries	1775		
York	1710	Hereford	1776	Cork	1720-22
Salisbury	1716	Birmingham	1778	Limerick	1759
Cambridge	1719	Montrose	1780	Belfast	1797

St. Bartholomew's and St. Thomas's Hospitals, originally ecclesiastical establishments, were instituted several centuries earlier, and were secularised, the former in

* *Statistical Journal*, vol. xl. p. 181.

1547, the latter in 1538. Kurt Sprengel, in his learned work on the History of Medicine, has stated that the supervision of hospitals was taken out of the hands of the Church, in consequence of the "insatiable avidity" and crying frauds of the ecclesiastics, which at length provoked the decision of the Council of Vienna, in the 14th century, 'that those institutions should thereafter be only administered by laymen, in order that the sick might be better treated.'* The Church appears, thereupon, to have made a final effort to retain a part of its authority in the matter, by inducing the Pope to order that in Italy, at least, no physician should attend the same case twice, without calling in a priest to watch over the safety of the soul of the sick person.

The early history of hospitals on the Continent of Europe, previous to the 18th century, and so long as they were directly associated with, or governed by, ecclesiastical authorities, was of the same character universally—the interests of the sick being sacrificed to those of the persons immediately connected with their direction and management. Indeed, they were rather houses of entertainment, than hospitals according to the present understanding of the term.

The Hotel Dieu in Paris, first appeared in history early in the 9th century, under the name of the Hospital of St. Christopher. In the 11th and 12th centuries, the Crusaders imported from the Levant, Leprosy and St. Anthony's Fire (Erysipelas), to arrest the rapid and fatal spread of which special institutions were created, said to have amounted to more than 19,000 in number in Christendom. In France alone there were 2,000, in the reign of Louis VII.

The creation of the religious Hospital Orders gave a new character to the institutions established by them—partly for the care and entertainment of pilgrims and travellers, and in part for the treatment of the sick and infirm. But one or two of these now survive in name, their exact nature and purpose having long since disappeared. The greater number of the hospitals created from the 12th to the 16th centuries were in reality religious institutions for particular classes and brotherhoods, in which the treatment of disease played a very secondary and unimportant part, during the whole of the Middle Ages. To the Arabs belongs the credit of having, as early as the 8th and 9th centuries, established hospitals in the modern sense of the word—the greatest and best of which was at Cordova, in Spain; at once a renowned school of practical medicine, and a splendid asylum for treatment of the sick and afflicted from the disorders and pestilences, prevalent in that age of dirt and disease.

As hospitals became rich from the bounty of sovereigns and individuals, their abuses multiplied. "Funds designed for charitable purposes were diverted from their destination by the cupidity of priests and monks. The hospital houses were converted into benefices in the hands of the ecclesiastics charged with their direction. The misconduct of the male and female ecclesiastics, their quarrels and their dissensions, often invoked the intervention of the higher authorities,"† until at length

* Kurt Sprengel, op. cit. vol. ii., p. 428.

† Art.: *Hopital—Grand Dictionnaire Universel du XIXme Siecle.* Par M. P. Larousse.

such public feeling as existed in those times, was outraged by these scandals, and the hospitals were permanently made over to laymen to manage. In the ultimate change amongst ourselves, the progress of the Reformation had much to say; and the new departure, which began in England in the 18th century, spread rapidly to the rest of Europe.

That the hospitals built in the 18th century should not present the conditions now deemed essential in such places, is scarcely to be wondered at. Regarding them, Mr. Lawson Tait, of Birmingham, has said that—

"It cannot be surprising if we look at the houses in which our forefathers lived in the 16th and 17th centuries, that their children in the 18th should be ignorant of all true principles of hospital construction or management; or that they should be impressed with any other idea than that which, in Miss Nightingale's words, tended to make it 'sufficient for all purposes of curing and healing, that the sick man and the doctor should merely be brought together, in any locality, or under any conditions whatever.'

"But, it is surprising to find that, nearly a hundred years after Howard's vivid descriptions of hospital mis-construction and mis-management, and many years after the burning words of Florence Nightingale, in a great hospital of six hundred beds, we have been able to diminish the mortality only one per cent. from what it was in Howard's time. (Guy's Hospital rate of mortality from 1780-90, 10·2 per cent.; 1850-60, 9·1 per cent.) If we go further back still to the first few years of the existence of Guy's Hospital, we find the mortality 13·8 per cent. If we also bear in mind that then there were many zymotic diseases now unknown, all of which were then treated in the hospital, and almost only there, and that even of those which still remain to us, cases are admitted to the hospital only by accident, and in a proportion which is infinitesimal (about ·38 per cent.), the conclusion is inevitable, that hospital hygiene has not advanced as it might and ought to have done."

The present conditions of life in all civilised communities, impose a strain upon mind and body by day and by night, which is extremely difficult to bear, without serious risk of premature decay and death. The ever-increasing dangers to life and limb from the continuous and progressive multiplication of mechanical contrivances to supplement and supplant manual labour, and to annihilate time and space, have imported into surgery fresh forms of accidents and injuries, and new pathological states resulting therefrom, which tax the highest resources of the science and art of the Surgeon, to contend with and counteract.

The gravitation of rural populations to urban centres, the result of new conditions of society, has caused the aggregation of human beings upon areas insufficient to maintain them in health and strength, without the aid of complex artificial contrivances. These conditions, with the insanitary surroundings inseparable from them, especially among the poor and improvident, coupled with the vices which are largely the outcome of undue pressure of population upon space and the means of subsistence, have become important factors in changing the form and character of many diseases, more especially those of the inflammatory and zymotic classes.

This state again demands the employment of the most advanced means which scientific progress has placed at the command of the Physician, to deal with successfully. All the above conditions, with a multitude of collateral circumstances intimately connected with them, invest hospitals with even greater interest and importance now, than they have ever previously possessed. Not only are they "Nature's schools where pupils

are taught her ways in diseases and casualties, and the effects of the application of the means of relief," but they are emphatically the only places in which all the phases and varieties of sickness, whether of new or of old types, can be studied in a strictly scientific manner. The administration of the active principles of curative substances when separated from the inert or injurious matters with which they are combined in their natural state; the proper employment of anæsthetic and antiseptic agents; the skilled use of all new physical and mechanical contrivances for the detection, treatment, and removal of disease and its consequences, in circumstances where alone they can be subjected to the strictest observation and control; and, above all, the pursuit of pathological inquiry in the manner absolutely necessary for the advancement of science, are among the most important uses of hospitals.

It is, I think, much to be regretted that no provision was made by the organisers of the late International Medical Congress, held in London in the year 1881, for the consideration and discussion of the all-important subject of the Construction and Management of Hospitals. It was the largest gathering of professional experts, from all parts of the world, ever brought together; and although its scientific results were in no degree commensurate with its social success, there were few questions submitted to it of greater present and future importance than that referred to above, or on which an authoritative expression of the opinions of the whole civilised world, would have carried greater weight. The adoption alone, could it have been secured, of a uniform general system of record of sickness and mortality in the hospitals of all countries, would have impressed a more imperishable stamp of usefulness on the work of the Congress than even the invaluable teachings of Pasteur and Lister, for they were as well and widely known before as after the meeting of Congress, to which they contributed nothing new.

Great doubts, apparently on good grounds, exist among ourselves as to the advantages and disadvantages of large hospitals as compared with small; as to the real causes of the persistent unhealthiness of many of those institutions, both new and old, whether dependent on structural or other conditions; and as to the best means of securing all the conditions necessary to minimise the risk to life of those who seek admission, or are taken to them. There is by no means universal consensus on this and many similar questions connected with hospitals. It would, therefore, have been invaluable to obtain upon them the views of the eminent practical workers in kindred institutions of every part of the world, after personal examination of all that we had to show them.

The primary function of hospitals is the successful treatment of diseases and accidents, in the strictest relation to the interests and advantages of the sick and stricken individually. To this all other relations, scientific and administrative, must be absolutely subordinated, in spite of the wide-spread popular belief to the contrary, particularly as respects Clinical Hospitals, or Hospitals forming part of Medical Schools.

What, then, are the cardinal conditions to be observed in the construction, management, and distribution of hospitals, to fit them for their special purposes in all the

important relations in which they stand to the public, and to the profession most immediately concerned in their efficiency? It was truly said by one of our most eminent surgeons, Sir William Blizard, nearly a century since, that—

"The value of medical science in every walk of life, independently of its application in preventing and curing disease, should be seriously considered. All men are indebted to the discoverers and cultivators of natural truths for some share of their useful knowledge, and of the felicity they enjoy. Many, therefore, are the objects, interesting to society, that present themselves in contemplating the professional concerns of a hospital; and, as in commercial and other affairs of life, they will be best understood by men who have most devoted their time and attention to the subject. Everything liberal may be expected where charity is the governing principle of action, and where the good done bears proportion to the degree of knowledge exercised. Purity of motive, sincerity of attention in the surgeons, will not then be doubted. It may not, however, be improper to observe that their credit and interest are involved in all the proceedings of a hospital; for its prosperity is their elevation, its depression their loss and regret."

To consider, then, this important question correctly, it seems to me to be desirable to group hospitals roughly into certain classes, and then to discuss, in as much detail as may be necessary to their right understanding, the general attributes which are common to all, and those which are more or less restricted to the special purposes of each group, the successful treatment of disease being the cardinal condition, or *raison d'être*, of every such institution.

The simplest arrangement of all hospitals actually in existence, is the following:—

1. Clinical Hospitals, or Hospitals attached to, or forming part of Medical Schools.
2. General Hospitals, or those in which all classes of cases, medical and surgical, are treated, with or without detached wards for infectious diseases and parturition. In this group, I think, should be placed the great separate Workhouse Infirmaries, for reasons which will be mentioned when they come under review.
3. Special Hospitals, such as Fever and Small-pox Hospitals, Lying-in Hospitals, Ophthalmic, Skin, Orthopædic, and other institutions devoted to specific purposes, usually indicated by their names.
4. Cottage Hospitals.
5. Convalescent Hospitals, the "missing link" between the hospital and the home.

Each of the above groups, again, needs to be considered with reference both to institutions now in existence, and to the hospitals of the future. From them I exclude dispensaries, free or provident, and all institutions which have no beds for taking in patients. These with the out-patient departments of all hospitals, which might, I think, with advantage in most cases be separated from them, are most important complements of our hospital system, and, with the home treatment of such cases as are adapted for it, render it complete in organisation. But the latter scarcely fall within the scope or purpose of this work.

The first step in the whole inquiry is to determine, as far as possible, what constitutes,

a healthy hospital, for this is universal in its application. In one of his classical reports, Mr. Simon has defined a healthy hospital to be—

"A hospital which does not *by any fault of its own* aggravate ever so little the recovery of persons who are properly its inmates, and this, the only right sense of the absolute word, governs the words comparative applications; so that when we compare them together with regard to their 'healthiness,' and call one of them the 'unhealthier' hospital, our meaning is that in this hospital, by means of some faults of its own, disease cannot be treated as successfully as in the other hospital; and the fault of its own, through which an 'unhealthy' hospital fails to attain the best results for its medical and surgical treatment, is of two kinds—either it is an *inherent fault*, as of site and construction; or else it is a *fault of keeping*, as dirtiness, or overcrowding, or neglect of ventilation." *

Various attempts have been made to solve the question of the healthiness of hospitals as compared with each other, by contrasting the results, chiefly of surgical practice, by an appeal to statistics. This doubtless is the true means of forming a correct judgment on all such questions as can be solved by the application of the numerical method. When figures are really exponents of facts, and are collected with mathematical accuracy, they "formulate the past, render the present fruitful, and prepare the future." But the terms of all comparisons, to be exact, must be identical, as dissimilar things cannot be compared in the strict sense of the word. Vital phenomena are so complex in their nature, whether in health or disease, and are influenced by so many collateral conditions, all of which require to be stated with minute care and accuracy, that the basis of a correct statistical comparison of the results of the practice of different hospitals, does not at present exist. Nowhere are the records of hospitals so kept as to afford more than a rough approximation to the truth, which has no pretension to scientific accuracy. In each and all of them some important factors are omitted, and in none that I am acquainted with are any statistics of therapeutics, or particular plans of treatment, properly kept. That these latter exert an important influence in determining the results of medical and surgical treatment in hospitals, independent of all internal faults of their own, who can doubt who has watched and noted the changes in doctrine and practice of the present century, from the heroic blood-letting and *nimia cura medici* of its early part, to the medicine expectante, homœopathy, hydropathy, and the important antiseptic surgery of our own times?

It is sufficient for my purpose to state that, although we have no sound comparative data to guide us to a strictly logical conclusion, we have an abundance of testimony from figures which are of considerable value in themselves, in relation to many medical and surgical questions of great importance. Taken by themselves, they show that when varying proportions of mortality occur from the same classes of surgical procedure in similar cases, in the same or different localities, or where the death-rates from fever inflammation, the process of parturition, and other general causes, range to an extent indicative of greatly increased risks to life in some circumstances, as contrasted with others, they point to the existence of something wrong. This *something wrong* demands the strictest investigation, which is the real position in which the question now is. What, then, are the different factors which require to be taken into account in estimating

* *Sixth Report of the Medical Officer of the Privy Council*, 1864, pp. 39, 40.

the general conditions of healthiness, in the sense used by Mr. Simon, or the reverse, of every hospital intended for the reception of the sick or disabled?

As usual in all human affairs, the agencies to be considered are moral and material. The former refer to those employed in the control, direction, and management of hospitals, the latter relate to structural and other conditions which we know, or believe, to contribute to placing such institutions in the best possible state to fulfil their special purposes. It is manifest, and to this general rule hospitals form no exception, that the best and most perfect instruments may fail in careless or incompetent hands, whilst good work may be done with imperfect instruments by the more skilled and careful.

The question of the government and staff of hospitals is thus scarcely second in importance to the principles which should be observed in their construction and arrangements, in relation to the successful treatment of disease. For convenience of treatment, I shall consider the whole subject under the following heads:—

I. The Control and Management of Hospitals.
II. The Principles of the Construction and Arrangements of Hospitals, with brief general descriptions of some typical examples of recent Hospitals.
III. The Consideration of the several Groups of Hospitals.

The organisation of medical relief in the Metropolis is a matter of so much importance, in connection with the hospital question, as to demand discussion in a work specially devoted to that object; but as it does not deal with principles intended for guidance in the future, and, although of national interest, cannot be applied to circumstances for which no parallel exists elsewhere, I have placed it in Section III.

I.—THE CONTROL AND MANAGEMENT OF HOSPITALS.

In the Introduction to his "Étude sur les Hopitaux," one of the most eminent and successful Directors of the Assistance Publique in Paris, M. Husson, wrote that questions of salubrity and hygiene, when they treat upon the regimen of hospitals, and the welfare of the sick poor, move and excite public feeling and opinion more than any other domestlc discussions.

"Science rightly attributes to them," said he, "a decisive influence on the results of treatment; the administration, on the other hand, bears them constantly in mind, and attaches so much importance to the application of the principles flowing from them, that it does not reduce them to practice without appealing to the lights and experience of the medical staff of hospitals.

"This exchange of ideas and views, always so useful, between the administration which watches over the national interests of the sick, and the practitioner who affords them his assiduous care, is one of the oldest and most precious traditions of the hospital administration of Paris."

And yet this 'precious' remnant of antiquity has resulted in securing for the capital of France, one of the most costly and least healthy of all recent monumental hospitals,

and, in its authoritative interference with the 'lights and experience of the medical staff,' extinguishing those lights and disregarding that experience at its own will—for, in truth, in practice it scarcely affects to regard them—through the medium of lay directors, it constitutes as mischievous and inefficient a system of the internal government of hospitals, as it was possible to devise.

M. Tenon, the earliest and best of the scientific reformers of hospitals, said, nearly a century since, that "the merit of a hospital does not consist exclusively in its construction"; and, he added, that a false estimate would be formed of such institutions if from the buildings, the furniture, and fittings, the sick and the attendants were disassociated, and if the rules and regulations which animated and directed their work, were not taken into account.

In truth, by no means the least important factor in the successful working of hospitals, is their right government. The concerns of all such institutions are many and various. For their proper regulation, the fittest agency for each part of the appointed work, should be selected or elected. The general government (including the financial control), the special regulation, and the professional agency (superior and subordinate) are all necessary for their effective management.

In the general government, the public, as distinguished from the purely professional interests, should be chiefly regarded.

In the immediate management, the professional element should not only be predominant, but absolute; for professional training alone can fit a man thoroughly to understand the multitude of matters of detail which require to be dealt with, with economy, despatch, and efficiency.

In most foreign countries the central and superior control, as well as the immediate management, is in the hands of a governmental administrative agency. In Paris, this is represented by the Director of the Assistance Publique, under the supervision of a council, presided over by the Prefect of the Seine, and consisting of members of the municipal council, medical members, mayors, and other notabilities. The director is believed to be practically an independent officer in all executive measures. He has under his orders a staff, comprising a general secretary and several bureaux, each with its superintendent in charge, as may be found detailed in the French National Almanac. The lay director of the hospital is a member of his staff.

A study of the laws of most European countries regulating the control and management of institutions devoted to the care of the sick, and to the relief of destitution, with which they are usually associated, has satisfied me that they will not fit easily into our system of self-government and absence of direct State interference; and that, beyond some useful general principles, there is little in them that will bear direct transplantation.

That our manner of dealing with them, although right in principle, is susceptible of considerable improvement in practice, I hope to be able to show when treating of the organisation of medical relief in this great Metropolis, which is a kingdom in itself. The chief and most important change required, I hold to be the entire separation of sickness from mere destitution, the former being merged in the general hospital system of the

country, as an integral and inseparable part of the great question of public health; all other matters connected with destitution continuing as at present, under the Poor-law Authorities.

The hospitals themselves, I consider, ought to have just so much of State control as to secure their proper direction, with the remedy of such defects as may be shown to exist. I know of no good reason why the different hospitals of London, and other great cities, should exhibit such different risks to life in similar circumstances, diseases, and accidents, as they do now, and have done for long past; and why a proper uniform system of hospital record, in all departments of their administration, should not be as compulsory as customs, trade, and other economic returns, in matters of far less general and scientific interest.

If the State interferes, as it does rightly, to protect all classes who are unable to protect themselves from injury and misgovernment, surely the sick and those who are afflicted by causes over which they themselves can exercise no control, demand the same consideration for the body, as they now receive for the mind and its disorders. It involves but the extension of a principle which is firmly established in our legislation, and it can easily be so regulated as in no way to interfere injuriously with the self-government which is still more deeply impressed on our national character, and guides us so surely and successfully in most matters of social and domestic economy.

In the lives of the poor, and of all engaged in manual labour, sickness plays a much more important part than it does with any other class of society. The munificent public and private charities of this country are amply adequate to deal with all legitimate demands upon them, without inflicting additional burdens upon the purses, or taxes upon the time and attention of the wealthy and benevolent, if they were only better organised, and somewhat more judicious care were bestowed upon their distribution.

General Management.

The general supervision of the concerns of all hospitals should be in the hands of a mixed committee, or body of governors, sufficient in number to be sub-divided into sections of convenient size, to control the financial arrangements, additions to, or alterations of buildings, and similar matters. For small institutions small committees would be sufficient.

Should the present precarious existence and unsatisfactory state of many hospitals depending entirely on voluntary charity—which live from hand to mouth, constantly exceed their incomes, draw upon their capital, if they possess any, press the benevolent with perpetual piteous appeals for aid, and are compelled to keep beds unoccupied from want of funds to fill them—lead to a change in the general administration of medical relief, by incorporating them in the Poor-law system of the country in such manner as to separate sickness from the relief of destitution from whatever causes, and rob it of the stigma now attached to pauperism; a change in the management of all State-supported, or State-aided hospitals, would become absolutely necessary by the introduction of an official element in their direction.

Should it not be deemed expedient, however, to introduce an official element into this body, there is fortunately, in such a community as ours, no lack of persons of cultivation and leisure, strongly imbued with philanthropic sentiments, ready and willing to undertake such duties.

This general committee, by whatever name it is called, should be purely administrative, and have no executive functions. On it should be men possessed of an adequate knowledge of finance, of structural arrangements, and of such economic principles as are required in the general control and direction of an establishment, of which the special function is to do the largest amount of good to the sick and suffering without prodigality or parsimony, and without fear or favour.

There are many circumstances connected with this general management of hospitals, in which the aid and advice of educated women would be valuable, both in council and in action. The laundry, the cooking department, the domestic arrangements of the nurses and female servants, as well as the women's and children's wards, would all benefit by such supervision. Hence, a certain proportion of all general committees should consist of ladies.

On the committee should also be the consulting physicians and surgeons of the hospital itself, and possibly other distinguished members of the profession, unconnected with the hospital, to act as a special medical committee; to see that, in the application of the means of relief, the institution is kept well abreast of the progress of the art and science of Medicine and Surgery, and to assist their lay brethren to deal with abuses where they are found to exist, in which technical and special knowledge are needed, to suggest the best means for their remedy or removal.

At present, the indisposition to associate members of the Medical Profession in such bodies, is as incomprehensible as it is prejudicial. Had they, for example, formed an integral portion of the governing bodies of some celebrated institutions which have recently appeared in an unenviable light, and shown how thoroughly unsound their system of management is, the scandals which have shocked public feeling, would never have been allowed to occur.

In such a body, the public and the profession would alike have confidence. The former would have the assurance that their money was well spent, that the hospital was humanely conducted, and that the poor and afflicted obtained all the advantages intended for them. The latter would be assured that the personal benefit of each patient was carefully considered, and that while none were made the subject of questionable experiments, the interests of the progress of Science were not neglected in introducing new and improved means for the cure, and, above all, for the prevention, of disease—the latter being of national importance.

Such an organisation would not interfere injuriously, if at all, with vested interests or founders' wishes, so long as these latter were in harmony with the constantly progressive changes in society, and the new conditions arising out of such changes.

The above is no hypothetical or speculative scheme, for, with some modifications of detail, it may be seen in active operation in some of the well-conducted hospitals of the United States at the present moment, and in the great hospitals of Edinburgh and Glasgow.

All persons engaged in inquiries into our hospital system know how difficult it is to obtain reliable information, and how little the public or the profession know of the exact state of most of our sick asylums. This does not usually arise from any desire for concealment, but because each is more or less a law unto itself, and there is a want of uniformity in the system of records, which are seldom kept in such manner as to be of any real scientific or administrative value, so far as the published statements of most hospitals indicate.

Special or Executive Control.

The immediate government of a hospital should be intrusted to a resident Medical Superintendent. It is so generally in the United States of America, in some of the greatest hospitals on the continent of Europe, in the most important hospitals of Scotland, and in the large and well-managed separate Poor-law Infirmaries of this Metropolis. To the medical superintendent, all persons within the walls of the institution, should be strictly and directly subordinate. There should be no concurrent, separate, or conflicting authority. He should not be charged with the treatment of the sick, and should neither possess nor exercise any power of interfering with the physicians or surgeons in their treatment of cases of disease, accident, or injury. The direction of all other internal concerns should be exclusively in his hands—such as the maintenance of order and discipline, the regulation of supplies of all kinds, the custody of all appliances and instruments, and the initiation of all such structural and other changes, as may, from time to time, be found necessary. In matters of finance and supply he should act under the orders of the special sub-committees of finance and buildings, appointed from the general governing body. He should regulate the admission and discharge of patients, and the keeping of the records of the hospital, with the aid of such subordinate staff as is always required in great institutions. The out-patient department should also be under his control. The appointment, removal, and distribution of all nurses, servants, and subordinates generally should likewise be vested in him, subject to the immediate control of a house-committee. He and all the sub-committees should submit an account of their proceedings monthly, or as much or less oftener as might be deemed necessary, to the general committee at its appointed meetings, with whom should rest the final sanction and approval of all matters connected with the institution. The general committee should have a paid secretary to arrange and keep its records, and be the official medium of communication between that body and the officers of the hospital.

If there be any class or kind of public institution which more than any other demands the possession of special and technical knowledge, and more direct unity of authority in its immediate management, I hold it to be a hospital. A medical superintendent, from his professional training, is alone competent to gauge at once with promptitude and decision all the requirements of such an institution; and, as he must always be appealed to in the last resort, common-sense and the proper conduct of business of all kinds in every other walk in life, indicate that he should possess the power, in the first instance, of dealing with every such matter as pertains to the economical and efficient control of a place devoted to the healing of the sick. Fettered as he would be by his responsibility

to special committees and the general committee, there would be no fear of his abusing such authority, for a sure and swift remedy could be found for such abuse. But, as a matter of fact, it is not abused in those institutions in which it is in use, as I have had abundant opportunities of seeing.

However, even our existing system, mediæval and out of harmony as it is with the age in which we live, is better than that of the director of a French hospital, acting solely under the orders of a central official authority, which is, as stated before, about the most inefficient aud mischievous form of government that I have ever seen in action.

Reform in the direction above indicated will not, I know, meet with ready acceptance from many benevolent and philanthropic persons whose views are entitled to respectful consideration. We are, as a people, slow to mend our ways, and have a not unnatural dread of changes, which are usually regarded as, more or less, leaps in the dark.

Yet this is in no way a speculative change, for it has long been in practical operation in other places, and is so in one important class of public hospitals among ourselves. Let those who have any misgivings on the subject visit and examine the institutions referred to for themselves, and see in their economy, efficiency, and the absence of all friction in their working, undeniable proof of the soundness of a system, which has passed from the region of discussion to that of accepted fact.

The axiom that unity of executive control means efficiency of management, applies quite as much to public as to private business. Hospitals, I contend, form no exception to this, and the more general rule that *those are best qualified to conduct a business successfully, who are best acquainted with its requirements.*

Nursing.

The most important of all the subordinate agency required in hospitals is undoubtedly that of nursing, of which, indeed, it would be difficult to over-estimate the value in its proper place, and in due restriction to its special purpose.

For the moral and domestic direction of the nurses, and for the thousand daily needs essential for their comfort and happiness, together with many collateral duties which a male superintendent cannot properly discharge, a Matron is required—not as an independent and co-ordinate authority, but as an integral part of the machinery of management, kept in harmony by the single direct ruling authority.

That skilled and trained labour is infinitely more efficient and trustworthy than unskilled and untrained labour, is undeniable. But, to elevate nursing into a special profession, and to arm it with independent authority in the management of disease or accident, I hold to be a mischievous mistake, alike in public institutions as in private life. It is, and must always be from its very nature, a subsidiary function, but not the less valuable or important on that account. To elevate the minor to the position of the major is as illogical in theory, as it is unsound in practice.

Neither the education nor the training of the most accomplished nurses can fit them for independent charges, nor are they intended to do so. The elementary and, of necessity, superficial acquaintance with so much of anatomy, physiology, chemistry, pharmacy, and physics, as are now imparted to them, are important auxiliaries in their practical

training, but cannot go further in rendering them in any way independent of the physician or surgeon, under whom they are acting.

To charge the head of the nursing staff with the maintenance of discipline, and to render her independent of the resident medical superintendent in such matters, is certain to cause friction, and to lead to disorder and disorganisation. The experiment was subjected to full and fair trial in the Episcopal Hospital of Philadelphia, a few years since, and ended in disastrous failure, as might have been foreseen. This erroneous procedure is also responsible for most of the scandals which have recently come to light, in connection with hospital management.

Nurses stand in the same relation to the surgeons and physicians of a hospital that non-commissioned and warrant officers do to the officers of the army and navy, and that skilled artisans in a factory or workshop do to the foremen and scientific directors of the works. To arm them with independence in any form is as impolitic in the one, as it would be destructive in the other.

I cannot, again, concur in any scheme of connecting the duty of nursing with any form of religious, or quasi-religious, organisation; for hospitals are open to all classes, sects, and creeds, and should be absolutely free from even the suspicion of any sectarian bias or proselytising tendency.

I have myself witnessed the great distress caused to conscientious sick persons by the reading of prayers, of the terms of which many of them disapproved; and I was more than once compelled to put a stop to it in my wards, in which intelligent men from all parts of the world were assembled, and amongst whom were representatives of nearly every known section of Christians.

Far be it from me to underrate the possession on the part of a nurse of the deepest religious feeling; for there can be no better guarantee of her tender consideration for the sick, and of her conscientious fulfilment of her proper duties, which are entirely secular and professional, and should remain so. Nearly forty years ago I myself applied to the Roman Catholic Archbishop of Calcutta, to grant me the services of some of his religious ladies to organise and introduce into the female wards of the Medical College Hospital, then under my executive charge as secretary and resident medical officer, an improved and skilled system of nursing, at that time quite unknown in British India. He complied, and for some four or five years these exemplary and truly Christian women conducted the duties of nursing in the most perfect manner, under my constant personal supervision, and that of my late colleague, the then Professor of Midwifery. The successor of the Archbishop above referred to, much to my regret, and with many apologies on his part for taking a step in opposition to the action of his predecessor, withdrew the ladies in question. His plea was that the earnest devotion of the nuns to purely secular work, interfered with the strict performance of their religious duties. From first to last they never stepped beyond the exact line of their hospital work, so far as the sick were concerned, or assumed functions or powers inconsistent with their relations to the professor or myself. The harmony of action and efficiency of nursing were unbroken, and we parted with mutual regret and regard. I assume, then, to speak with authority on a question which has recently greatly exercised the public mind.

I do not enter into the question of the right method of training nurses, because it would need an undue amount of space, and is not necessary to my contention. Moreover, it has been treated exhaustively by one who can never be mentioned without an expression of the respect and admiration due to exceptional knowledge of the subject, to rare ability in its consideration, and to a life-long devotion to a work which will for all time be associated with her name. The only parts of Miss Nightingale's scheme of which I disapprove, are some of the provisions touching the relation of hospital management to efficient nursing.

The nursing department of St. Thomas's Hospital, with the exception above noted, the excellent arrangements of the great infirmaries in Scotland, and the special provision for the same end made at the John Hopkins Hospital at Baltimore, with many others which might be mentioned, are all typical and efficient modes of dealing with the question of training, in the only manner that appears to me to be thorough and free from objection. In most of them the religious difficulty is very properly avoided, and the divided responsibility is non-existent.

The proportion of nurses to sick, and the establishment required for day and night work, must vary so greatly with the nature of the cases and the character of the hospital, as to render it difficult to adopt any fixed rule or standard on the subject. The following remarks of Professor de Chaumont on the whole question, represent the most recent professional view of—

"*Nursing*.—The arrangements for nursing the sick have greatly improved in recent times, although controversy still goes on as to the best means of carrying it out. In arranging for the nursing in a hospital, both efficiency and economy have to be considered. Miss Nightingale recommends large wards of thirty-two beds each, as at the Herbert Hospital, on the ground that the head nurse is sufficient for such a number by day, and one by night. In the Edinburgh New Infirmary the wards are not so large, the medical being arranged for twenty-one and the surgical for fourteen patients. Circumstances must to a large extent determine the arrangement; but it seems desirable, on the whole, that the work of a nurse should be confined to a single ward at a time, if possible. The duties of nurses ought also to be confined to attendance on the sick, and no menial work, such as scrubbing floors and the like, should be demanded of them; a proper staff of servants ought to be employed for such purposes. It is also desirable that a separate pavilion for lodging the nurses should be set apart, and that fair and reasonable time for rest and recreation should be allowed. Some discussion has taken place as to the advisability of placing the nursing of a hospital in the hands of a sisterhood or a separate corporation. It will, however, be admitted that the best plan is for the nursing staff of each hospital to be special, and under one head in the establishment itself, even although it may be connected with some main institution outside. The nursing must, of course, be carried on in accordance with the directions and treatment of the physicians and surgeons."*

The slight condemnation, more implied than expressed, in the above remarks, as to giving a quasi-religious character to hospital nursing, does not indicate the real danger of our hospital system drifting back to the condition so strongly reprobated in the 18th century.

Regarding a much later period, when the supreme ecclesiastical control had long ceased, M. Husson says—

"The almost unlimited authority accorded to different religious congregations in divers hospitals, if we put faith in La Rochefoucauld Liancourt, who cannot be suspected of exaggeration in such a matter, had engendered numerous abuses."

* Art.: "Hospitals," *Encyclopædia Britannica*, Ninth Edition, vol. xii., p. 305.

In his seventh Report, speaking of the Hotel Dieu, he says—

"The religious hospital attendants have the direction of all the wards, and of nearly all departments of the interior; they control the treatment of the sick, the administration of remedies, and the distribution of food. All the servants of the house are subordinate to them; they are absolute mistresses of the discipline of the wards, under the direction, nevertheless, of the Bureau of Administration, and of the conduct of the medical staff. They are, no doubt, to be admired for their zeal, their piety, and their assiduous care of the sick; but whatever may be the merit of this eulogy, we cannot help qualifying it by some less favourable remarks after certain recent authenticated facts . . . . We cannot help believing that it is chiefly to the despotism exercised by these religious attendants in the Hotel Dieu, and their resistance to all authority, that the perpetuation of certain abuses must be attributed, as well as very great inconveniences, of which we do not hesitate to denounce the deplorable results."

And further on—

"The poor are equally discontented with the services of the sisters and of the servants, accusing the former of hardness and despotism; the latter, of neglect and ill-will." *

The nursing arrangements of the Western Infirmary, Glasgow, are models for imitation elsewhere, and are free, as are those of all Scottish hospitals, from the errors and pretensions of the otherwise excellent system adopted in England.

The mode of appointment of the medical officers of all civil hospitals in the kingdom is probably not free from objection; but so long as it brings the best men to the front, and secures to the sick the ability and care necessary for their restoration to health, there is no pressing reason for suggesting a change. To men possessed of the requisite knowledge and skill, hospital offices are sure passports to public favour and to professional reputation. This will, however, do little for those who lack the higher qualities which go to the formation of a perfect surgeon and physician, such as are to be found in all our great institutions.

Hospital Records.

The only other matter necessary to notice in this place, is that of the proper keeping of hospital records, an all-important branch of the management of such establishments. From the absence of uniformity of system, from the indisposition of many hospital authorities to afford any information as to their affairs, from the untrustworthiness of most of what is made known, and from the omission in some, even of the best-kept returns, of important factors, there is scarcely a fact connected with the treatment of diseases, accidents, or injuries in these institutions, which can be determined with anything approaching to scientific accuracy.

Mr. Lawson Tait, in his Essay on Hospital Mortality, has stated, on the authority of others, that a loss of life as great, although not as striking, as that which excited public indignation in connection with the Scutari Hospital† during the Crimean War, is

* Husson, *Étude sur les Hopitaux*, p. 174. Rapport fait au nom du Comité de Mendicité, des Visites faites dans les Hopitaux de Paris, par M. le Duc de La Rochefoucauld Liancourt, p. 3.

† A parade has constantly been made of the mortality of the army in the Crimea, and we are left to draw the inference that it was, in a great degree, due to the shortcomings of the medical department of the army at that time. Nothing can be more untrue. It was caused entirely by military mal-administration, and by the medical branch of the service having no effective control over its own affairs.

constantly going on in our civil hospitals, and that it may be checked by exactly the same means which in 1855-56 brought down the disease and death rate of our Crimean Army from 40, to less than 3 per cent.

"That there is some truth in this," he goes on to say, "no one who has had much hospital work can doubt for a moment, though to what extent it is true must, I fear, long remain a mystery, and that chiefly for the reason that it is almost impossible to obtain data which are not open to objections more or less forcible. How carelessly kept are the records of most of our medical charities, none know save those who have had to examine them. The managing authorities are usually content with publishing a report which contains a balance sheet and a bare statement of a number of patients which have been treated during the year, often without mentioning so important a feature as the number of deaths which have taken place. And this is by no means confined to small hospitals, for some of the largest and most important hospitals in the country, publish reports which are absolutely worthless as sources of information. In one point they all join. There is a uniform tone of congratulation on the success of the hospital, and an increase in the number of patients is hailed with rejoicing; whilst the committees always regret when the 'usefulness of the hospital has been somewhat diminished during the past year.' Surely this is done in thoughtlessness. They must be oblivious of the fact that anyone accepting gratuitous assistance is being pauperised, and that our indiscriminate system of medical relief has much to answer for in the improvidence of our labouring population.

"Be that, however, as it may," Mr. Tait adds, "one thing, I think, will be admitted on all hands. If any body of men take upon themselves not only to administer public charity, but to look after the lives and health of our poorer neighbours, they are bound to give an account, not only of their expenditure but of their results. There are few hospitals which do this completely and well; but amongst those which do, I think it desirable to mention especially, as worthy of mention, the reports of Charing Cross Hospital, of the infirmaries of Glasgow, Paisley, and Greenock, and the Hospital for Sick Children at Birmingham."

For the financial and business concerns of hospitals nothing more is required than the ordinary forms of balance sheets, so constructed as to show to what exact head each portion of income and expenditure should be assigned.

The disease register, without being overladen with redundant or unnecessary details, should contain all needful particulars as to age, sex, domicile, occupation, disease (whether primary or secondary), length of time under treatment, hereditary tendencies, and, as respects surgical cases, the careful separation of traumatic from other classes of surgical affections, with special reference to those requiring operative proceedings.

Pathological and therapeutical statistics should also be included in hospital returns, probably in separate tables. The whole of the particulars above mentioned should be carefully tabulated, and analysed in the briefest possible form, but on a uniform system.

In 1877, in recording the proceedings of the Public Health Section of the ninth International Statistical Congress, I stated that, among the questions which press most urgently for solution, is that of a proper system of hospital record to determine a number of questions which demand the scientific application of numbers for their solution. The statistics heretofore collected are constructed on far too narrow a basis to afford more than a very rough, and, in most instances, inaccurate idea of the risks to life from treatment in particular public institutions. Except with respect to amputations, fevers, parturition, and such diseases as are treated in special institutions, the published returns furnish no information whatever of a multitude of facts of vital importance in relation to disease generally, which are scarcely of less interest and value than a more accurate and exhaustive acquaintance with epidemic visitations. And even as respects those diseases which have been the subject of special investigation, the records are not so specific as they ought to be.

France is no better off than we are, in this respect. M. Husson, in his great work on hospitals, recorded the following remarks, which are as true now as when they were written twenty years ago. He says—

"After an attentive study of all the material ameliorations which the Administration has introduced into the service of these hospitals, it remains to examine the results attained by so many efforts, and so much solicitude for the care of the sick.

"Figures, rigorously exact, can alone enlighten us upon this point; but it is, unfortunately, only too certain that beyond the tables of mortality published annually, and which present, in an abstract form, the relation of the number of admissions to that of deaths, the hospitals of Paris have never possessed the essential and indispensable elements of a rational and conclusive system of statistics.

"It is true that since 1857 the Administration has gathered together from each hospital, an account of their great surgical operations and their results. But this is only a special side of the question, and, with regard to it, we shall see how defective their statements, the object of a special examination of a particular subject, really are.

"It should be, then, with the greatest reserve that the tables published by the administration since 1804 must be studied, to ascertain the death-rate in the hospitals, and the average duration of treatment.

"These documents can be studied with profit only on the understanding that they contain general facts and summaries, from which the light of circumstantial detail is absent." *

I have dwelt long, and placed great stress upon this matter, partly because it is one of the gravest and most injurious defects of our present hospital system, and, in part, because no perfectly satisfactory means of correcting other cardinal defects can be devised, unless their exact causes are accurately ascertained.

There is, probably, no branch of human knowledge, to which the application of the numerical method is better fitted, and from which it is calculated to yield a greater harvest of valuable truth, than to the logical interpretation of the facts of medical science. Nowhere can these facts be more perfectly collected and scrutinized, than in the practice of our hospital wards.

There is, at the same time, none other in which it is more necessary to guard against the fallacies incidental to, and, in some degree, inseparable from, this method of inquiry; in which more rigorous exactness is necessary in the collection of the facts themselves; and in which greater caution is required to avoid hasty or dogmatic deductions from mere numerical results.

It cannot be denied that the facts of medical science are so complex in their nature, so liable to be influenced by an infinite number of collateral and minor considerations, which can only be properly studied in public institutions under a continuity of control and observation impracticable in any other circumstances, as to render the application of numbers to their solution much more difficult, than to the interpretation of purely physical phenomena in any other branch of scientific inquiry.

All attempts, therefore, to compare large hospitals with small, to show the superiority of one form of construction over another, based on their mortality results, as at present ascertained, or on the average length of time cases were under treatment, are so deficient in scientific accuracy as to become mere guesses at the truth; and they must rely upon other data for their solution, still more fallacious than the partial and imperfect figures to which we now have access.

* *Etude sur les Hopitaux.* Husson: Paris, 1862, pp. 24, 7-8

Since the late Sir James Simpson and Professor Erichsen wrote upon the subject of hospitalism, a large amount of information has been collected which requires to be carefully digested; and if, with even such imperfect data as now exist, it can be shown that inexpensive huts and tents afford the best chance of restoration to health, and diminished risk to life to those struck down by accident or disease, and that costly palaces in the shape of monumental hospitals, not inaptly termed "Versailles of Misery," are liable to become abodes of pestilence, however well administered, some fixed rules for the guidance of the future will doubtless be adopted, to turn to the best possible account the experience of the past.

In dealing with health—which when once lost is so difficult to find again, and with life, the needless sacrifice of which can never be repaired—by statistical evidence alone, gathered in the hospitals themselves on a strictly scientific basis, can this consummation, devoutly to be desired, be attained; and by it alone will it be possible, in the words of Professor Radicke, of Bonn, "to stem the stream of baseless, and, to a great extent, erroneous doctrines by which medical science threatens to be overwhelmed."

II.—THE PRINCIPLES OF THE CONSTRUCTION AND ARRANGEMENTS OF HOSPITALS.

For more than a century past the subject of the construction of hospitals has attracted attention, and been discussed and re-discussed by a multitude of able men; sometimes with scientific precision uninfluenced by personal feeling; often with anger and acrimony, for few social questions have at times more strongly moved public feeling; and, not unseldom, with the profoundest sentiments of sympathy with the sick and suffering, and the most earnest desire to place them in the position best calculated to afford them the fairest chances of life, and restoration to health.

The labours of John Howard in this field are well known; and various other persons, particularly on the Continent of Europe, devoted attention to the matter long anterior to his time, as, for example, in a proposal to establish a convalescent hospital in connection with the Hotel Dieu in the middle of the 17th century, which, however, was never carried out; in the plan of a radiating hospital devised by Desgadets, the architect of Louis XIV., whose work is contained in a folio manuscript, deposited in the National Library of Paris; and, subsequently, in the various plans devised and discussed in relation to the rebuilding of the oldest Hotel Dieu, after the destructive fire of 1772.

In January, 1773, the administrators of the Hotel Dieu strongly advised its removal to the Plain of Grenelle, for the following reasons:—

"The public press has long demanded it; the restricted area of ground occupied by it; the corruption of the air and water; the injury which this house causes by its infection to everything surrounding it; the danger of fire, and a thousand other disadvantages seem to have united all suffrages on this point, if we except certain personal interests, which should always be set aside in such institutions."

And it was added, that it would free the Seine from the filth with which the Hotel Dieu pollutes it; it would procure pure air, vast courts, and gardens necessary for convalescents.

The first serious attempt to treat the subject with scientific accuracy was that of MM. Tenon and Bailly, when considering the grave defects of the old Hotel Dieu, and the best means of remedying them. The classical work of the former laid the foundations of the system now being adopted, and is the most valuable contribution ever offered on the question. It is somewhat singular, that after the lapse of nearly a century, the question of the entire removal of the same Hotel Dieu should again have given rise to prolonged discussions in the Academy of Medicine and the Surgical Society of Paris, and of the official commission appointed to consider and carry it into effect. It is still more singular that, in spite of all this, the new Hotel Dieu is still in Paris itself, and the experience of a century has been disregarded in its location, so persistent is error and so difficult to dislodge. The conclusions arrived at by the Société de Chirurgie have since guided the action of the most advanced reformers in this direction, as I shall endeavour to show further on. They preceded those issued officially in 1864.

The Crimean War, the contest between Prussia and Austria after the Schleswig-Holstein conflict, the great war of secession in the United States, and the Franco-German war, again strongly directed the attention of the public and of the profession to the best means of dealing with accidents, injuries, and disease in large bodies of men suddenly collected in overwhelming numbers, so as to avoid the fearful destruction of human life, inseparable from the old methods of managing such matters. The successful application of the arts of peace to the operations of war, was shown in the adoption of the principles so long since advocated by Tenon.

The removal of St. Thomas's Hospital, the building of the Herbert and Netley Hospitals, the reconstruction of the Edinburgh and the building of the Western Glasgow Infirmaries, and the building of several new hospitals in different parts of England, the best of which are indisputably some of the great Poor Law Infirmaries, attest the practical interest in the subject taken by ourselves.

The detailed report of Messrs. Bristowe and Holmes, with the remarks of the distinguished medical officer of the Privy Council, published as a Parliamentary paper, with the writings of Miss Nightingale and Captain Douglas Galton, are still authorities of value on this important and vexed question. More recently the hospital question has been taken up in Germany, and treated with the scientific accuracy and thoroughness characteristic of the German nation.

To attempt to take note of the ground covered by the various contentions in this century of conflict of opinion, would be as unprofitable as it is impracticable, in a reasonable compass. It is, however, unnecessary. It will be sufficient for my purpose to state the conclusions arrived at, after prolonged discussion in Paris in 1864, inasmuch as they have in the main been observed in the latest hospitals built on the Continent of Europe, and in some of those recently constructed elsewhere; the chief exceptions being the costly failures of the new Hotel Dieu and St. Thomas's Hospital, the former from a deliberate and intentional disregard of the true principles which have taken so long to establish, the latter from a singular, and not very intelligible misapplication of those principles. It is difficult to understand how those responsible for this latter structure could have considered its division into huge blocks, six stories in height from the basement,

connected by continuous closed corridors, with many of its internal arrangements equally defective, to be a correct representation of the pavilion principle, as understood and described by those who have so long advocated it. That it is, in its infancy, more unhealthy than many of the older hospitals is the truest test of the grave error which has been committed. With us the deathblow to the aggregate or palatial plan was given by the late Sir James Simpson and Mr. Erichsen ; for although the accuracy of the basis of the arguments of the former has been disputed, and the views of both have not obtained the same acceptance with us that they have done in other countries, their practical adoption in the most recent hospitals of Germany, France, and the United States affords the best possible proof of their accuracy.

It was well said by Leon Lefort, one of the most competent authorities on the subject, that it is sometimes supposed that the question of hospital construction is an easy one, that architectural considerations should predominate, that hospitals should serve for the ornamentation of towns, that they are as easily planned as streets, and that the science of health or hygiene has little to do with them. He disputes the correctness of this view, inasmuch as the best authorities on health and disease have shown that it demands the application of the most profound knowledge of medicine in all its branches, for its correct understanding.

The celebrated Philibert Delorme, the *protégé* of Catherine de Medicis, and first architect of the Tuileries, now about to rise from its ruins, in his "Traité Complète d'Architecture," published three centuries ago, foreshadowed the true principles involved in the construction of hospitals. "It would be better," he wrote "for the architect to fail in ornamentation, such as columns and facettes, which all study most, than in those rules of nature which tend to the convenience, use, and profit of the inhabitants, and not the decoration, beauty, and enriching of buildings, which are only for the contentment of the eye, and bring no advantage to the *life and health of man.*"

I pass over other authorities, some of considerable eminence, to come to one who will, I believe, exercise a more permanent influence on the whole question of collective dwellings than most of his predecessors or contemporaries. I refer to Monsieur C. Tollet, a French civil engineer and architect.

In 1876, M. Tollet presented to the Academy of Sciences in Paris a memoir concerning the principles which should regulate the construction of collective buildings for both men and animals. In it, he states, that he was thus inspired by views formulated for then a century by the most competent hygienists, views which have remained sterile by the united influence of routine and vanity, and by the irrational opinion that the potential voice was that of the constructor in a question of health, touching which the only profession competent to deal thoroughly with it, was scarcely considered, and when consulted, disregarded.

M. Tollet has applied his system successfully to barracks, schools, and hospitals. That system, which bears his name, is one of single-storied pavilions, raised on plinths and built in separate blocks on a peculiar form of construction—that of the spiral or pointed arch—which, in my opinion, unites in the greatest degree the best sanitary conditions with moderate cost, and the greatest permanent retention of healthy attributes. I shall refer more at length to them when I come to the general description of the St.

Eloi Hospital at Montpelier, and other institutions of a like character, constructed, or in progress, by him.

In the chain of hospitals now arising on the ramparts around Paris, in which old abandoned barracks have been utilised as administrative buildings, and wards on the Tollet system are constructed to contain the sick, will be found the means of best providing for the sick poor in their own localities, and of removing some of the old hospitals which are beyond the reach of remedy of the original evils of their construction. One of these Tollet institutions, the Hôpital Bichat, is completed and in use.

I shall not attempt to discuss the difficult and still undetermined problems connected with the causes of the vitiation of the air of a hospital, together with the conditions under which septicæmia and blood-poisoning occur in wounds, and in some constitutional diseases. The existence of such influences cannot be denied. Whether they be due to putrefactive fermentation, to the development of germs and living organisms, or to any more subtle and less easily detected general morbific agency, is comparatively of little importance in the determination of the question under consideration. The end to be sought is the best means of depriving these agencies of their power of mischief; and this is now admitted to be by placing all institutions in which many persons are congregated under the same roof, whether in health or in disease, in the best possible state to secure the utmost attainable purity of all the essentials of health and life, such as air, soil, water, and the agencies which affect an individual, or may from him extend to other persons, and ultimately infect whole communities. Hence I shall reproduce, *in extenso*, the conclusions arrived at in Paris, for reasons already stated; and after considering the leading features connected with hospital construction, briefly refer to such of the most recent as appear to be best fitted to fulfil their purposes.

The conclusions of the Surgical Society of Paris, after ten prolonged sittings, were as follows:—

"1. A hospital should be placed in an open space, upon a dry soil, with an inclined surface. This space should be large. A superficial area of fifty square metres (about sixty square yards) for each sick person is the minimum space that should be allowed, and this should be increased as much as possible, and should be augmented progressively with the increase of the number of sick.

"2. The air of a hospital will be pure in proportion to its distance from thickly-populated places. In the centre of cities, hospitals for urgent cases alone, which are necessarily restricted in numbers, and for clinical purposes, should be retained. This measure of health will be at the same time one of economy, as it will allow large towns like Paris, to instal their hospitals on large areas at less cost.

"3. Good hygienic conditions are easy to obtain in hospitals of from 200 to 250 sick. These conditions are impossible to obtain in large towns, if double the amount of these figures is exceeded. Within these limits of numbers, the expense for all purposes, is not in excess of that of hospitals containing larger numbers.

"4. The constituents of the atmosphere intermingle chiefly in a horizontal direction; hence the necessity of combating, by increased space, the effects of contact, and of the proximity which constitutes crowding and the influence of which is communicated from patient to patient, ward to ward, and from one building to another.

"5. To strive successfully against contagious influences not only needs an increase of the cubic space allowed to each sick person, but in addition, and above all, demands an increase of superficial area, which is at present insufficient in all our civil hospitals. For similar reasons the multiplication of stories is contra-indicated, as each of them generates a more or less vitiated atmosphere. From a rigorous hygienic stand-point, the superposition of stories should be limited to two.

"6. It is illusory to believe that a large cubical capacity in wards can replace an absence of external space and aëration, or to suppose that an abundant artificial ventilation can supply the place of either of those conditions. Nothing can compensate for the insufficiency or absence of natural aëration.

"7. Buildings completely isolated, and all having the same aspect, freely exposed to light, and to the action of wind and rain, should be placed in a single or in parallel lines, at intervals of from 80 to 100 metres (rather more than from 101 to 119 yards), so as to secure effective separation and external aëration.

"8. Small wards of from fifteen to twenty beds are easy to superintend with care. In them the mutual discomfort of patients, and the chances of direct contagion, are diminished, and the rapid removal of all impurities is increased. They are preferable for the ordinary care of the sick, and do not affect prejudicially the special arrangements required for certain classes of disease, which need more space and the isolation of separate rooms.

"9. The furniture of wards should interpose no obstacle to the free circulation of air. Bed curtains should be suppressed whenever it is considered necessary.

"10. Wards should be separated by partitions, or rooms devoted to common service. One of them should be used as a day and dining-room for the benefit of all patients able to get up, and thus cause a daily incomplete emptying of the sick room.

"11. The periodical and regular evacuation of all sick wards, and their complete rest for months at a time, have produced such good effects in the military hospitals of France, and in the hospitals of other countries, as to be deserving of general adoption, and is a pressing necessity in times of epidemics.

"12. Arrangements should be made to secure that all odorous and infectious matters, dejections, dressings, water used in cleansing, &c., should be rapidly destroyed or removed, and never be allowed to remain within or near the rooms occupied by the sick, or be permitted to cause any perceptible smell.

"13. The central administration of the hospitals should be supplemented and assisted by a permanent consulting (advising) committee of health, holding periodical meetings. This committee should consist of physicians, surgeons, administrators, architects, and engineers, with power to call into council all the heads of hospitals who are not members of the commission.

"The periodical meetings of the physicians, surgeons, and administrators of each hospital could furnish valuable advice to the central administration, to enable it to deal efficiently with all measures of progress."

Bearing these conclusions in mind, and knowing that, although susceptible of modification in some circumstances, they were based on a careful examination of the hospital systems of all countries at that time, and of our own in particular, I shall now proceed to consider the chief points which require examination, in any proposal for the building of the hospitals of the future.

These are (*a*) site and surroundings, (*b*) ventilation and warming, (*c*) water supply, (*d*) the dimensions and distribution of buildings and wards, (*e*) size of hospitals, together with (*f*) furnishing and fitting.

(*a*) Site and Surroundings.

An ideal site for a hospital would be where the conditions of soil, subsoil, drainage, water-supply, and all surroundings were most free from local causes of impurity, and where there were fewest buildings and habitations to exclude or intercept air and light, or to be themselves active agents in the creation of causes of unhealthiness, such as factories, workshops, &c.

Sufficient practical experience and knowledge of the subject have been acquired to show that gravel and sand are more likely to be healthy than clay or any impermeable medium, which needs costly artificial contrivances to get rid of surface moisture and soluble impurities; that a hillside would in most, but not in all, circumstances be preferable to the base of a hill; that an elevated plateau or plain would, in temperate climates, be more advantageous than a bottom or valley, and so on.

But the necessities of the times in which we live, particularly in great cities and centres of industry, compel us to select, not that which is best in itself, but what is procurable at least cost, and in most accessible proximity to those who need it.

In London, for example, most of the older hospitals, which are now in densely crowded, or in unhealthy localities, were, when they were originally built, either in open fields, or so far removed from buildings of all kinds as to be free from most of the reproaches which now attach to them. Each recurring census return in Europe and in the United States shows with what startling rapidity manufacturing and other industrial towns and cities are expanding, and how quickly the centres of population in them are shifting. A glance at the map, which will be found in the Appendix, will bring out in startling relief this fact as respects London. The census of 1871 gave it a population of 3,254,260 inhabitants, occupying an area of 125 square miles, in which the density of the population of the whole area was 40 persons to an acre, and in its most crowded and least healthy localities range from 205 per acre in Whitechapel, to 325 per acre in St. Anne's, Soho. The census of 1881 changed these figures considerably, as shown in the Appendix. Now, Switzerland, with a population of 3,000,000, is spread over 15,980 square miles; Sweden, with a little more than four and a half millions, occupies 171,000 square miles; Holland, with about four millions, 12,730 square miles; and Denmark, with scarcely half the population of London, 14,760 square miles.

In addition to this extreme pressure of population upon space and the means of subsistence, the map indicates the present provision of all kinds in the metropolis for sickness in all its forms, and how very unequally it is now distributed, as I shall endeavour to explain when treating of the organisation of its medical relief. The same fact is witnessed, although in a diminished degree, in the sixteen towns of the United Kingdom which have a population of more than 100,000, and in the half dozen others which have probably by this time reached that number. This condition must be carefully borne in mind in all discussions on the relative merits of town and country sites, as proper places for hospitals for the use of town populations.

Wherever practicable, general hospitals should undoubtedly be placed in the outskirts of towns, as near as possible to the bulk of the population who require to resort to them; and all convalescent hospitals, imbecile asylums, hospitals for incurables, and similar institutions, should invariably be placed well clear of the town. But hospitals attached to schools of medicine, and those which are intended for accidents, injuries, and acute cases which will not bear distant carriage, must still be in towns; hence their construction and arrangements should be so managed as to minimise the evils inseparable from their position.

Dispensaries, and all institutions for out-patients, or those who are not sufficiently ill to be confined to bed, should be placed in the midst of the populations needing them, for obvious reasons.

Every hospital, wherever placed, should be surrounded by a zone of aëration, unencumbered with buildings or any other cause of obstruction of light and air, to a distance of at least double the height of the buildings.

The interspaces, which should be found in all hospitals in town or country, should not be paved or concreted yards shut in by buildings, but open cultivated gardens, accessible to the convalescent, with shelter from the weather, so as to enable them to be as much in the open air as possible, whenever it is prudent or proper for them to be out of doors.

The aspect of a site, which will determine that of the buildings, should, wherever there is a choice in the matter, be such as to command the greatest amount of sunlight at all seasons. The duration, force, and other conditions of the prevailing winds should also be closely studied, as they now are in France and Germany, and the greatest care should be taken not to place hospitals where those winds blow over parts of country unhealthy, from whatever cause, natural or artificial.

The natural drainage and watershed of the locality should also be noted, together with its geological formation, where there is any choice of position.

(*b*) Ventilation and Warming.

Some authorities seem to think that the healthiness, or otherwise, of hospitals is more a question of ventilation than of any other condition—that, so long as you give to each occupant of a sick bed an adequate amount of space, cubical and superficial, and renew the atmosphere in which he lives and breathes, to such extent as to remove with sufficient frequency, all obvious and perceptible causes of impurity, without making this admission of itself a source of danger or annoyance—it matters little how many you place in each ward, to what extent you pile story upon story, or whether your hospital be placed in town or country. Some, again, appear to be satisfied that artificial systems of ventilation are of little or no use, and that what is termed natural ventilation is the only sound and efficient means of procuring a sufficient current of pure air, to counteract the unavoidably unwholesome influences of a sick ward. Others believe that dilution of the septic poison is sufficient to rob it of its power of mischief, provided it be carried to a sufficient extent.

I take leave to differ somewhat from all these views. Although not susceptible of strict mathematical proof from any statistical data at our command, there is an abundance of evidence on record of an adequately exact nature, as regards prisons, barracks, factories, schools, and other institutions in which large numbers of human beings are congregated under one roof, to prove that their healthiness, or the reverse, bears a direct and definite ratio to the numbers aggregated upon a given surface, each having a sufficiency of air for healthy respiration in ordinary circumstances. So true is this, that in many examples known to me personally, in India and elsewhere, a hygeiometric scale of their salubrity might almost have been constructed, based upon the increase or decrease of the number of persons contained in them, all other conditions remaining unchanged.

If two or three persons, sick or well, are placed in the space which only one can occupy with safety, not only is a state of atmosphere conducive to disease created, but disease itself is the result. A very striking example of this is mentioned in Tardieu's "Dictionnaire d'Hygiene Publique." From 1843 to 1847, whenever King Louis Philippe went to St. Cloud, the number of soldiers who were attacked by and died of virulent typhus fever, was very considerable. A disastrous epidemic broke out on every occasion eight days after the arrival of the King, but as soon as His Majesty left St. Cloud and returned to Paris, the fever disappeared and the troops were healthy. The condition of the soldier was the same; his food was the same; his clothing the same; his duty the same, except that there might have been more pomp and parade when the King was present than when he was absent; but, beyond that, he was not exposed to any of the vicissitudes of war which

could account for this unusual sickness and mortality. The cause of it was simply overcrowding. The usual garrison contained 400 or 500 men, for whom there was ordinarily ample space in the barracks, but when the King was present 1,200 men were packed into the same quarters; hence sickness and death, as always happens in such circumstances.

It is tolerably certain, again, that any one person can bear his own exhalations with comparative impunity, but, that he is liable to be poisoned by those of his neighbours, in an increasing ratio proportionate to their number. To such an extent is this correct, that if it were possible to place every sick or wounded person in a separate cell, and isolate him strictly from all others, the extension of all infectious diseases dependent upon a specific contagium, and all the ordinary forms of septicæmia, might be checked, and possibly extinguished.

The beneficial influence of such separation was remarkably illustrated by an involuntary experiment performed in one of the prisons under my supervision in Bengal. Towards the end of the Orissa famine, a large number of half-starved, sickly men were sent to a district jail, on account of certain grain robberies of which they were convicted. When that prison became dangerously overcrowded they were transferred to another prison in a different district, which had spare room. The majority of these prisoners were placed in fairly ventilated wards, with ample room for each, according to the standard measurement allowed. About 120, however, for whom there was no spare room elsewhere, were put in as many separate cells, having 480 cubic feet of space each, and practically without ventilation; for, although they had open grated iron doors, they were situated in long corridors at right angles to the prevailing winds. A considerable number of the former died from different diseases, but chiefly from diarrhœa; while there was not a single casualty among the latter, who were said to have been the sickliest of the lot on admission, and who were on this account placed in the cells, which had long been known as the healthiest part of the prison in question.

A remarkable paper has recently been published in the *Annales d'Hygiène et de Médicine Légale*,* by Dr. Layet, Professor in the Faculty of Medicine at Bordeaux, on what he terms "The Co-efficients of Aëration, or the Renewal of Air necessary to Prevent the Effects of Overcrowding in Inhabited Spaces." The professor contends that the quantity of air to be renewed for a person breathing in a space of 20 cubic metres, differs from that required for the same person breathing in a space of 100 cubic metres. In the same manner if three, four, five, or six persons breathe in the same space, the figure of ventilation would not be the same, as if each of them breathed in the whole extent of this space. There is, therefore, no uniform unvarying figure of ventilation, without reference to the size of the room, and the number of persons breathing in it. He has accordingly prepared a table of the co-efficients of aëration, to show at once the amount of air required to be renewed, in the different conditions of space and number, and, in addition to habitation, the deterioration caused by the ordinary processes of lighting, which rob air most of its oxygen, and return to it most carbonic acid gas. This is of

* No. 25, 4me Série, Jan. 1881.

importance where large numbers of people are assembled in a given space, and shows the considerable amount of air needed for renewal in such circumstances—a fact in harmony with the necessity at all times to counteract the ill effects of overcrowding, and other causes of devitalisation. The table, which appears to me to be one of considerable interest, is contained in the note subjoined,° and the question has been discussed

* Table of Co-efficients of Aeration.

Space in Cubic Metres.†	Co-efficient of Aeration or quantity of air necessary per man and per hour.	Co-efficient of Aeration per candle producing 15·45 litres of Carbonic Acid per hour.	Co-efficient of Aeration for a lamp burning 42 litres of oil per hour, and producing 55·65 milli-litres of Carbonic Acid per hour.	Co-efficient for jet of gas, giving a light equal to that of preceding light, and producing 88 litres of Carbonic Acid per hour.
	Metr. Cub.	Metr. Cub.	Metr. Cub.	Metr. Cub.
4	151·000	...	...	...
5	121·000	...	...	...
6	101·000	...	...	...
7	86·600	...	...	...
8	76·000	...	...	...
9	67·600	...	...	...
10	61.000	31·900	110·300	177·000
15	41·000	21·600	75·200	118·300
20	31·000	16·450	56·000	89·000
25	25·000	13·480	45·520	71·400
30	21·000	11·300	38·000	59·666
35	18·200	9·828	32·800	51·285
40	16·000	8·722	28·824	45·000
45	14·520	7·866	25·733	40·111
50	13·000	7·180	23·250	36·200
55	11·900	6·618	21·236	33·000
60	11·000	6·150	19·550	30·333
65	10·230	5·754	18·123	28·160
70	9·600	5·410	16·900	26·142
75	9·000	5·120	15·840	24·570
80	8·500	4·862	14·912	23·000
85	8·294	4·635	14·139	21·770
90	7·650	4·525	13·366	20·555
95	7·540	4·253	12·748	19·570
100	7·000	4·090	12·130	18·600
105	6·512	3·945	11·623	17·800
110	6·454	3·800	11·116	17·000
115	6·216	3·686	10·692	16·200
120	6·000	3·572	10·275	15·666
125	5·800	3·474	9·904	15·100
130	5·616	3·376	9·571	14·538
135	5·444	3·291	9·255	14·055
140	5·284	3·206	8·950	13·571
145	5·136	3·131	8·682	13·150
150	5·000	3·060	8·420	12·733
155	4·870	2·992	8·188	12·370
160	4·750	2·931	7·956	12·000
165	4·636	2·874	7·752	11·676
170	4·530	2·818	7·547	11·352
175	4·430	2·762	7·365	11·120
180	4·332	2·716	7·183	10·889

† A Cubic Metre is 35·316581 Cubic Feet English.

at a meeting of the Society of Public and Professional Hygiene in Paris, where it was objected that the method was defective in taking note only of the amount of carbonic acid and aqueous vapour present in an atmosphere breathed by many persons, whereas it is the presence of organic matters that is really most injurious in such circumstances. True as this may be to a certain extent, the impurity caused by carbonic acid is a factor

TABLE OF CO-EFFICIENTS OF AERATION—*(continued.)*

Space in Cubic Metres.	Co-efficient of Aeration or quantity of air necessary per man and per hour.	Co-efficient of Aeration per candle producing 15·45 litres of Carbonic Acid per hour.	Co-efficient of Aeration for a lamp burning 42 litres of oil per hour, and producing 55·65 milli-litres of Carbonic Acid per hour.	Co-efficient for jet of gas giving a light equal to that of preceding light, and producing 88 litres of Carbonic Acid per hour.
	Metr. Cub.	Metr. Cub.	Metr. Cub.	Metr. Cub.
185	4·242	2·666	7·020	10·576
190	4·157	2·626	6·857	10·263
195	4·076	2·585	6·711	10·030
200	4·000	2·545	6·565	9·800
205	3·922	2·508	6·432	9·590
210	3·852	2·482	6·300	9·381
215	3·800	2·458	6·179	9·200
220	3·726	2·445	6·039	9·000
230	3·608	2·344	5·865	8·652
240	3·500	2·285	5·663	8·346
250	3·400	2·236	5·452	8·040
260	3·306	2·188	5·291	7·810
270	3·222	2·143	5·130	7·580
280	3·142	2·103	4·983	7·325
290	3·068	2·066	4·837	7·070
300	3·000	2·030	4·710	6·866
320	2·874	1·955	4·490	6·512
340	2·764	1·915	4·272	6·158
350	2·715	1·872	4·180	6·028
360	2·666	1·840	4·133	5·830
380	2·579	1·810	4·086	5·634
400	2·500	1·772	3·782	5·400
420	2·428	1·726	3·670	5·200
440	2·362	1·713	3·550	5·000
450	2·304	1·700	3·473	4·911
480	2·254	1·659	3·350	4·715
500	2·200	1·618	3·226	4·520
520	2·154	1·596	3·105	4·390
540	2·111	1·575	3·080	4·258
550	2·071	1·562	3·025	4·200
580	2·034	1·538	2·940	4·026
600	2·000	1·515	2·855	3·853
650	1·922	1·475	2·712	3·708
700	1·857	1·440	2·590	3·516
750	1·800	1·421	2·482	3·346
800	1·750	1·388	2·391	3·200
850	1·727	1·365	2·325	3·080
900	1·666	1·343	2·256	2·955
950	1·632	1·326	2·185	2·830
1,000	1·600	1·309	2·113	2·760
1,500	1·400	1·206	1·742	2·173

of sufficient importance to be able to determine in all circumstances, for it is chiefly upon this, that most of the practical rules adopted in ventilation are based, and upon it is founded the doctrine of the amount of cubic feet of air necessary for healthy respiration

TABLE OF CO-EFFICIENTS OF AERATION—*(continued.)*

Space in Cubic Metres.	Co-efficient of Aeration or quantity of air necessary per man and per hour.	Co-efficient of Aeration per candle producing 15·45 litres of Carbonic Acid per hour.	Co-efficient of Aeration for a lamp burning 42 litres of oil per hour, and producing 55·65 milli-litres of Carbonic Acid per hour.	Co-efficient for jet of gas, giving a light equal to that of preceding light, and producing 88 litres of Carbonic Acid per hour.
	Metr. Cub.	Metr. Cub.	Metr. Cub.	Metr. Cub.
2,000 ...	... 1·300 ...	... 1·154 ...	... 1·556 ...	... 1·880
2,500 ...	... 1·240 ...	... 1·138 ...	... 1·445 ...	... 1·704
3,000 ...	... 1·200 ...	... 1·103 ...	... 1·371 ...	... 1·587
3,500 ...	... 1·172 ...	... 1·088 ...	... 1·325 ...	... 1·518
4,000 ...	... 1·150 ...	... 1·062 ...	... 1·278 ...	... 1·440
5,000 ...	... 1·120 ...	... 1·060 ...	... 1·222 ...	... 1·352
6,000 ...	... 1·100 ...	... 1·051 ...	... 1·185 ...	... 1·293
7,000 ...	... 1·080 ...	... 1·044 ...	... 1·158 ...	... 1·251
8,000 ...	... 1·074 ...	... 1·038 ...	... 1·139 ...	... 1·220
10,000 ...	... 1·060 ...	... 1·031 ...	... 1·111 ...	... 1·176
20,000 ...	... 1·030 ...	... 1·015 ...	... 1·055 ...	... 1·088
40,000 ...	... 1·014 ...	...	...	...
60,000 ...	... 1·001 ...	...	...	...

Now, as to the manner of working this Table:

Suppose one person to breathe in a space of 10 metres, we see at once in consulting the second column that the quantity of fresh air to be introduced is 61 metres per hour. In another space of 100 cubic metres, for instance, a school-room, if there be but one scholar in it, 7 cubic metres an hour of pure air will be sufficient to introduce. If there is one pupil and a lighted lamp, there will be required 7 cubic metres + 12 cubic metres, or 130 litres, which corresponds in the fourth column to the space of 100 cubic metres.

If instead of one pupil there should be 10, each of these ten would have 10 cubic metres, and for each of them the corresponding co-efficients at 10 metres each would be 61; the total amount of fresh air per hour would be equal to ten times these 61 metres, or 610 cubic metres. If, with the above, there were two lamps, each vitiating 50 cubic metres, twice the co-efficient of 50 cubic metres should be added, that is to say, twice 23 cubic metres, 250=48 cubic metres, 500: from which it follows that ten pupils breathing in a room of 100 cubic metres, lighted by two Carcel lamps, the co-efficient of total aëration would be 656 cubic metres, to give 500 per hour.

The following prefatory remarks in Dr. Layet's paper, explain the grounds on which the above calculations are based:—

"It is generally admitted by physiologists, that an adult man takes into his lungs (inspires) 10 cubic metres of air (353·17 cubic feet), which gives 7 litres (each litre being one part, three quarters and 1-100th) a minute, or 420 litres an hour. Consequent on the change which it undergoes in the lungs during respiration, this adult takes in these 420 litres, 22 litres, 320 of oxygen, and throws out in the expired air 19 litres. Two hundred of carbonic acid is, in round numbers, 20 litres + 20 gr. 40 of watery vapour.

"Suppose, then, a space of 10 cubic metres, in which a single person breathes, these 10 metres have the normal vitiation, *i.e.*, $CO^2 = 0{\cdot}0005$. At the end of an hour his breathing will have thrown out 20 litres of carbonic acid, which are $\frac{20}{10000}$ of 10 cubic metres. These 10 metres then present at the end of an hour a figure of vitiation equal to $\frac{5{\cdot}20}{1000}$ or 25 ten thousands; at the end of 10 hours, the figure of vitiation will be represented by the 5 ten thousands of normal vitiation already existing, plus ten times 20 litres, or $\frac{205}{10000}$. What then must be the amount of air which must be introduced and breathed during these ten hours, so that the amount of vitiation caused by carbonic acid gas must stand at the normal rate 0·0005?

"Let x be the quantity of air necessary, 205 must be to x as 5 is to 10,000, and a rule of three calculation gives for x the figure of 410 cubic metres. But as x is the quantity which has been breathed in 10 hours, it has only to be divided by 10, to give the co-efficient of aeration per hour and per person for a space of 10 cubic metres, which is 41 cubic metres. In this calculation no account is taken of the organic matters held in suspension in the surrounding aqueous vapour. In representing by 10 litres the mean of the watery vapour which remains in suspension in the air—watery vapour which is fed by our perspiration and by respiration—it is in this quantity of water that the organic products exhaled are contained; so that it is an hourly mean of 30 litres of gas and noxious vapours in our normal state, and not the causes of vitiation only derived from ourselves, that we have to compensate by a renewal of air. The calculation is the same, but it acts upon 30 instead of 20 litres."*

* *Layet:* Revue d'Hygiene et de Police Sanitaire, vol. ii., pp. 1091-1099.

in all circumstances. Professor Tyndall's lecture on Dust, and the labours of Pasteur and others on the nature of Organic Impurities, are gradually throwing a flood of light upon the whole question, and prove that the fewer the number of sick persons collected in a given space, however perfect the ventilation and other physical conditions, the better, and the more likely they are to escape the consequences of the particular vitiation of the atmosphere which causes blood-poisoning in most of its forms.

The problem, then, to be solved in all questions of ventilation is somewhat complex; hence the difficulty of dealing with it in such manner as to establish a general law applicable to all places and circumstances, as well as to all seasons and climates. From this cause, doubtless, arise the very different plans recommended by the highest authorities, engineering and medical.

The conditions to be secured are the utmost purity of air obtainable; that it shall never fall below the normal standard of the external air, or contain more than 000·5 of CO^2 Gas; as uniform a temperature as is found to be consistent with the maintenance of health at different seasons, and as rapid a renewal conformable to the above conditions, as will secure that as little vitiated air as possible shall enter the lungs in each act of respiration. Physiology and chemistry have scarcely dealt decisively with the first two factors, for persons in health, since Arago considered 10 cubic metres an hour to be necessary; General Morin from 20 to 25 for an adult; M. Hudelo 30; and M. Wazon 40 cubic metres for a full grown person, so that in any case the introduction of fresh and the removal of effete air, must be tolerably rapid and complete in all circumstances. Pathology is still engaged in determining what amount and kind of organic impurities are prejudicial to persons in health and injurious in disease, not only in relation to the individual, but to his becoming in turn a focus of infection to others; for it is in this manner that zymotic diseases arise and extend. The sick, moreover, require a larger amount and more rapid renewal of fresh air than those in health.

The advocates for the antiseptic system of surgery again claim that it has removed some of the important objections to the old plans of hospital construction and aëration, in a manner and to an extent which I consider to be extremely doubtful, but with this I shall deal anon.

The measure of the purity of the atmosphere surrounding a building of any kind, will be that of the air finding its way into it, and its temperature will stand in very much the same relation. Hence the necessity of artificial contrivances to regulate it, in the extremes of heat and cold. But, in so mild and equable a climate as ours, expensive and complex contrivances for artificial ventilation do not appear to me to be needed so much as they are in the hospitals of the northern parts of the United States, and in Central and Northern Europe.

All mechanical arrangements for ventilation should include warming, as a measure of economy as well as of comfort. Not only does the air of a sick ward need to be pure and of uniform temperature, but the floors ought equally to be warmed, as they were in old Roman buildings, and are in China. There are many and ingenious and efficient contrivances for effecting this.

The union, then, of natural and artificial ventilation, the former by means of sash windows, Tobin's tubes, and a multiplicity of simple means of admitting and removing air, the latter by open fires, acting as ventilating shafts, supplemented by the moderate and judicious use of warm water coils, will usually accomplish all that is desired.

To attempt to enumerate the infinite mechanical devices by which all this can be accomplished, is impossible. They may safely be left to the architect and the engineer, for whose guidance there is an abundant literature on the subject, both as to the end to be attained, and the means of securing it. They will be dealt with authoritatively in the second part of this work.

A point generally disregarded in all discussions on the subject of ventilation, is the purification of the air itself in sick rooms, which constantly contain the elements of their own corruption. These septic agencies may be diluted, and, to a certain extent, removed, by constant and rapid renewal of the hospital atmosphere; but they have a tendency to attach themselves to walls, bedding, &c., and their entire removal is a matter of much importance—so subtle is their action, so difficult their detection, and so imperfect our knowledge of the exact mode of their operation.

The Hindus of every part of India with which I am acquainted, have, from time immemorial, possessed a means of purifying the atmosphere of their rooms and huts, by spreading a light coating of a mixture of earth containing organic matters, on their walls and floors, which enables them to dispense, to a considerable degree, with ordinary ventilation. The process is called "leoping," and is usually performed by the women of the household. With a view to submit this proceeding to a practical test, I had four cells in the Presidency Jail of Calcutta, each containing 480 cubic feet of air and practically unventilated, carefully prepared. Two of them were limewashed throughout, and the two others "leoped." I had four healthy prisoners locked up in them at night, one in each cell. On opening the cells next morning, the two which were limewashed were stuffy and offensive, redolent of the peculiar animal odour exhaled by native prisoners in such circumstances. The two others were as fresh and as pure as if no one had slept in them. This led me, as head of the prison department, to direct the application of the principle generally in all the jails under my administrative control, so far as it was susceptible of direct application to walls, floors, and earthen beds. I also employed charcoal extensively for the same purpose—the purification of the air of prison wards from animal exhalations—and, I had reason to believe, with success. This seems to me to be deserving of careful trial in Europe.

In crowded cities, and in all positions in which the external air is likely to be contaminated by organic matters and malarious emanations, in winter especially, it might be subjected to a certain appreciable amount of purification by being passed through cotton-wool or charcoal, particularly in winter, when all openings for the direct admission of the cold external air are compulsorily closed.

Some writers have recommended that the walls of all masonry hospitals should be porous, to admit of the penetration of air at all times. This would, however, be attended with the grave disadvantage of their intercepting and retaining septic poisons. Masonry walls should therefore, I am of opinion, not only be absolutely impenetrable, but be coated

with some hardened substance capable of being thoroughly cleansed without injury whenever such a proceeding is desirable or necessary.

In some great hospitals, in addition to the effete air of the buildings generally, that of all waterclosets, sinks, and fire-places, and all other sources of noxious exhalations, are passed through a great central ventilating shaft, represented by a tall, towering chimney. This does not appear to me to be in all situations a safe proceeding, and it may possibly explain the cause of the origin of the sickness, which is said to find its way into houses situated in the immediate vicinity of some of the great hospitals in Paris.

I have dwelt thus at length upon the subject of ventilation because, as I have already mentioned, some eminent authorities regard the whole matter of the unhealthiness or otherwise of hospitals to be mainly a question of this character. Hence also the coining of the barbarous term "hospitalism," which has led to much of the "logomachy" and differences of opinion which have arisen on the hospital question.

The French term "*malaria nosocomiale*" is both more correct and expressive, and if it could be condensed into a single word, such as "nosocom-aër," would be preferable to Sir James Simpson's invention, which is liable to considerable misapprehension, and includes other conditions which have no real connection with the atmosphere of hospitals.

I assume that the best adjunct of all schemes of ventilation—scrupulous cleanliness—is observed, as it undeniably is in every well-regulated hospital in this country, particularly since the introduction of a higher class of nurses, for it is upon their intelligent and incessant care and attention, that the absence of all noxious agencies from impurities of any kind, of person, place, or appliances, is dependent. Associated with the purity of person and place is that of the disinfection and cleansing of all clothing and bedding, and the immediate destruction of all dressings, &c., for which, as a rule, due and proper provision is or requires to be made.

(*c*) Water Supply and Drainage.

The question of water-supply is one of the greatest importance in relation to the healthiness of hospitals, for if soluble impurities be dangerous to persons in health, their ingestion into the systems of the sick is still more injurious, from their diminished power of resisting disease. The great attention now paid to the subject, and the improved supply and distribution in all our larger towns, secure an abundant, and it rests with the hospital authorities to make it a wholesome, allowance. When hard it should be rendered soft by the Porter-Clark process, and the supply should be constant and practically unlimited, for at least double the quantity needed for the healthy, is required for the sick.

Connected with water-supply is that of baths, and in this respect the French and German hospitals are, as a rule, much better furnished than our own. Every large hospital should have a complete system of baths for cleansing and therapeutic use, such as are now found in the University College Hospital of London; and all smaller institutions throughout the country should be supplied with both fixed and movable baths.

Should the water-supply in country places be obtained from wells, or from storing of rain water, the greatest attention to its purity should be paid. The drainage in towns must of necessity be connected with the general drainage of the locality, and exceptional care be taken for the disconnection of the drains and pipes of all kinds with the wards, by means which are now well known to all architects and engineers. To cause the ventilation of closets, sinks, and lavatories to be connected with great chimneys in crowded localities I hold to be erroneous, and likely to be injurious, as they are now believed to be. To allow them to ventilate directly or indirectly into the sick wards, or into any part of the building, is a fatal and mischievous error, for there are no more efficient agents of evil in disseminating foul air throughout a many-storied structure, than staircases and corridors which act as ventilating shafts, and rapidly render the atmosphere of such places impure in composition, by the operation of the general law of the diffusion of gases. The measure of the worst will, in a few hours, become that of the best, and the upper floors consequently be less pure and wholesome than those lower down, in many-storied buildings.

When hospitals of any kind or class are isolated, and unconnected with any general system of drainage, all excretory matters should be strictly dealt with on one of the dry systems in use, and on no account should connection with cesspools or tanks, or any scheme of sewage utilisation with water be allowed, unless all such matters are previously disinfected. The more carefully they are deodorised, and, if necessary, as in typhoid dejections, disinfected, the less liable they will be to prove injurious before they are returned to the great natural purifier—the earth—aided by rapid vegetation.

In the construction of all hospitals proper provision for the above purposes should never be neglected, or sacrificed to any false economy, as too often obtains at present.

(*d*) Distribution and Dimensions of Buildings and Wards.

In all the most recent hospitals of Germany, France, Belgium, the United States, and Scotland, and in several of our great Poor-law infirmaries, the pavilion plan has been adopted for the sick wards, and all accessory and administrative buildings are more or less completely separated from them. In some the blocks of all kinds are absolutely detached, without connecting corridors of any kind (Friedrickshain in Berlin, the John Hopkins Hospital at Baltimore, the Fever and Small-pox Hospitals at Glasgow). In others the separation is nearly as complete, having external open covered passages for intercommunication (the Heidelberg Hospital, the St. Eloi Hospital at Montpellier, and other similar buildings on the Tollet system in France). In a third arrangement the intercommunication is by means of closed corridors and staircases run up to the first floor, thus leaving the sick wards as respects their aëration and lighting partially detached (the Menilmontant Hospital in Paris, the Royal Infirmary in Edinburgh, the Western Infirmary in Glasgow, and several Poor-law infirmaries).

I omit all reference to such institutions as the new Hotel Dieu in Paris, and St. Thomas's Hospital in London, as their cost alone prohibits their being accepted as examples for imitation, even if they were not, as I believe them to be, defective in other

respects. Some recent Poor-law institutions, well constructed and otherwise not badly arranged, are made to contain from one to two thousand inmates—an aggregation of sick, in mind and body, universally condemned by the medical authorities of all countries, and therefore not to be quoted for instruction or guidance; for in them, the cardinal principles which should regulate all such matters, are sacrificed to administrative convenience and economic reasons. As a rule, in all the above forms of arrangement the administrative buildings are centrally situated; and the out-patient departments, pharmacies, laundries, kitchens, nurses' and servants' quarters, &c., are grouped in the manner most convenient for the general administration of the whole institution. They will of necessity vary very considerably, according to the uses and size of the hospital, and its connection or otherwise with a medical school.

It is obvious that if kitchens, laundries, and store rooms have any tendency, as some of them must have, to create an atmosphere likely to be prejudicial to the sick, their complete separation is the only perfect plan of dealing with them. The arrangements will be mentioned in connection with the special institutions described in Part II., as illustrating the most recent forms of hospital construction which have found acceptance —such as the Menilmontant Hospital in Paris; the St. Eloi Hospital, about to be erected at Montpellier, in France; the Friedrichshain Hospital at Berlin; the Western Infirmary at Glasgow; the St. Marylebone Infirmary just completed; and an example of a town hospital in New York on the many-storied plan, which is a remarkable and successful attempt to adapt old principles of construction to modern sanitary requirements in a restricted locality.

The number of beds a hospital should contain must depend so much on its nature and position, coupled with the needs of the population in whose midst it is placed, that no fixed rule can be adopted, such as the Chirurgical Society of Paris hinted at, in its third conclusion. Sanitary conditions, subordinated in a limited degree to administrative and economical convenience, are alone entitled to consideration in the determination of the question.

If economy of administration alone were consulted, or in combination with a decrease in the cost of the ground on which a hospital is placed, the number of beds might practically be unlimited, as it was in that pest-house, the old Hôtel Dieu; and as it is in a lesser degree, in some of the older general, and more recent poor-law hospitals. The number of stories on the same base and covered by the same roof might in such circumstances be as many as could be occupied with safety, by means of lifts and similar contrivances. But, supposing these conditions to be correct, which they assuredly are not, the limit of the sick who may safely be congregated on a given area is soon reached, and would long since have been determined with absolute accuracy, had proper hospital records been kept. The problem to be solved has been well put by M. Trélat. He said—

"It is now an undisputed fact that great collections of men and animals generate a condition of health, which is injurious to all exposed to it. Whether these aggregations are temporary or permanent, accidental or periodic, much or little crowded, in a close or an open space, consisting of healthy or sick, the result is always of the same character. The effects of aggregation soon make themselves felt, varying only in their intensity and gravity according to their internal conditions."

Dr. Farr, in the Twenty-fourth Annual Report of the Registrar-General (p. 230), constructed a table to show the relative mortality of hospitals, based upon the number of their inmates.

PRINCIPAL GENERAL HOSPITALS IN ENGLAND AND WALES, 1861.

(Special Hospitals excluded from this Table.)

	Number of Hospitals.	Inmates.	Average number of Inmates in each Hospital.	Deaths.	Mortality per cent.
Hospitals containing 300 inmates and upwards... ...	5	2,090	418	2,101	100·53
200 and under 300	4	913	239	838	91·78
100 and under 200	22	2,898	132	2,041	70·43
Under 100	49	2,634	54	1,240	47·08
Total	80	8,535	107	6,220	72·88

It is obvious that there are so many sources of fallacy underlying such a statement, so many conditions necessary to be understood are not mentioned, so much difference in the classes of sick admitted to such institutions, and the period over which the inquiry extends is itself so extremely limited, that the table is of no further scientific value than as embodying a rough approximation to what may prove to be a truth, on a more extended and strictly scientific examination.

Mr. Lawson Tait has constructed tables on a wider and more reliable basis for determining the same question, with a nearer approach to accuracy, as the following statement shows:—

SUMMARY OF THOSE HOSPITALS (179) FROM WHICH COMPLETE INFORMATION WAS OBTAINED.

(Arranged in Groups, according to the number of Beds in average occupation.)

No.	PERIOD OF OBSERVATION—1861-70.	Average Beds Occupied.	Average number of Patients to each Bed.	Mean Residence in Days.	Mortality per cent. of Beds.	Mortality per cent. of Patients.	District Mortality per 1,000.	REMARKS.
I.	54 Hospitals under 5 beds ...	2·82	12·	34·5	62·92	5·03	20·14	
II.	12 Hospitals from 5 to 9 beds	6·82	11·14	32·03	59·97	5·02	21·25	
III.	26 ,, ,, 10 to 19 ,,	13·44	11·3	32·23	79·77	7·00	21·	In this III. Group there are 6 hospitals, with an average mortality of 11·57 and if these were eliminated the average mortality of the 20 others would be 5·636, and the bed rate 61·26.
IV.	8 ,, ,, 20 to 29 ,,	25·	9·4	39·65	46·16	5·63	21·	
V.	6 ,, ,, 30 to 39 ,,	33·96	9·88	35·12	58·09	5·94	22·3	
VI.	8 ,, ,, 40 to 49 ,,	43·77	9·6	40·17	57·06	5·97	22·3	
VII.	11 ,, ,, 50 to 74 ,,	61·88	10·35	36·33	61·69	5·77	21·8	
VIII.	15 ,, ,, 75 to 99 ,,	84·05	11·08	34·26	77·54	6·66	24·13	
IX.	10 ,, ,, 100 to 124 ,,	113·35	11·85	32·48	79·18	6·7	24·	
X.	17 ,, ,, 125 to 199 ,,	143·74	11·95	31·46	93·34	7·92	24·92	
XI.	5 ,, ,, 200 to 299 ,,	211·91	12·39	30·18	118·85	9·15	30·6	
XII.	7 ,, over 300 beds	417·3	10·74	33·38	101·53	9·6	25·	If the mortality were the same in XII. as it is in XI. (that is ·433 less), 140 lives a year would be saved.

Regarding this table, Mr. Tait remarks, as all statists hold it to be, "that if the employment of large masses of figures enables us to get rid of minor errors, I think I

may fairly say that the returns now before us afford as reasonable a basis for estimating what really is the mortality of our general hospitals, as can be obtained;" and he adds, "that if all hospitals would keep their records correctly, and publish all necessary details, their relative and absolute utility could be rightly estimated." *

The same accurate authority shows that mere size has not a constant influence in raising the death-rate of a hospital, and that by mismanagement and other causes, a small may be made as unhealthy as a large hospital.

Again, although I at one time accepted and acted upon the doctrine of averages as the surest basis for determining mortality rates in public institutions, I am now disposed to think that a more correct comparative estimate of the healthiness or unhealthiness of hospitals would be obtained, by calculating the number of deaths on the actual number treated, and by determining the actual risk to life of a day's residence in each institution. From a statement of this kind recently published by Monsieur Loua in the *Journal de la Société de Statistique* of Paris, it appears that in the hospitals of the whole of France the mortality rate from 1871-6 oscillated between 8·5 and 10·5 per cent. of the actual number treated, and the risk to life of a day's residence in hospital from 0·00237 to 0·00327. In 1876 it was 0·00268, while the daily risk to life of each individual of the entire population was 0·000063, from which it follows that the chances of death in a hospital were forty-two times greater, than in the ordinary conditions of life. The sick, however, are only subject to this increased risk during their actual stay in hospital. All such modes of calculation must, however, of necessity be incomplete and fallacious, and no plan will afford even an approximation to scientific accuracy until the whole of the factors involved—age, sex, hereditary tendencies, actual disease, accident or injury, occupation or position in life, &c., &c.—are carefully collected and collated. All this has not yet been done, even in relation to amputations and obstetrics.

A curious experience of the superior value of the pavilion to the block system of hospital construction, was acquired during the occupation of Paris by the allied armies in 1814. The sick and wounded soldiers, French and foreign, were treated in the hospitals until no more room could be found for them, when they were placed in the slaughter-houses, vacated for the purpose. In the great hospitals, the Hôtel Dieu, Pitié, and St. Louis, the mortality of wounded French soldiers ranged from 1 in 5, to 1 in 8. In the abattoirs (slaughter-houses) of the Roule, Montmartre, and Menilmontant, the number of deaths among the French varied from 1 in 7, to 1 in 13. Of the foreign soldiers wounded, the deaths in the hospitals were from 1 in 7, to 1 in 13; and in the slaughter-houses, 1 in 10, 1 in 11, and 1 in 19. So struck was the Conseil-Général des Hôpitaux by these results, that they reported, "That the use made of the buildings (abattoirs) for the treatment of the sick had made it manifest that their distribution was better fitted for their new use, than any of the existing hospitals. That experience had thus proved the correctness of the views of Tenon and Bailly in their reports on the [old] Hôtel Dieu, and the utility of the division of hospitals into separate pavilions—an idea which should be followed in the construction of all hospitals, in which should be united conditions of health and

* *An Essay on Hospital Mortality*, by Lawson Tait, F.R.C.S.: London, 1877; pp. 42 and 43.

convenience." Still earlier in the field was our own countryman, Dr. Brocklesby, an army physician, who published in 1764 a nearly forgotten work, under the title of "Œconomical and Medical Observations, from 1758-1763," tending to the improvement of military hospitals, and the cure of camp diseases incident to soldiers, &c. This work has been rescued from oblivion by one of the most learned and philosophical writers of our time, Dr. Guy, in his Lectures on Public Health, and will be referred to again when I speak of hut hospitals and tents, and their proper place in the treatment of disease in civil life.

It is now beginning to be ascertained that the accumulation of large numbers of sick in hospitals, in addition to being detrimental to themselves, is a source of danger to those dwelling in their immediate vicinity; and that this is especially true of fever and of all other hospitals in great cities or densely-peopled localities.

Nearly a century since, Sir William Blizard wrote—

"Hospitals are too much crowded with patients. Parade of numbers blinds the judgment, and diverts attention from simple principles and clearly deduced rules of conduct. The system of hospitals in respect of numbers, is founded on a glaring error. By curing, relieving, and dismissing in a shorter time, the sum of patients admitted in a given period, may be even greater from a less, than from a larger number of inhabitants. However airy, then, the situation of a hospital, of whatever amplitude and number its wards, still its happy effects will be governed by the proportion of sick persons within its walls. It may be admitted, upon the whole, that the limitation of number in hospitals should be far below what it generally stands."

The late Dr. Rumsey, in one of his excellent papers on "Some of the Fallacies of the Statistics of Health and Disease," sums up the general results of the discussion on hospital mortality in the following words:—

"(1) That the disease in hospitals and other large institutions, especially the mortality following operations (and universally that after childbirth), are greatly increased by the mere aggregation of patient and, *cæteris paribus*, in proportion to the density of that aggregation, apart from all other circumstances which might affect success or endanger life; (2) that the death-rate calculated, as it should be, on the number of patients, and not on the number of beds, increases with the size of the establishment and the number of its inmates; and (3) that wherever this assemblage of the sick and hurt occurs in the centre of a crowded population, the rate of mortality attains its maximum."

In strict relation to its uses, the number in a hospital may range from the few beds in a cottage hospital, through every stage of increase, to the large hospitals required for town populations, which, in turn, will each fulfil its functions by restriction of its beds to a maximum of 200 or 300; whilst in the vicinity of great cities, where ample ground is procurable at reasonable cost, and the pressure on space is minimised by subdivision, there may be 600 beds, which number should never, in my opinion, be exceeded on any pretext whatever.

As to the number of beds in a ward, however ample and complete the ventilation and healthy the surroundings, they ought never to exceed thirty-two, with annexes containing one, two, or three beds for the separation of cases which need them. Indeed, it would be better if the numbers were still more limited, were it not for the difficulty and cost of nursing the sick scattered through a large number of very small wards. Each pavilion in which they are placed should be self-contained, with provision for nurses, baths, water-closets, lavatories, small kitchen, and all other accessories. The minimum of cubic space

allowed should be 1,200 feet, and of floor space ninety-six square feet for ordinary cases of sickness, these quantities being increased for surgical cases, and for all diseases causing exceptional deterioration of the air of a ward. But one bed should, if possible, be placed in the interspaces or piers of windows, and two rows of beds should never be exceeded in a ward, of which the width should vary from twenty-four to thirty-feet—the latter in clinical wards only—and all beds should, if possible, be nine feet apart, as wisely obtains in the new Royal Infirmary at Edinburgh.

As to the number of stories of which the portions of hospital buildings devoted to the sick should consist, I entirely agree with the views of the Chirurgical Society of Paris, and in the manner in which they are now being carried out in Germany, Belgium, in the United States generally, and by M. Tollet, in France. Professor Lister is reported to have said to a distinguished surgeon of New York, in reply to a question as to how far the construction of a hospital would be likely to influence the results of antiseptic surgery—a question suggested by the four stories of superposed wards at Blackwell Island, which he was then visiting—"It is immaterial how many stories of wards there may be in a hospital, provided that the details of the antiseptic method are accurately carried out in them all. If these details are faithfully observed, hospitalism can be prevented." This is a much too restricted use of the term "hospitalism," as generally understood. That antiseptic surgery has done much to counteract the evil effects of septic poisons in some classes of surgical cases is undoubted; but, all other conditions being unchanged, I do not understand how it can exert the smallest influence in preventing the evil effects of an atmosphere laden with the exhalations of a large number of sick in other wards, placed in several stories under the same roof. The cases to which the antiseptic method is strictly applicable are a minority of those admitted to most general hospitals, even in surgical wards, and the majority, particularly of fevers, lung diseases, &c., demand a purity of atmosphere on their own account, which is difficult, if not impossible, to obtain in a multiplication of stories.

In the United States, in Germany, and in M. Tollet's plans in France, single stories are preferred for surgical and fever wards on good and sufficient grounds, and two stories are not exceeded for medical cases.

(*f*) Furniture and Fittings of Hospitals.

This is a matter of much importance as respects all cases, medical and surgical. It was first seriously considered in Tenon's "Memoir on the Hospitals of Paris," and has been dwelt upon at a considerable length by M. Husson, in his "Etude sur les Hopitaux," published eighty years afterwards.

The mechanical contrivances of the last century were so rude and rough, and so little attention has been paid to personal comfort, that many of the defects noted by Tenon no longer exist. They have not, however, altogether disappeared, for four rows of beds are still found in some of our hospitals; not a few workhouse infirmaries have still two in a bed; and, in the cases of young children, I have seen as many as four sick in the same bed. In some of them, again, the beds are placed lengthways along the

walls, and so close together, that it is difficult to get between them, and in a few instances they are still encumbered with the curtains which have nearly everywhere become things of the past.

The remarks of Tenon, on the terrible state of the old Hôtel Dieu, in relation to this matter, may still be studied with much advantage.

The furniture and fittings should be of the plainest and most simple description, consistent with their fitness for their special uses, and should interfere as little as possible with the free circulation and purity of the air in the wards. Hence all curtains, shelves, cupboards to contain medicines or dressings, and everything not absolutely necessary for the comfort of the sick, should be prohibited. Foreign observers have remarked upon the cheerless and comfortless look of our hospital wards, but have admitted, after careful examination, that combined with their scrupulous cleanliness, they were, after all, best adapted to secure the successful treatment of disease. The introduction of flowers, pictures, and other amenities to a moderate extent is not only permissible, but beneficial, yet, even in this matter care requires to be taken, that they do not diminish the purity of the air in the wards.

To attempt to enumerate the numberless articles of furniture for the sick room now existing, would be a hopeless task. It is sufficient to state generally that all contrivances calculated to secure the most scrupulous purity and cleanliness of place and person, to give ease and comfort to the sick, to arm the surgeon with the instruments best fitted for his work, and to provide the physician with the agencies he needs, should be found in all well-regulated hospitals. Those who desire further information on the subject should consult M. Husson's great work, notwithstanding its being now nearly out of date, and should visit the Parkes Museum, in which it is hoped will ultimately be found all the most recent contributions of art and science, to this important department of hospital arrangements.

Types of the Most Recent Forms of Hospital Construction and Arrangements.

The great work of M. Husson, the reports of Messrs. Bristowe and Holmes, the treatise of Dr. Oppert, the excellent monograph of Capt. Douglas Galton on the Herbert Hospital, together with many others scattered through our medical and architectural publications, particularly in the *Builder*, under the able direction of Mr. George Godwin, contain detailed and valuable information on the subject of hospital construction and arrangements, brought up to a late period. In Germany, in Italy, and in the United States of America, there is also a wealth of information for those who seek for further instruction. I must, therefore, content myself with a very few typical examples, bringing the question up to date, to show how far the principles now accepted are being carried into effect.

Some authorities who have written wisely and well, after long practical acquaintance with hospitals, have doubted whether they were blessings or the reverse to the sick poor, from the heavy, and in some cases lamentable, risks to life incurred by those resorting to

them. One of them, apparently despairing of their ever being so constructed and managed as to diminish those risks adequately, has even recommended their entire abolition. More than one other, of the greatest eminence amongst authorities, is of opinion that the hospitals of the future should be constructed of temporary materials, so as to be destroyed and renewed every ten years without undue cost, and that no more money should be squandered in building palaces which rapidly become abodes of disease and death.

Upon this subject, M. Ch. Sarazin, one of the best and most reliable of recent authorities, has said—

"To these generally admitted ideas [detached pavilion hospitals, not exceeding two stories, and constructed of permanent materials], is opposed the *radical* view. No more *permanent* hospitals; they must be replaced by *hut hospitals* [wooden huts]. The permanent hospital is the *hospital sepulchre*, which nothing can keep wholesome, and which entails fabulous expenditure. The hut hospital, renewed in nearly all its parts every ten or fifteen years, alone presents the hygienic conditions necessary for hospitals, and admits of the realization of appreciable economies."

Mr. Lawson Tait, in remarking upon the gangreous action in wounds taken on in the Scutari Hospital, from disgraceful insanitary conditions, states that—

"This gangrene used to be common in our civil hospitals, and is too frequent even now. It may affect wounds of the most trifling nature. No reasonable person now doubts that it was and is due to bad sanitary arrangements. . . . . That is, it is certain that a badly constructed or badly managed hospital will give bad results, even when it is not sufficiently unhealthy to be constantly exciting 'hospital gangrene' and 'hospital fever,' and from the facts of ovariotomy it is equally certain, that the nearer a hospital approaches the conditions of an isolated private dwelling in its construction, and in the relations of its inhabitants, the better will its results be.

"In conclusion, I can only reiterate the opinions of Miss Florence Nightingale and Mr. Cadge, that it would be infinitely better to leave the sick and hurt in their own homes, than to place them in buildings where they are exposed to the risks apparent in the returns of certain hospitals."*

The celebrated Paul Dubois, in 1855, declared before the Academy of Medicine in Paris, that a woman would incur less danger to life in being confined unaided in the streets, than in being delivered in the Maternity or the Clinique.

The perverse and persistent disregard of the true principles involved, which have been pointed out for more than a century, justified this gloomy view, particularly in Paris, where some of the practices pursued until lately, would be a reproach to the heads of the profession in that city, were they really responsible for them. The recent changes made in some of our metropolitan hospitals, in the vain attempt to bring them up to a higher standard than their original defects will admit of, show that those principles are far from being accepted among ourselves; while the enormous cost, and other objections to the new Hôtel Dieu and St. Thomas's Hospital, make it impossible to refer to them otherwise than as examples to avoid.

The most notable examples of erroneous views of re-construction with which I am acquainted, are those carried out in the University College and Westminster Hospitals, neither of which can be considered to be in harmony with principles now so universally recognised, that to depart from them must be regarded as a reproach.

* Lawson Tait: Op. cit., pp. 129-30.

It is not so with those which I have selected for illustration from a very wide field. I have purposely taken such as were not as yet, so far as I know, made known to the profession in England—until I described them in the *Lancet*, in 1881—while they contain the latest expression of opinion on the question. Some of them are costly, and do not wholly adopt the conclusions of the Chirurgical Society of Paris, but they are all essentially advances on the *status quo ante*, as described by Husson, Holmes and Bristowe, and Oppert, the authorities best known in England. Two of them carry the conclusions above referred to, to their logical result—the Friedrichshain and St. Eloi Hospitals.

The General Hospital of Friedrichshain in Berlin.

Germany possesses many fine hospitals, in which improvements in structural arrangements were apparently slow of adoption, until the building of the Rudolf-Stiftung Hospital in Vienna, in 1861, which was opened for patients in 1865. This magnificent institution, intended to accommodate 800 sick, all diseases being admitted except small-pox, was founded by the present Emperor in honour of the birth of his son, whose name it bears. The pavilion plan, as represented at that time by the Lariboisière Hospital in Paris, was not deemed suitable for the climate of Vienna. Hence, a combination of the corridor and pavilion principle was adopted, in which the latter is not, however, very prominently represented. The wards are spacious and lofty, the cubic space allotted to each patient is 1,480 feet, and all the internal arrangements are excellent, while the great central courtyard is tastefully laid out as a garden. It is said to have cost £250,000 in construction, or about £312 a bed.

The works on hospitals, with copious illustrations, by Dr. C. H. Esse, in 1868 and 1873, show a decided advance in the practical application of the pavilion principle in Germany; but it was in 1870, in the adoption of the plan since carried into practical effect in the Friedrichshain Hospital of Berlin, that the "new views" were accepted in their entirety. Hence I have selected it as a recent and complete type of a pavilion general hospital, perfect in all the details of its arrangement, as illustrating that form of construction.

The history of this hospital is extremely interesting, as showing how it was called into existence to meet a great public want, and how in the final arrangements the most eminent authorities in Germany were consulted—Virchow, Neumann, Kalske, Voigt, Esmarch, Baum, Von Langenbeck, Esse, and others of note,—and how their united voices, with a weight of authority unequalled, concurred in the principles advocated so long ago by Tenon, Bailly, and the eminent Frenchmen of that day.

The leading spirit in the matter was admitted to be the celebrated Berlin professor, Virchow; and Esmarch, still more renowned as a practical surgeon, expressed his satisfaction at the carrying out, for the first time in Germany, of the new ideas of hospital construction, and the science of health, particularly with respect to placing surgical cases in single-storied pavilions, with direct roof-ventilation, and the adoption of an entirely isolated building for surgical operations. These eminent men were of opinion, that in surgical wards for cases where there are injuries or operations, from twenty to thirty beds in a well-ventilated ward are not too many, if severe wounds and

serious operations are treated in separate rooms, which should also be provided for traumatic tetanus, hydrophobia, and cases attended with delirium, &c. The provision of a sufficient number of such rooms is shown in the plans to be quite consistent with, and easy of adoption in detached pavilions.

The free admission of sun, light, and air to every part of a sick ward, the regulation of ventilation as much as possible by natural means, and in some classes of cases by open fires, the provision of day rooms, the careful regulation of the water supply, the north and south exposure of the buildings, and the distance of the pavilions from each other (52 metres, or 173 feet), the provision of an ice-house, and the proper distribution and careful arrangement of all the accessory buildings, administrative and economical, were the subjects of minute study and attention.

All the pavilions are self-contained, with every convenience for complete detached use.

In the double-storied pavilions, six in number (three for men and three for women), provision is made for sixty-four patients, the sick being placed in the two upper floors.

The ventilating arrangements provide for the admission by day and by night, at all seasons, of from about 2,200 to 2,500 cubic feet of air suitably warmed for each bed, and means of bringing fresh cold air from without in such manner as not to cause draughts or inconvenience to the sick. The entrance and exit of air are so arranged as not to attain a greater velocity than 19-in. per second at any point where a patient can be affected by it. The buildings, generally, are lighted by gas, which is carefully ventilated to prevent the results of its combustion being distributed in the wards. Measures are taken to prevent the exit of effete air from being injurious or finding its way into any part of the building, and registers are provided to regulate the amount of ventilation, which may at any time be doubled in case of need.

The single-storied or surgical pavilions, four in number, are on the north side of the great enclosure, two for males and two for females, each containing thirty-two beds.

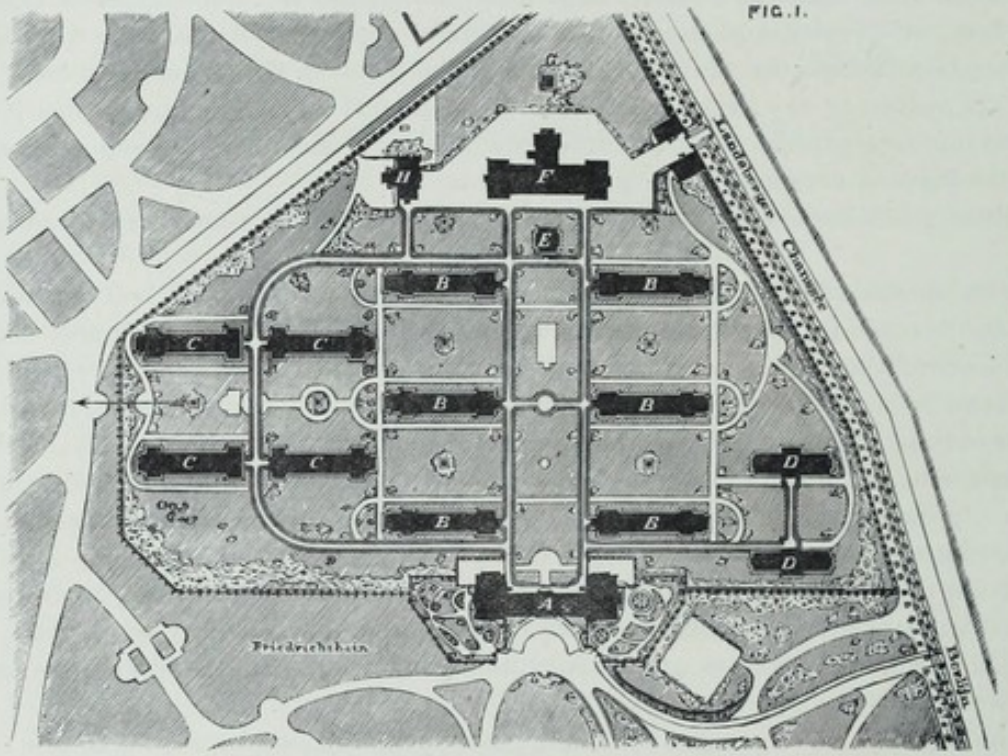
There are two isolation pavilions, one for males and one for females, containing forty-four beds in each. Each pavilion is self-contained; the entrance floors are placed opposite each other, and both are in a separate enclosure, and approached by a separate access, so as to effectually isolate them from the other wards in the general enclosure. They are intended for the treatment of cancer and other malignant diseases which are unsightly, of ophthalmic affections, and the infectious fevers. Of the prudence of placing these different classes of disease in the same building, some contagious, and others not so, I am by no means sure.

The superficial area on which the buildings stand, and which also contains the gardens and open spaces in the enclosures, appears to be a little more than twenty-three acres. The hospital being for 600 beds, there is no pressure of population on area in the arrangements.

From the small plan which accompanies this brief sketch, the form of the land will be seen to be irregularly triangular, and the detached buildings to be—A, the administrative departments in front; B, the six double-storied medical wards, right and left of the main entrance; C, the four surgical pavilions, single-storied, to the left of these; the two

double-storied isolation wards, D, to the right of the main entrance; E, the great bath house; F, in the immediate rear of the centre, the great economy building; on the left the mortuary, H, with a separate entrance for funerals; behind it, G, the ice-house, and to the left separate gates, and means of access to all these departments. In the rear of the mortuary is a lime-pit. The whole of the interspaces are gardens, accessible to the

FIG. 1.



sick; the small white, oblong space in the central garden is the site of an intended chapel, and on the left, in the surgical enclosure, is that of a projected building for operations. These may have been supplied since I visited Friedrichshain, for the plans before me are dated 1876.

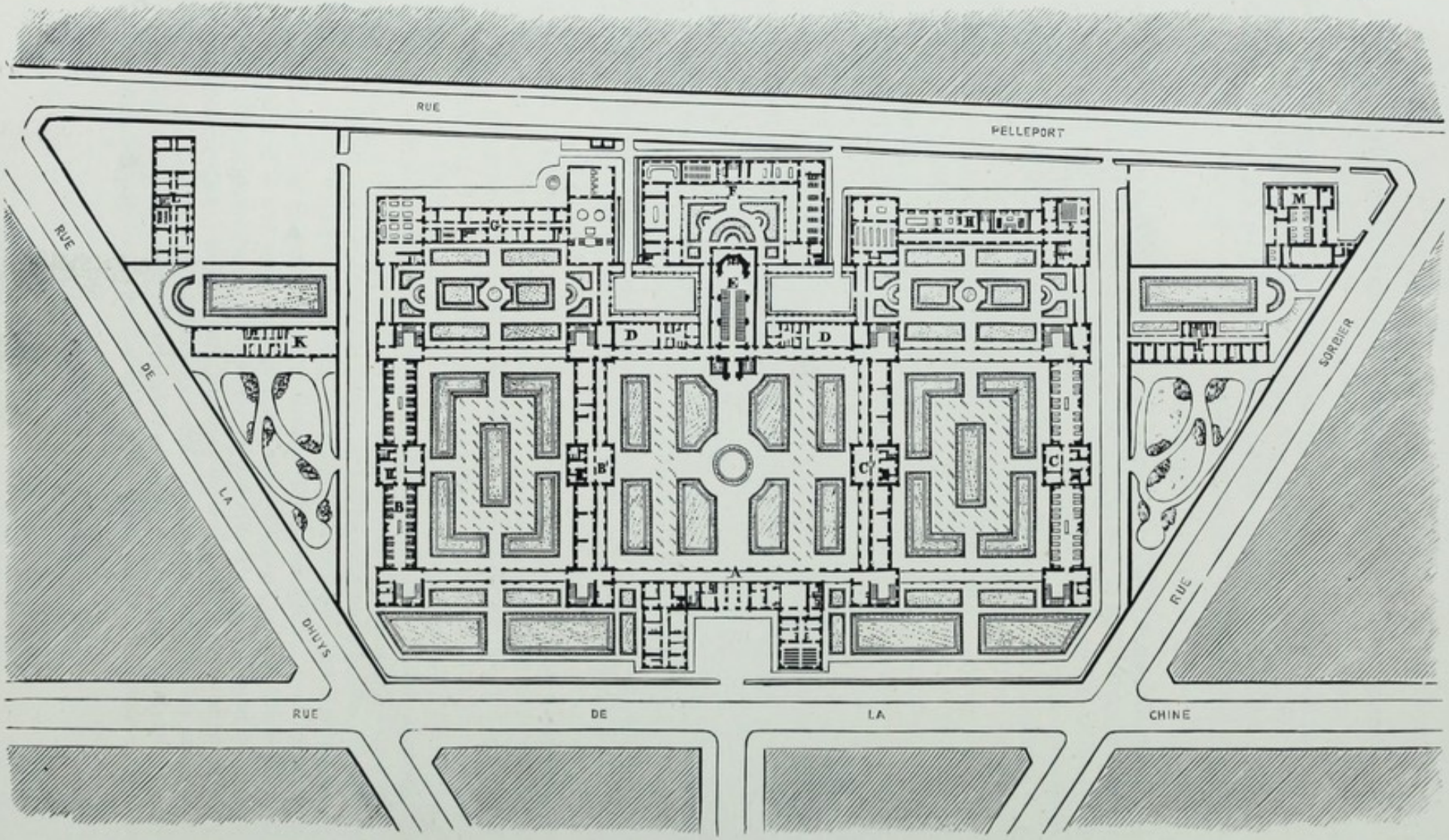
It would occupy an undue amount of space to attempt a detailed account of the administrative and economical departments, with the other accessories above mentioned. They struck me as more complete and perfect in all their details than any places of the kind I had seen elsewhere, at the time of my visit. The whole cost of the grounds, buildings (which are well constructed and of considerable architectural pretensions), and the details of arrangements (which are of true German thoroughness, leaving nothing unforeseen or unprovided for), was 4,217,261 marks, or about £351 a bed. A hospital of similar character in general design, but with differences of detail, has since been erected on the banks of the Necker, in connection with the University of Heidelberg. The plans and description of it, by Professor F. Knauff, were published in 1879, in Munich. I preferred, however, describing that which I have myself seen, and which has now been sufficiently long in practical operation to test its merits, and defects.

The architectural details of these hospitals will be given in the next part of this work. There are other hospitals in Berlin well worthy of description, such as the Augusta Hospital, the Moabit and Charity Hospitals, but none of them illustrate the new views of hospital construction so completely as that above mentioned.

Menilmontant.

The Menilmontant Hospital is situated on an elevated ridge in one of the healthiest quarters of Paris. The land on which it stands is an elongated trapezoid, is bounded by broad streets on the four sides, and is sufficiently removed from all dwellings to have an ample zone of aëration.

The hospital consists of a series of buildings detached from each other, but connected by galleries on the ground floor running from the entrance gates round the principal court and garden. The maternity and small-pox pavilions are, however, entirely detached, as are the mortuary and store departments. In front, facing the mayoralty of the arrondissement, are the administrative buildings (A), containing the quarters of the officials, the admission and out-door services, with waiting rooms, &c. The wings of this building are single-storied, and the central portion four-storied, of which the attics are occupied by the servants. In the centre of the buildings is a large planted courtyard on each side of this court, and four ranges of sick wards (B C), grouped in couples, with gardens between each group, and open galleries connecting them together and communicating with the administrative buildings. The two on the right hand are for women (C), and those on the left for men (B), each of them consisting of a ground-floor, two upper stories and attics. They all contain two end pavilions, a central pavilion, and two ranges of wards. In the end pavilions are the staircases, separation-rooms of one, two, or three beds, the rooms of the surgeons and physicians, and the examination-rooms. The central pavilions contain the offices, the convalescent day-rooms, the superintendent's rooms, the baths, lavatories, and closets, the lifts, hoppers for dirty linen, and on a mid-floor the cloak-rooms. In the body of these ranges are the sick wards. There are two wards on each floor, and three ranges of wards on the upper floors. These are all symmetrical, except on the ground-floor bordering the central courtyard (B C), where there is a series of rooms, opening into each other, of three or four beds each. The wards are lighted by twelve windows reaching to the ceiling, and opening in three sections. All the angles of the walls and ceilings are rounded, the walls and ceilings being coated with varnished impermeable stucco. The two isolation pavilions (I K), one for parturient women, the other for small-pox cases, are placed behind the sick wards on each side, and separated from them by the road running round the buildings. Each of them has separate gardens for the sick, with sleeping and dining rooms for the establishment. The maternity pavilion (I) has a ground and an upper-floor, and a second story in the centre. The ground and first-floors are connected in their whole length by an open passage, on which are eight rooms on each floor, there being sixteen separate rooms in all. These rooms are entirely separated from each other, and each has an anterior cabinet and small antechamber, to protect the inmates from currents of the outer air. On the central upper floor are the quarters of the nurses, attendants, and night-watchers.



General Plan of the Menilmontant Hospital. *Fig. 2.*

The small-pox pavilion (K) has a central double story, with two single-storied wings. In the latter are the patients in two wards, of sixteen beds each, for males, and the like number for females. In the centre are the quarters of the establishment. The chapel (E) faces the principal administrative building, and is at the far end of the central court. On each side of it are the general baths (D), for the treatment of internal and external diseases, and all are accessible under cover. Each service has a waiting-room, a bath-room containing twenty baths, a hydro-therapic room, a vapour bath, and other dependencies. Behind the chapel are the linen store (F), and the dwelling and sleeping rooms of the female servants. These are complete and well-arranged for all their purposes. The clothing is not washed in the hospital. The pharmacy (H) and kitchen (G) are in a line with the linen department, the former on the right, the latter on the left hand. These are likewise very complete and well-arranged for all their numerous uses, and in the garrets are the quarters of all the subordinate attendants of each.

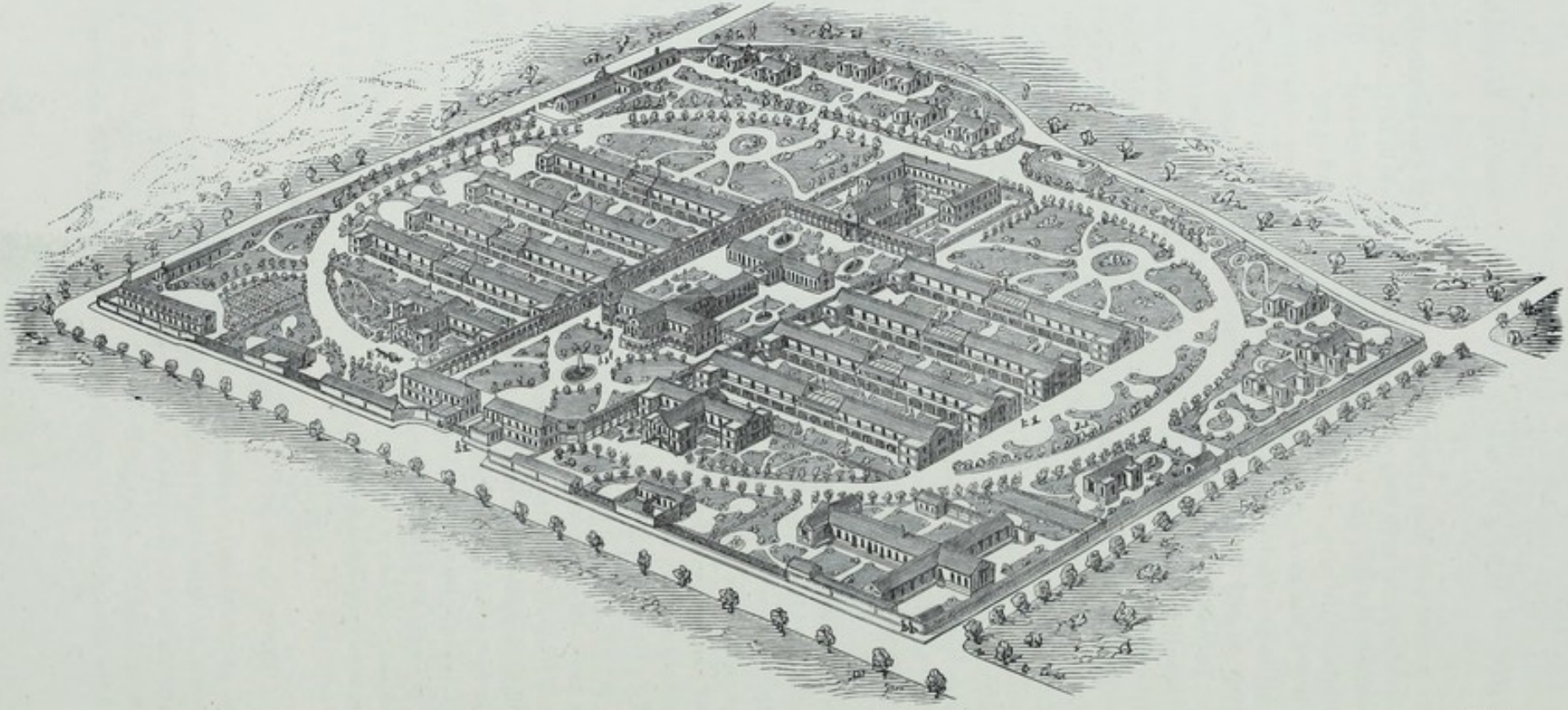
In the two opposite angles, on the right hand, behind the maternity, is the mortuary (N), and behind the small-pox pavilion the general store-room (L), on the left hand. Each of these also is very judiciously planned and distributed for its special purposes. The mortuary is provided with every means for the proper disposal of the dead, and has a Catholic and a Protestant chapel, with an external communication for the conduct of funerals.

This is a very fine hospital, and much in advance of what was, at one time, considered a model for imitation, the unhealthy Lariboisière; but I think that, in adopting the pavilion principle, it should have been adopted in its integrity, and four-storied buildings with intercommunications should have been avoided. On the cellar floor is a very perfect tramway arrangement, running round the whole of the buildings, and connected at intervals with staircases and lifts. I fear that this may become a source of danger in the future. The placing of additional patients in the attics in times of epidemic or other pressure, does not appear to me to be a judicious proceeding; and the intercalation of supernumerary beds (*brancards*, of which I saw two), in the ordinary sick wards, is an unmixed evil. The great ventilating chimney may also act prejudicially on the neighbouring dwellings, as similar structures are supposed to have done elsewhere in Paris.

The hospital has been too short a time in existence to admit of any opinion being formed as to its superiority to the other institutions of the same class and character in the same city. I ought to have mentioned that it is supplied with a well-arranged series of railways and lifts, and has a complete system of electric bells throughout. Suitable mechanical arrangements for weighing and distributing fuel, and lightning conductors, have also been provided.

Hospital of St. Eloi at Montpellier, France.

This hospital, now in course of construction, was described in the "*Annales d'Hygiene*," by M. Emile Bertin, Professor of Hygiene, in 1879. After considerable discussion as to the incurable defects for the treatment of the sick, of the old hospital attached to the celebrated Medical School of Montpellier, it was determined to erect a new hospital a short way out of the town, but easily accessible from it; and the plan ultimately adopted



PERSPECTIVE VIEW OF THE HOSPITAL OF ST. ELOI AT MONTPELLIER.

Fig. 3.

was that of M. Tollet, upon a system which contains many features of originality, and is based mainly upon the conclusions arrived at by the most advanced authorities on the subject.

M. Tollet's system may be briefly described to be based on the subdivision of the sick into small and manageable numbers, lodged in single-storied buildings, distributed over a sufficient area to prevent undue pressure upon space, and yet so connected as to be facile of access and administration. His wards are built upon the plan of the Gothic arch, to avoid all stagnation of air, or arrest of organic and other matters floating in it, by angles or corners of any kind; are intended to be easy of heating and ventilation in winter and summer, without the adoption of expensive mechanical contrivances; to admit of the provision of ample superficial and cubical space for each patient; to be constructed of materials capable of the most perfect cleansing, and to be as nearly as possible fire-proof; to be provided with verandahs, to which the beds can be transferred, with little or no disturbance of the sick, in fine weather; and to have the accessories of baths, water-closets, and dependencies of all kinds so completely cut off as to be unable at any time to impair the purity of the atmosphere of the sick-room.

Provision is made in his distribution of the buildings for a careful classification of the sick and injured, and for the isolation of all infectious diseases, so that every kind and class of sickness may be effectually treated in the same enclosure, without any risk of undesirable complications, or injury either to the sick themselves, or to the inhabitants in the vicinity of the hospital.

The hospital of St. Eloi has been approved by a special commission of the professors of the Faculties of Medicine and Science, and by the Municipal Council and Hospital Commission of Montpellier, by the General Council of Civil Buildings at the Ministry of Public Works, and by the central authorities of the "Assistance Publique," in Paris. By a decree of March 1881, it was declared to be a work of public usefulness, in exchange for the existing hospital, which is well calculated for other purposes connected with the University. The site was very carefully selected, and the buildings have been arranged in the aspect best fitted to secure the maximum of air and light. On this plan M. Tollet has already built large artillery barracks and a military hospital at Bourges, of which the Dean of the Faculty of Montpellier reported in November 1880—

"The hospital at Bourges, which I have just examined in all its details, consists of twelve pavilions, and the (necessary) administrative buildings, and is on the Tollet system. This system rounds off all re-entering angles, and suppresses all salient projections. It permits of the isolating of groups of diseases; it neutralises and attenuates the effects of the radiation of infection; it provides spare rooms, and a super-abundance of aeration, eminently wholesome. The admirable statistical results of this hospital need not, therefore, excite surprise. The official reports record the signal services rendered by the separate pavilions in a serious outbreak of typhoid fever in the camp of Avron and the garrison of Bruges. Thanks to the isolation of the typhoid cases, and the hygienic measures carried out, the mortality was minimised, and none of the sick suffering from other diseases, and none of the nurses and attendants, were attacked."

The consecutive successful results of surgical operations were equally constant, and important proofs of the healthiness of the system of construction. The military report states that—

"So far we attribute our exceptional success to hygienic conditions. We operate in conditions which may be called antiseptic. The air of the sick rooms is as pure as the external atmosphere. We must add

a remarkable fact gathered from the admission registers of the hospital, that not one of the four thousand soldiers quartered in the barracks built on the Tollet system was attacked by the prevailing disease, and that all the typhoid and contagious cases came from the other barracks."

The St. Eloi Hospital is divided primarily into three distinct and independent portions, each having an entrance from without. The first consists of the main body of the hospital and its establishments, and occupies the central rectangle of the general enclosure. The second is the contagious disease department, which is placed in the salient angle of the north side; is surrounded by a belt of tall, tufted trees, and so arranged that the prevailing winds blow across it so as to carry all exhalations and emanations away from the main buildings. The third is the Maternity Department, and is divided into two departments, well separated from the rest of the buildings. That for parturition is placed in the southern angle of the great quadrilateral, and is protected by a belt of large trees, planted at the base of the general hospital, which also shelters it from the cold winds. The infirmary of this department is far away from it, and from all other buildings, on the north-east boundary of the main enclosure, as seen in the accompanying general perspective plan. Each of the three compartments is self-contained, and has its own establishments.

The chief entrance is at the south-west end, and in front of it are regularly arranged in its centre, and on two sides of a large square court, the administrative buildings and the hospital wards. The former provide amply for all the establishment, stores, and accessories necessary in so large an institution, including a chapel, stables, drying grounds, &c. On either side are the eighteen pavilions of the common hospital, divided into two distinct branches. All the buildings of the main hospital are connected with the pavilions by great open galleries, tramways, and telephonic communication. The contagious and maternity branches are absolutely separated. The dissecting department is as far removed as possible, in the direction of the fever quarter. The laundry and drying grounds are at an equal distance from the nearest ward. The buildings will be lighted with gas throughout.

Each separate pavilion consists of a long room, with an annexe at each end, one containing a couple of beds for isolation, a dining-room and lavatory; the other, quarters for the attendants, medicine-room, linen-store, bath, water-closet, and dirty linen shoot.

As the form of construction is entirely new, and as many eminent authorities consider the occurrence of pyæmia, erysipelas, and similar hospital opprobria to be mainly, if not entirely, a matter of ventilation, I will reproduce, in M. Tollet's own words, the principles applied by him to the aeration and warming of his sick wards:—

"In proportion to the facility of ventilating simple constructions provided with apertures on all their enveloping surfaces, is the difficulty of renewing the air of many-chambered and storied buildings. In the latter, very complicated and costly mechanical contrivances must be resorted to, which rarely produce the effects expected; whereas in the former, simple natural ventilation can be practised at all seasons, and in all states of external temperature. Natural ventilation, as I understand it, is the movement of air which occurs in an enclosed space at all times, without the aid of any mechanical contrivance. We distinguish between summer or ascending ventilation, resulting from the natural movement from the ground towards the highest point of a building of air warmed by contact with the occupants, and winter, or the reversed ventilation—that which is caused by heating. The amount of fresh air renewed by natural ventilation is infinitely greater than that which can be obtained by the most costly mechanical contrivances. Thus, in a room of the capacity of 1,500 cubic metres, nearly 53,000 cubic feet, the air can be renewed by the opening of a

single window in less than half an hour, with a velocity equal to 0·50 m., or nearly two feet, in every second. Winter ventilation is intimately connected with warming. If, as a measure of economy, open chimneys are not used, an apparatus should be so arranged as to draw its supply at will directly from the external air by means of tubular connections, or indirectly by exhausting the air of the room. We should be able, also, to reverse the ventilation, and withdraw the vitiated air under each bed, and drive it out by the smoke tubes, as practised in the surgical wards of the Military Hospital at Bourges. I only insist on this point, that the heating apparatus shall present warming surfaces sufficient to render it unnecessary to superheat the air emitted by them, to obtain a mean temperature of 60° F. They can also be so arranged as to connect them at will with ventilating chimneys. It was supposed *à priori* that the large wards of the Bourges Hospital, with a capacity of 53,000 cubic feet, would be difficult to heat at all in winter, and would need a large expenditure of fuel. Two experiments, made at an interval of a year, one at the temperature of 31° F. and the other at 28·4° F., proved that a cube of air of 2,118 feet per bed, renewed two or three times every hour in winter, could be easily and cheaply heated to 60°. I also wished to take into account the movement of air in a pointed arch vessel, and I ascertained it to be very regular and constant, only at each experiment there was the difference of a degree of heat between the surface of the soil and that of the highest point, which is very natural. The difference at the height of a man was not half a degree."

I have been thus particular in giving an outline of the proposed application on an extensive scale, at Montpellier, of M. Tollet's system, because it appears to me to fulfil all the conditions of salubrity required in hospitals, more completely than any other form of permanent structure that I am acquainted with, and because a general hospital on this plan, satisfying all the exigencies of disease and accident in the same locality, I hold to be the right means of providing for the medical relief of any community in whose vicinity it is placed. So far as it has been tried in barracks, it has been eminently successful, and also in the military hospital at Bourges. From August 1879 to June 1880, in the first months of its existence, all the surgical operations and cases of traumatic injury admitted—several of them very severe—were successful, there having been only a single death from cardiac embolism, eleven months after the accident, in an artilleryman, whose leg was fractured by the bursting of a shell. The hospital is new, and all new structures are free from the majority of the bad effects of old buildings. The numbers, likewise, are too small for any sound deduction, yet the result is encouraging.

The Hospital Bichat, placed on the ramparts of the fortifications of Paris, and the local hospital at St. Denis, on the Tollet system, with some modification of details, have already been built, and will be considered in their architectural features in the second part of this work. There appears to be some doubt as to the exact cost of these constructions, but, there is none, in my opinion, as to the merits of the system from the standpoint of health, which I hold to be the major factor in the question of the construction and arrangements of hospitals.

The Western Infirmary, Glasgow.

The most recent general hospital built and occupied in Scotland is the New Royal Infirmary of Edinburgh, but I have selected the Western Infirmary at Glasgow, its immediate predecessor, as a better type of hospital construction, embodying most, but not all, of the principles of what in Germany has been termed the "new view" of the question. Both of these institutions, however, are excellent examples of a judicious union of the corridor and pavilion plans, so as to combine most of the advantages of the latter, with few of the defects of the former. The chief features of excellence in both are

their admirable adaptation to clinical purposes, their excellent system of ventilation, the placing of a single bed in each window pier, with an abundance of floor space, for which the Edinburgh Infirmary in particular is a model for imitation. Their system of government, nursing arrangements, and internal economy generally, under the direction of a resident medical superintendent with full powers, leave little to be desired. Their chief defect is in the arrangement of the baths and closets in immediate connection with the wards. These should have been more completely detached than they now are, for although, so long as the buildings are new and as scrupulously clean as they were at the time of my visit, no evil results will be experienced, I am by no means sure that this immunity will continue when they are old, and time has told, as it is certain to tell, in discovering the chinks in the armour of construction.

The Edinburgh report of the year (October 1879 to October 1880) shows that the daily average number of patients was 469; the greatest number at any one time having been 525, the least, 208; and the average time under treatment, 31·6 days. The whole number of deaths was 436, giving a mean annual rate of 8·2 per cent. of treated. Deducting the deaths within forty-eight hours of admission, in cases brought in a hopeless state, 85 in number, the death-rate was 6·6 per cent. The institution has been too short a time in existence to test its healthiness or unhealthiness in the sense attached to the term as applied to hospitals, and statistics constructed on the basis of a general average, without breaking up the figures into the details necessary for their right interpretation, can only be accepted as a rough-and-ready, but in no way scientific, manner of determining the question.

The Western Infirmary of Glasgow, originally projected in 1846, was carried into effect some years subsequently, and is now in the seventh year of its practical working. It consists of nine ward blocks, with a central portion containing the operation and lecture theatre. The blocks intersect one another in three places, and in the intersections are placed the stairs, hoists, and shoots. The medical clinical theatre is in a detached building on the western side; the washing department is in a building to the north. It has a separate pathological department, and admits all classes of cases except infectious fevers, for which there are exceptionally good arrangements, under the Public Health Department, in the neighbourhood of Glasgow. The nurses' quarters are also separated from the main body of the infirmary, which is placed on high ground in the immediate neighbourhood of the University to which it is attached, and has an abundance of open ground on all sides, to secure in perpetuity an ample zone of aëration. The large wards, seventeen in number, contain from fourteen to eighteen beds each, and have windows on both sides. There are smaller wards for the separation of such cases as need it. The cleanliness of every part of the house, at the time of my visit, was simply faultless. The nursing arrangements, and those for clinical instruction, are, as in Edinburgh, deserving of all commendation, and far in advance of anything that I have seen elsewhere, at home or abroad. In both of these great Scottish institutions the fees of the students for hospital attendance are credited to the hospital, as they ought to be everywhere. In the year 1879-80, 2,245 patients were admitted, of whom 153 died, or in the ratio of 7·4 per cent. of all cases treated to the termination; 27 of the deaths were

in cases admitted in a hopeless state, and all of them died within twenty-four hours of admission. Deducting these, the death-rate was 6·2 per cent., reported to have been the lowest in any year since the opening of the institution. The average residence in hospital was 36 days—40·5 for medical and 31·5 for surgical cases; the average daily number of patients having been 199·5, with a maximum of 217, and a minimum of 179. There is a special clinique for skin diseases in this infirmary, with a suitable arrangement of baths, under the charge of Dr. M'Call Anderson, similar to that introduced in University College, London, by the late Dr. Tilbury Fox. The architect is Mr. John Burnett, of Glasgow.

I say nothing of the well-known Royal Infirmary at Glasgow, which has undergone several recent improvements, doubtless with success. But I am of opinion that all attempts to bring these antique institutions up to modern standards by processes of patching, are mistakes. The only sound method of dealing with them I hold to be, to diminish the number of beds by one-half, then to utilise the additional space thus acquired in such manner as to remedy their most obvious defects, and to build small hospitals elsewhere, where they are needed, on such principles as are now accepted by all but those who decline to quit the ancient ways.

The New York Hospital.

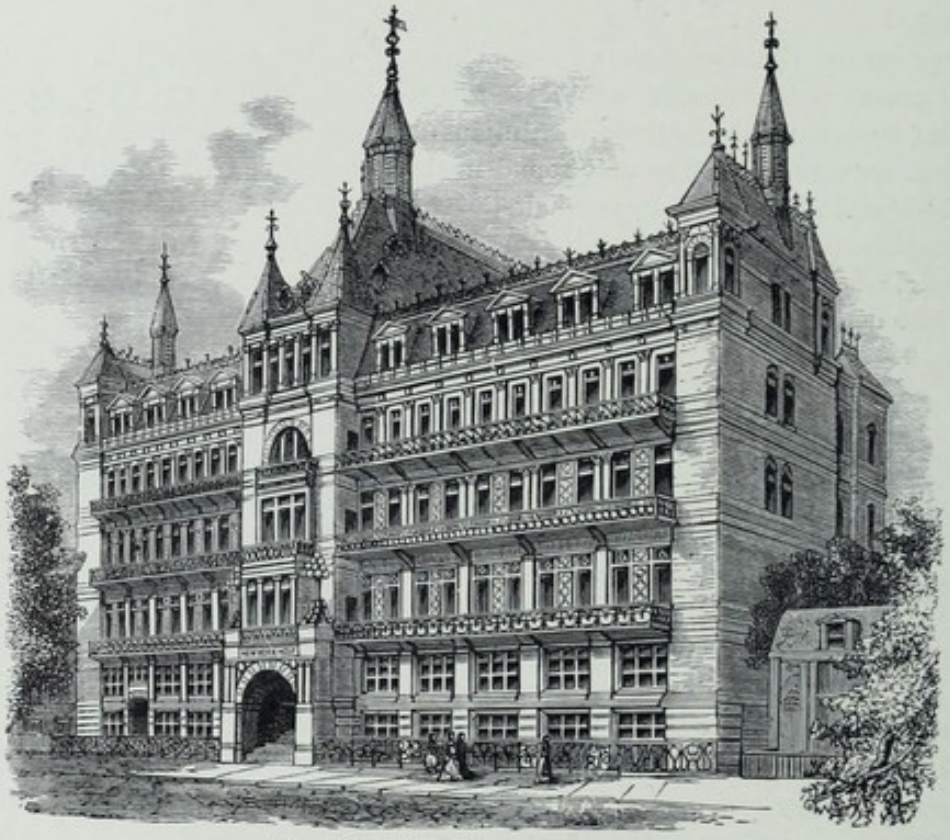
This institution, which was opened five years since, is a striking example of how the exigencies of a restricted position have been turned to good account in the construction of a building of many stories, in such manner as to adapt it to the more recent views of the sanitary requirements of places designed for the healing of the sick. Its history was given by Professor Van Buren in an inaugural address, delivered on the opening of the building in March 1877. It consists of a main building having a block front of 175 feet and a depth of 36 feet; a rear central wing 50 feet long and 27 feet 3 inches deep, and at each end of the structure a rear building containing the main plumbing for the wards, each 16 feet 6 inches wide and 29 feet deep, connected with the main building by a passage 8 feet wide, and 9 feet 3 inches long. The building is constructed with a cellar, basement, and five upper stories, and the central portion and rear centre wing is carried to a still greater height, to contain the kitchen and laundry.

Great difficulties connected with the foundation have been successfully overcome, and the heavy structure is without a crack.

The main entrance is in the centre of the front, the entrance for ambulances towards the west end of the building. The basement east of the main entrance is assigned to the out-patients' department, with rooms for male and female patients, consulting and toilet rooms, and the usual accessories. West of the main entrance are the principal apothecary's rooms, and small reception wards. The gatekeeper's lodge adjoins the ambulance entrance, behind which are two wards and the post-mortem room, the latter having a gallery for students, well lighted. Adjacent to this is the dead-house. In the rear centre wing are two night-wards, each 13 feet by 15 feet, a store-room, and the two wards for delirium patients. The ambulance stable is in the rear east wing, opposite the

post-mortem room. A horse, ready harnessed, is always there. The cellar under the main building is chiefly occupied by the heating, ventilating, and elevator apparatus. The boiler room is placed in the courtyard, east of the ambulance entrance. There are extensive coal vaults, storage cellars, and refrigerators under the east and west courtyards.

The principal entrance is in the centre of the street façade, with stone steps leading to the vestibule and main hall, from which corridors give access to the rooms in the east



THE NEW YORK HOSPITAL. *Fig.* 4.

and west divisions of the building. At the rear of the hall is a wide easy stone staircase, which, with two steam elevators, gives access to the upper stories. One of these elevators is of sufficient size to contain a bed, with its attendants, and of sufficient power to raise the car with safety, when crowded to its full capacity of thirty persons. The other elevator runs from the cellar to the sixth story, to carry up the *employés*, and to transmit supplies of all kinds to the kitchen and laundry. The large elevator is reserved for patients, students, &c.

On the first floor, to the right of the east corridor, are the medical board-room, the house surgeon's room, and a private ward; on the left are two private wards, of one bed each, with bath and waterclosets. At the end of the corridor is the children's ward, 30 feet 6 inches long by 30 feet wide, containing 14,541 cubic feet. Connected with it

are a nurses' room, bath room, lavatory, and watercloset, and a store-room for the children's clothing.

The west corridor leads to the main reception room and office. The superintendent's office, house physician's, and five private wards for paying patients, with store-rooms, waterclosets, &c., are connected with it. This corridor also leads to the pathological department, and students' gallery of the post-mortem room. At the entrance to this gallery there is an iron staircase leading to the courtyard. The second, third, and fourth stories are constructed on the same plan, and in each the central hall divides the story into equal similar parts. These contain six wards each, are 29 feet 6 inches by 77 feet 3 inches, and 16 feet high, and in each are 21 beds, which gives a little more than 1,800 cubic feet of air to each. Connected with each ward, in the centre of the building, is a nurses' room and dining room. To each dining room is attached a closet and refrigerator, and it is connected with the kitchen by a steam dumb-waiter. At the extreme end of each ward is a corridor, connecting it with the end wings, which contain each a bath room, a hot air bath, a foot and hip bath, a lavatory, and waterclosets. All these are so separated from the wards, as to be independently ventilated. Each ward, again, has two closets for linen, and the main hall on each story is provided with closets for patients' clothing. On the street face of each ward is a broad balcony, with seats built permanently into the windows. All corners and angles are rounded, to aid ventilation. The first story ward differs from the others in having bidet baths for women.

The west side of the main hall in the fifth story contains a surgical ward for nineteen beds. It is 26 feet wide, 78 feet long, and 16 feet 5 inches high, and allows 1,800 cubic feet to each bed. Its general arrangements are the same as for the other wards. In the centre wing of this story is an isolation ward with two beds. The capacity of the hospital, exclusive of the children's wards, is 163 beds, including the private or paying wards. Each bed is connected with the nurse's room by an electric communicator, which may at pleasure be connected with or disconnected from a bell. The button is so arranged that it can, at the discretion of the nurse, be within reach of, or withheld from the patient. Sockets have been built into the wall behind each bed, into which metal brackets can be hooked, which swing over the beds. From these, handles are suspended beneath the patient, to enable him to raise himself or change his position without assistance. The nurses' rooms are connected with the janitor's room on the first floor by speaking-tubes. The janitor's room is connected with the entrance doors, the office, the private wards, the first story and basement offices, the autopsy room, and stables, by speaking-tubes or electric communicators. Each nurses' room is connected with the office by speaking-tubes. The ward dining rooms have speaking-tubes connected with the kitchen.

The east side of the hall in the fifth story is occupied by the operating theatre, and rooms connected with it. This theatre is very carefully arranged, and has a top and north light supplied through 261 square feet of hammered glass.

The sixth story contains the kitchen, pantry, store room, laundry, drying room, and linen closets. All are provided with the most modern and complete apparatus and machinery.

The seventh story is occupied by wash rooms, engine and blower rooms, water tanks, exhaust-fan blower, and disinfecting room.

To the administrative building, directly in the rear of the hospital main building, at a distance of 10 feet 6 inches from it, two stories have been added, which are connected with it by an enclosed bridge at the level of the staircase landing. This is also approached on the first floor by a balcony running across the administrative building, and by a bridge. The lower part of these stories contains bedroom accommodation for thirty nurses in the training school of the hospital, also the necessary offices. The rooms are provided with separate entrances and corridors, leading respectively to the rooms for male and female nurses. The upper story forms a single room, with windows on all sides and two skylights, of which that in the centre is 22 feet by 51 feet in size. This is used as a convalescent room, and is divided by partitions to separate the males from the females. This room is 64 feet wide, 90 feet long, and 18 feet high. It is filled with rare plants, aquaria, and means for occupying and amusing the patients; is maintained at a uniform temperature; is light, bright, and cheerful, and is a beautiful summer and winter garden, of which it would be difficult to over-estimate the value in accelerating the recovery of the sick and injured.

The arrangements for heating and ventilation are combined, and contain several ingenious features of novelty for the admission of fresh and removal of foul air in all parts of the building with the avoidance of draughts and careful regulation of temperature. The whole is under control, and can be regulated with minute accuracy, even to the supply of each particular bed, which could, if necessary, be practically isolated. The windows in the wards are opposite to each other, and are so arranged as to supply air with the minimum draught when open. The hospital occupied two years in building, and cost 595,069 dollars. The architect is Mr. George B. Post, of Broadway, New York.

This truly excellent hospital, in the economy and perfection of its structural arrangements, for an institution constructed on the multiple ward system under the same roof, is by far the most complete and perfect that I have seen in any country. Whether it will ultimately effect the object of eliminating septicæmic disease entirely from its catalogue of ills, due to local insanitary causes, remains to be seen, for it has been too short a time in effective operation to determine such a question. So far as ample space, prodigal ventilation, and the prevention of noxious agencies finding their way to the sick are concerned, everything appears to have been done which science could suggest and far-seeing philanthropy adopt. The provision of a permanent convalescent home within its own walls, attests the wisdom and forethought of its founders.

Another of the recent hospitals in New York, which is on a different principle, of which the basis is the pavilion plan, is the Roosevelt Hospital—a special endowment somewhat similar in character to that of Guy's in London; it was opened in 1871. It is devoted to poor and paying patients in equal proportions, and as it is at present, so far as I know, unknown generally in Europe, it equally deserves description. In the Soldiers' Home at Washington, built under the supervision of Dr. Billings, of the United States Army, the kitchen and laundry are on the upper floor, as in the New York Hospital, and the result has been equally successful in maintaining freedom from the usual pollution of

air, inseparable from the operations carried on in such places. The system of heating and ventilation is also somewhat similar.

In all recent additions to the older hospitals of the United States, the pavilion plan, pure and simple, has been adopted, and nearly all the surgical pavilions are single-storied, as shown in the Sturges Pavilion of the Bellevue Hospital, of which I published an account in the *Builder* in January 1881. The first of these single-storied separate wards, raised on a plinth, and freely aërated below, I was informed, was constructed in connection with the Presbyterian Hospital at Philadelphia, where there are at present two wards on this plan, and another was about to be added.

Excellent pavilions, containing many modern improvements, have been added to the Massachusetts General, and Boston City Hospital. In the latter I also saw how successfuliy tents were used, in addition to wooden pavilions, in dealing successfully with a very protracted and intractable outbreak of diphtheria.

I have considered it desirable to retain my description of the New York Hospital, as an improved type of multiple-storied town hospital, in compulsory localities where the cost of land renders such a form of construction imperative, and in my "Notes on Hospitals," published in 1881, I suggested a modification of this type, for the rebuilding of such institutions as University College Hospital. But, I am so satisfied that many-storied hospitals are, and should remain, things of the past, that I have not deemed it necessary to reproduce that plan, or by its republication to give any sanction to a retention of the errors of the past, in any form or for any purpose.

By far the most important, however, of all the hospital constructions in the great Republic is the Johns Hopkins Hospital at Baltimore, which is now not quite half-built. It is the outcome of a munificent bequest, is to be attached to a great medical school, and is being arranged under the advice and supervision of Dr. John Billings. It stands on fourteen and a-half acres of ground, bounded by streets on all sides, and is strictly on the pavilion plan, complete in all particulars. In it are to be illustrated all the most advanced views in hospital construction and arrangement, and it will probably still take some years to complete. Hence it will be better to defer an account of it to the period of its finishing and occupation, as changes will doubtless be made in many of the details, during the progress of the building. So far as it had gone when I saw it in September 1880, it appeared to me to promise to become one of the finest institutions of its kind and class in existence.

The Civil Hospital of Antwerp.

Rotundas, or buildings round both within and without, have long been known in architecture. Round churches and round towers exist in several countries; but a circular hospital—that above mentioned—is a novelty reserved for our own time, and is now in course of construction at Antwerp; hence the need of describing it, as a form of structure supposed by its authors to embody in a high degree, the conditions accepted as desirable in all such institutions.

A radiating hospital, which is by no means the same thing, was proposed to replace the first Hôtel Dieu, and one on an extended scale was instituted in the United States, during the war of secession.

In 1878, the learned and accomplished Professor John Marshall, of University College, published a proposal for a hospital with circular wards, in the belief that this form of construction was calculated to secure the most complete hygienic conditions as to lighting, warming, aëration, facility of supervision and management, classification of the sick, separation of the diseased and hurt, and economical allotment of ward space; and, that it consequently is preferable to the pavilion principle, as represented by oblong wards with through ventilation, the administrative buildings in both cases having no immediate connection with the accommodation for the sick.

Professor Marshall suggested his plan for the rebuilding of University College Hospital, an institution which must be credited with an exceptionally large share of the structural defects, which are now held to unfit such places for the successful treatment of disease.

Somewhat anterior to the promulgation of Mr. Marshall's scheme, and necessarily without any knowledge of it, M. Baekelmans, a distinguished architect of Antwerp, submitted, in 1872, in competition with four other architects, a plan for a civil hospital to contain 468 beds for patients, of which the sick wards were circular in form, contained in eight separate two-storied blocks, raised upon plinths connected by under and over ground corridors, and thus detached from the central administrative and other accessory buildings.

This plan, drawn up in strict conformity with the requisitions and conditions of the hospital administration of Antwerp, secured the first prize, and was unanimously adopted for execution.

The architectural features and structural details of this original and important institution, will be described in the second part of this work.

In the original design seven of the circular pavilions were intended for medical and surgical cases, and the eighth was to be devoted to an obstetric or maternity pavilion. The administrative buildings were placed at the entrance, and in the central enclosure were the chapel, quarters for the establishment connected with each ward, and in each of them were four rooms for the isolation of severe cases, with the kitchen, pharmacy, and quarters for the nursing establishment—a religious community—with four large day and dining rooms for convalescents, the whole connected by a continuous gallery of communication.

Near the entrance, and behind the administrative buildings, were, on the left hand, an operating theatre, and on the opposite side the mortuary, whilst in the rear of all, entirely detached, were a great laundry and wash-house.

In the inner enclosure were four courtyards for exercise, and around the whole of the buildings, within the outer boundary wall, are open spaces, which will probably be converted hereafter into gardens or exercising ground. Within the outer wall is also a large tank, for receiving the sewage of the whole building.

As usual in Belgium, after being submitted to and scrutinized as well as passed by the local authorities at Antwerp, before receiving final sanction, the plans were referred to the Superior Council of Hygiene at Brussels. By this body several suggestions for improvement were made, chiefly with a view to the opening out of the central closed

courts, the suppression of the maternity pavilion, and consequent removal of all child-bed diseases from the general hospital, the alteration of certain details of ventilation and warming, and the enlargement of the area on which the actual buildings were to stand. The Central Commission conferred with the architect, M. Baekelmans, and expressed misgivings as to the form of the buildings, and their decided preference for what was termed the "Belgium type," a small hospital erected at Mons. The Commissioners were evidently indisposed to the trial of a new and, in their view, doubtful experiment; were hostile to costly permanent masonry structures; and exhibited a decided leaning towards smaller and less expensive forms of building on the pavilion plan, for the hospitals of the future. They pointed out what they believed to be the inconveniences of circular wards, doubted the greater facility of supervision said to be afforded by them, and questioned the accuracy of the chief recommendation of the circular form, viz., the combining of the maximum of capacity with the minimum of cost, with the consequent enormous cubage of air relied on as the chief guarantee of salubrity.

Their remarks on this point are deserving of reproduction, as too much importance is attached by many among ourselves to mere quantity of air space, as an element of healthfulness. They said—

"But after all, is it in this amount of cubic capacity (60 cubic metres per bed) that the best solution of the question of ventilation is found? With good ventilation much less space would suffice, and is it not rational to suppose that renewal in a given time is easier in a small cubical area? In the matter of ventilation it must not be forgotten that it is not only all-important to give constantly pure air, but to be able to remove vitiated air as quickly as possible, without causing hurtful draughts. The processes of ventilation are not yet so perfect as to ensure full reliance; hence it is better to be a little cautious, and not to run the risk of increasing the inconveniences we have pointed out by building too great wards.

"Nothing, then, justifies us in declaring *à priori* that circular will answer better than oblong pavilions with rounded angles the purpose of their invention."

The plans were accordingly referred back for reconsideration, and M. Baekelmans ceased to be associated with the work. He had already adopted such of the recommendations proposed by the Superior Council as an increase of the area of building permitted, but would have nothing to say to a change of its form.

The circular form was, however, adhered to by the local authorities. Most of the suggestions of the Superior Council were adopted, and the institution is now being constructed on M. Baekelmans' lines; for to him all credit that may result from this new and striking experiment, will indisputably belong.

The Civil Hospital of Mons.

This institution, designed by Monsieur Hubert, a distinguished architect of Mons, in 1867, has been the subject of considerable local controversy, and, as it has been termed by the Superior Council of Hygiene at Brussels the typical hospital of Belgium, a brief reference to it seems to be desirable.

It consists of a central building forming the façade, containing the administrative offices, with behind it the chapel, and on the ground floor or basement the kitchen and accessory departments. At the sides of this are two elongated wings at right angles to it, in which are operating and consultation rooms, day or dining rooms, small separation wards, with arrangements for baths, &c.

At right angles to, and projecting from, these lateral wings are on each side three two-storied pavilions, containing the sick wards proper. They are separated from the main building by small double-storied glazed galleries, with doors at each end, to isolate them from all atmospherical and other influences likely to be prejudicial from any source external to themselves, and connected with the main building.

Two of these pavilions on each side are devoted to the ordinary sick, the third being assigned on the female side to some religious sisterhood, and on the male side to paying patients. The wards, eight in number, contain sixteen beds each, the lower floor being devoted to surgical, the upper to medical cases.

This mixing up of religious communities with sick asylums is not a judicious arrangement, as the latter purpose is always more or less sacrificed to the former.

The hospital is well situated, and surrounded by gardens, the whole site occupying four hectares (about 15½ acres) of land, which will admit of extension hereafter, by additional pavilions for the sick, should it ever be necessary, without injury to the integrity and healthiness of the existing buildings. The galleries of communication are placed on the ground floor and that above it.

The aspect of the pavilions is east and west, with a window at the distant end. The lighting and aëration are excellent, but the heating is at present defective.

The building is not fully occupied, and is incomplete in several particulars, such as proper baths, &c., from want of funds.

The wash-house and mortuary are altogether detached from the main buildings, and in the central building is a well-arranged out-patient department.

In the rear of the main building are detached wards for disinfection, and the treatment of communicable skin diseases, such as favus, &c.

The general arrangement of the main buildings, which are connected by an open corridor running round them, presents nothing striking or original. What is strictly typical is confined to the sick ward pavilions.

This completes my selection of types, for, although there are many other institutions possessed of features of great excellence deserving of imitation, there are none more completely illustrative of the new view of modern hospital construction, than those I have attempted to describe.

The architectural treatment of the question admits of greater latitude of illustration, inasmuch as it can take note of portions of buildings, and enter into details of arrangements, irrespective of the whole structure, a proceeding which would be inadmissible in a general review, such as this is intended to be.

This introduction deals advisedly rather with principles, than with practice. Its primary object is to serve as a guide to architects and engineers, of the purely medical and hygienic aspects of the great question of hospital construction and arrangements, so far as science is at present able to determine them.

To the constructive professions belong the all important share of giving effect to those principles, in both their scientific and practical bearing *They* work with physical agencies, of which all the relations can be determined with almost mathematical

accuracy. On the other hand, the physician and the surgeon, together with their allies, the physiologist and the pathologist, have to consider questions, the final causes of which are, and, probably, ever will be, beyond the reach of human research. Many of such as may in time be revealed, are at present unknown quantities, and must be dealt with more or less empirically; hence, the same certainty in solving the problems of life and death, health and disease, and the best means of prolonging the one and postponing the other, is altogether unattainable. This treatise is, however, the first attempt in any language to discuss the question in a strictly logical manner, by the separate action of the professions most immediately interested in its right solution, in the natural order of their respective responsibilities.

Classification of Hospitals.

The proper classification of hospitals, with reference to their special uses, appears to me to be a matter of some importance; for, although the general principles to be observed in their construction and arrangements are fundamentally identical, each class of hospital requires some modifications of detail, and some special arrangement to fit it for its particular purpose.

For example, the careful regulation of temperature and artificial means of purifying the air of the wards themselves should be provided in all institutions specially devoted to the treatment of consumption, the more especially since the exact nature and unsuspected communicability of that disease are now beginning to be ascertained.

The proper regulation of the light is requisite in all ophthalmic wards and hospitals. In special institutions for skin diseases, a complete system of balneological arrangements is needed, and so on.

But the *raison d'être* of special institutions for many of the purposes for which they are now created, is less than it ever was, since the plan of building hospitals in detached pavilions admits of each such division being specially arranged and constructed to serve its particular use, so as to bring all classes of disease, accident, and injury within the same enclosure, and under the same general control and management.

For facility of treatment, I propose to arrange all hospitals in the following order:—

1. Clinical Hospitals.
2. General Hospitals (*a*, Women; *b*, Children).
3. Lying-in Hospitals.
4. Fever and Small-pox Hospitals.
5. Special Hospitals—
   - (*a*) Cancer Hospitals.
   - (*b*) Consumption Hospitals.
   - (*c*) Ophthalmic Hospitals.
   - (*d*) Hospital for Skin Diseases.
   - (*e*) All other Institutions of similar character.
6. Cottage Hospitals.
7. Convalescent Hospitals.

In my introductory remarks I classed maternities and fever hospitals under section 5 among the special hospitals, but further consideration satisfies me that they are far too general in their nature and extent to be so treated, and that it is better to give them a more general character, as they affect all classes of the community, and are as widespread in their incidence as the general hospitals themselves, differing only in the particular character of the affections admitted to and treated in them.

Clinical Hospitals.

By clinical hospitals I mean hospitals attached to medical schools, which need, therefore, to be fully organised for the purposes of practical instruction in all branches of medicine. They should be provided with physiological and pathological laboratories, and be armed with all the means of conducting scientific inquiries—be, in fact, schools of research, as well as of technical teaching. The difference needed in their structural and other arrangements, as respects the sick, are greater space in the wards for clinical teaching, more complete classification of disease, the careful selection of typical cases, and special provisions for nursing and the admission of students to learn their profession. All classes of cases should be admitted to them, except infectious fevers; and a certain proportion of incurable disease should always be found in the smaller rooms annexed to the principal wards. They should have special facilities for the treatment of ophthalmic affections and skin diseases, and a small detached obstetric clinique, as in the Menilmontant and St. Eloi Hospitals.

The primary intention of hospitals should never be sacrificed in them to the schools to which they belong; nor should the system of clinical teaching and nursing be permitted to become a source of annoyance to the patients, further than is absolutely necessary. The Scottish Infirmaries, hereinbefore mentioned, are models in these respects.

The instruction itself should, I venture to think, be graduated, the student being first sent to the out-patient department to learn the physiognomy of disease, and the proper methods of examination for its diagnosis and detection. When he has shown himself by examination to be competent to perform this duty, he should be allowed to enter the clinical wards of general hospitals, and not until then. A student engaged in actual attendance upon the sick should not be occupied in dissection, and when engaged in pathological examinations the most scrupulous attention to the prevention of carrying with him any possible means of injury to the sick, should be strictly enforced.

The last stage of instruction should be in the clinical hospital. The number of sick in a clinical hospital should not exceed 200, for within this limit every type of case and disease could be gathered together, by the proper organisation of the system of admission to all such institutions.

While the numerous bodies connected with the medical corporations and schools of the United Kingdom have been for years engaged, and are still occupied, in devising the best means of regulating the study of medicine and surgery, from the elementary subjects of anatomy, chemistry, botany, and so much of physics as are necessary to their right understanding, through physiology, up to medicine and surgery in all their branches, whether as arts or sciences, a scheme of medical education and examination was

elaborated in the Medical College of Calcutta by myself and the colleagues with whom I was then associated, so long ago as in 1845, which, although deficient in some particulars, was in advance of anything attempted in Great Britain, even at the present time.

The particulars of this scheme will be found in the printed reports of the time, and all that I need refer to at present is the character of the examinations to test proficiency, which were then adopted.

In anatomy, chemistry, botany, and materia medica, in addition to written papers, were oral and practical examinations. In anatomy, the dissection and demonstration of anatomical and surgical subjects in the dissection room; in chemistry and materia medica, the identification of drugs and chemicals, and explanation of their properties and uses; in botany, the identification and description of plants brought up from the Botanical Gardens for the purpose.

But the most substantial advance was in the teaching of medicine and surgery, and the system of clinical instruction adopted. As Professor of Medicine, I was, residing as I did at the College, Superintendent of the out-patient department, and there I compelled every student of my class to attend, to learn the visible signs and proper mode of examination of disease, with a view to its diagnosis and treatment.

Until he brought from my assistant and house physician, who directed their studies, a certificate of diligence and efficiency in this department, he had no chance of obtaining a clinical clerkship.

In this clerkship he had carefully to examine and diagnose every case assigned to him, to examine the secretions, and to submit to the house physician, when he went his rounds, a written statement of all he had ascertained. This officer [during the whole of my tenure of the Professorship, the late Prosunno Coomar Mitter, a singularly gifted and accomplished physician, whose early death was a great loss to the institution] went carefully over the ground again, and prescribed for the case during the intervals of my visits. When I came into the ward, the notes were read over, the diagnosis verified, and the treatment, with the reasons for its adoption, explained.

On the termination of the case, a careful abstract record of it was prepared by the clerk for the hospital registers, and, if fatal, the pathological examination and its results were entered.

In the last year of their pupilage, the best conducted and most proficient clerks were appointed practising pupils, and allowed to treat a certain proportion of the cases themselves, under the constant supervision of my house physician and myself—a proceeding originally instituted by Professor Graves of Dublin.

The final examinations in medicine and surgery were thoroughly practical, and subsequently to my leaving the College test cases were selected in the hospital wards, for examination and diagnosis by the candidates for degrees and diplomas.

I am induced to place all this on record, at this distant date, to show what, in my judgment, are the real uses of clinical hospitals, as well as in justice to my fellow-labourers and myself, for it is the ill fortune of those who work in the distant possessions of this great Empire, under difficulties unknown in this temperate climate, to be entirely ignored in their native land.

I mention it also because it has an important bearing upon our general hospitals and dispensaries, which are not at present utilised as they might and ought to be in the education of the medical profession of the future, as I shall endeavour to show in the proper place.

I have not referred specially to the great endowed hospitals, because they are both clinical and general hospitals, and have attached to them medical schools.

Their system of government is altogether out of harmony with the age in which we live, and their whole state needs to be carefully inquired into, both with respect to the work they have to do, their manner of performing it, and the charters under which they act. They are noble foundations, have some imperishable memories associated with them, and will be none the worse for a wholesome amount of State control, however strongly they may resist it.

General Hospitals.

By general hospitals I understand all institutions not directly connected with schools of medicine, maintained by public subscriptions, and which are in their character essentially private charities. They should, I am of opinion, contain provision for the treatment of all classes of disease and accident, including infectious fevers, and be constructed and arranged on the same principle as clinical hospitals, omitting the provision necessary for systematic clinical teaching and for the scientific investigation of disease. In this category of hospitals should be placed the great separate Poor Law Infirmaries, and they should, under proper regulations, and with due provision for the maintenance of the privacy essential to their good government, have the services of a small staff of clinical clerks and dressers, to assist the surgeons and physicians, and to aid to this extent in the practical training of the future medical practitioners of the country.

Their size should be proportioned to the needs of the population for whose benefit they are intended, and they should be placed in such positions as to secure to the poor within a radius of one or two miles, according to density of population, medical aid in the hour of need, without having to travel too far to seek it.

They should, as a rule, not contain a greater number of beds than 300, nor less than 100, for within these limits all varieties of cases, surgical and medical, including lying-in and fever wards, can, by proper arrangement, classification, and separation, be contained.

We have not at present any reliable statistics to show the proportionate incidence of sickness to population in a given area, and, indeed, it would be difficult to frame a fixed rule on the subject, from the very different conditions in which the closely-packed poor live in the great centres of industry. Now, however, that, under the operation of special Acts of Parliament, large portions of many great cities are so dealt with as to displace great bodies of the poor, wherever they are compelled to remove, due provision for their medical relief in the new locality should, I think, be compulsory. If, in that case, they are still closely surrounded by habitations, and land is too valuable to admit of an adequate amount being obtained for a hospital on the pavilion plan at reasonable cost, it would be better to erect one after the design of that of New York, than to leave them, as they are at present compelled, to seek relief for sickness in old and unsuitable institutions at great distances.

Among the Poor Law infirmaries which are types of excellence in their general arrangements, and which might, with little difficulty and much advantage, be at once converted into general hospitals, are the St. Marylebone Infirmary, recently occupied, and the Poor Law Infirmary at Hope, near Manchester, approaching completion. They are both on the pavilion principle, modified to suit the views of the authorities having control over them.

But, in my opinion, all the general hospitals of the future should be constructed strictly on the lines of the Friedrichshain at Berlin, or St. Eloi at Montpellier, each pavilion being self-contained, and thus shielded from the risk of being injurious to any other class of sick in its vicinity. In this manner the whole of the wants of each locality could be met in the most complete and economical manner, and the scandalous multiplication of small special hospitals, under no proper control of any kind, be prevented.

In this manner due provision might be made even for the infectious fevers, and so much of the maternity needs of each locality as would require to be treated in public institutions, matters that will be referred to again anon.

The conclusions upon the subject of general hospitals, arrived at by the Commission presided over by General Morin, in 1865, were as follows:—

"Large hospitals are needed for large towns; but, the healthiness of a hospital being in an inverse ratio to its population, hygienic conditions being the same, the population of a large hospital should not in general exceed 500, except in special circumstances.

"Admission to hospitals should be open to all diseases, whatever their origin or nature, whether more or less contagious.

"In large towns, persons attacked by contagious diseases, although not excluded, should nevertheless be treated either in special hospitals, detached pavilions, or in separate wards. In smaller towns or less important localities, the hospitals should be equally open to all, but the arrangements for their treatment should be as above.

"The division of the sick by categories of disease and age is advantageous, but is not absolutely necessary. The separation of children and adults is so; but very young children, under seven years of age, may with advantage be placed in the women's wards, as obtains in the hospitals of Paris.

"As respects small and moderate-sized hospitals, where a special service cannot be formed for sick children, they should be isolated from the other patients, and be placed under the direct supervision of the establishment."

Although not immediately connected with this branch of the subject, the remainder of the conclusions of this Commission may well find a place here, as they contain the conditions, prescribed by authority, to be observed in the erection of all hospitals in France. In a circular issued by the Minister of the Interior, in 1865, to all Prefects of Departments, the attention of all local administrative authorities is directed to them, as affording precise and detailed instructions for the erection of new buildings, and the improvement of old ones:—

"Convalescent hospitals are useful; the admission of convalescents demands a rigorous control, to prevent abuses.

"The localisation of a hospital is subordinated to two principal interests: the *salubrity* of the hospital itself, and its *proximity* to the agglomeration of population for whose benefit it is intended.

"To be completely healthy, the following conditions should be united; an unexcavated soil; a free and extended site; absence of dwellings,, marshes, humid fields, excavated ditches where water lies, and rivers drying up in summer; to avoid low lands as well as the summits of hills; to take note of the prevailing winds, both for the selection of the site and the aspect (ventilation) of the buildings.

"Hospitals should consist of several bodies of buildiugs completely separated from each other; these buildings should be connected for facility of service. They should not be double in depth. The spaces

separating them should be at least equal to double the height of the buildings. It is always advisable to give more extension to these interspaces.

"An east and west exposure of the sick wards is the most desirable

"It is advisable that all hospitals should be one-storied above the ground floor (*rez-de-chaussee*), when that floor is devoted to the sick; in no cases should they exceed two stories.

"The upper floor should always be separated from the roof by attics, in which patients should not be placed.

"When, in the same hospital, there are several pavilions, they should be united by a gallery to the height of the ground floor, the roof of which should form a terrace. This gallery should lead to the principal entrances, as well as to the interspaces, and should be lighted by closed bays, or large and numerous windows, and should be in communication with all the chief departments devoted to the sick, as well as the other portions of the institution—chapel, pharmacy, kitchen, baths, &c.; in other words, enable everyone to get everywhere under cover, without impairing the isolation of the separate pavilions.

"Except in very special circumstances each sick ward shall not contain more than sixteen beds, one to each window pier, with intervals of at least 6½ feet between them. The head of the bed to be 1 foot from the wall. The feet of the beds to be opposite each other, and to be at least 11 feet 2 inches apart. The height of the wards shall be about 14 feet, giving to each patient about 2,000 cubic feet of air.

"The wards shall be lighted on both sides of the building. At one of the ends of each ward there shall be one or two rooms with one or two beds, so as to raise the ward number to 20.

"The dimensions of each ward shall be indicated in legible, plain, prominent figures on the entrance door of each ward.

"In large hospitals, two parallel wards may be built on each floor, provided they are separated by large landings and partition walls, in which case regular ventilation must be provided for the wards and staircases.

"Every sick ward should have attached to it a nurse's room, a small kitchen, a lavatory, a bath, and a water-closet; all these must be ventilated, and separated from the ward by a passage, so cut off as to prevent any bad smells finding their way to it.

"Every hospital shall be provided with spare wards, to permit of the ordinary wards being occasionally vacated for cleansing purposes, or to arrest any outbreaks of epidemics in them.

"Dining-rooms, day-rooms, pharmacies, general kitchens, baths, laundries, mortuaries, and all other necessary buildings, shall be provided for all hospitals, in suitable positions.

"An operating theatre shall also be provided, and be placed and arranged so as not to be a source of disquiet to the other patients, and to serve as a lecture room."

The above rules are still in force, and do not differ materially from those of the Chirurgical Society, hereinbefore detailed.

The most objectionable of them is that relating to parallel wards with inner corridors, a form of construction which should never be permitted on any plea whatever. Many of the great workhouses in England are constructed on this principle, and a prolonged experience of their use, points to their absolute condemnation from the stand-point of salubrity.

Every general hospital should have separate pavilions for the treatment of the diseases of women and children, for whom special institutions are not only unnecessary, but out of place. This need not, in any way, prevent the women's wards being superintended by female surgeons and physicians, should such a proceeding be deemed desirable or necessary; but to separate them from the general hospital system of the country, on any pretence whatever, I hold to be a mischievous mistake, and one not likely to be attended with advantage to the sick, or to tend to the proper training of the medical body of the future, whether male or female.

The general arrangements of the women's and children's wards should be identical with those hereinbefore indicated, with such trifling particulars of detail as may be

considered necessary for their special needs. There should be no difference in the amount of space allowed for children and adults.

Lying-in Hospitals.

Maternities, or special lying-in hospitals, are comparatively modern institutions on the Continent of Europe, and appear to have attracted particular attention in France, from the exposure in 1795 of the calamitous results of the treatment of parturient women, in the ordinary wards of the old Hôtel Dieu. The subject had, however, been considered and discussed as early as 1664. From the end of the last century until 1840 little, however, was said about it, when it began to be ascertained that, although placed in one of the healthiest quarters of Paris, the great Maternity was peculiarly liable to outbreaks of puerperal fever. The original intention of special maternities, advocated by Tenon, was early departed from as insufficient for the increasing wants of the city, and as not affording the extent of clinical instruction required. Separate obstetric wards were in consequence added to several of the general hospitals in Paris. These continue to the present time, with, I believe, eminently evil results.

The first lying-in ward in England was opened by Sir Richard Manningham in 1739, in the parochial infirmary of St. James's, Westminster, and shortly afterwards, in 1751, the Rotunda Hospital in Dublin was established. This is probably one of the best conducted and most efficient establishments of the kind, in existence. The statistics published by Dr. Evory Kennedy for the first 113 years of its existence appear to show that during this lengthened period the average death-rate in 190,783 deliveries was 1 in 72, and that it had fluctuated remarkably, having oscillated between 1 in 14 in 1862, the year of heaviest mortality, from exceptional causes, and 1 in 227 in 1766. Although such figures need explanation in many important particulars, they appear to indicate that a high death-rate is inseparable from the aggregation of parturient women, however skilfully treated or carefully managed.

In a table kindly furnished to me by Dr. Atthill, of the Labour Department of the Rotunda Hospital, are the following figures, bringing down the information to a very late date :—

Years.	Labour Department.			
Ended March 31st.	Admitted (non-parturient eliminated).	Died.		
		Number.	Ratio per cent.	One in.
1871	1,128	27	2·39	41
1872	1,206	23	1·90	52
1873	1,179	29	2·46	40
1874	1,183	18	1·52	65
1875	1,238	16	1·29	77
1876	1,175	39	3·32	30
1877	1,035	22	2·12	47
1878	1,101	11	1·00	100
1879	1,110	17	1·53	65
1880	1,168	27	2·30	43
Ten years ended March 31, 1880	11,523	229	1·99	50

The deaths in this great institution are chiefly among the same class of broken-down constitutions, from moral and physical causes, as are seen in the workhouse wards of our great cities.

The best known authority on the question is, however, Mons. Lefort, whose work on Maternities, published in 1866, is a storehouse of great historical and scientific value for those who care to pursue the subject further. He collected the figures of 1,843,095 deliveries—935,781 confined in towns, of whom 1 in 212 died, and 888,312 delivered in maternities and hospitals, of whom 1 in 29 succumbed. The above figures are overwhelming in showing the great risks to life from the old methods of dealing with the parturient poor; and although they are, as all data regarding hospital mortality must unfortunately be acknowledged to be at present, altogether deficient in scientific accuracy, they are sufficient to establish the general truth that the parturient state is similar to great traumatic injuries in its tendency to generate septicæmic poisons dangerous to the individual and to others, from their eminently contagious character, and liability to extend from epidemic causes or insanitary conditions.

The last comparative experimental inquiry on the subject was conducted in Paris, and the figures from the 1st of January 1873 to the 30th of June 1875 were given by M. Lefort, to whose initiative and persevering efforts the change in affording medical relief to the pregnant poor of that city was due.

The aid given to this class in the French capital, is fourfold—

1. The obstetric wards of the general hospitals.
2. The special lying-in hospitals: 1st, the maternity; 2nd, the clinical hospital; 3rd, the maternity branch of the Cochin hospital.
3. The home delivery of the indigent by the official midwives.
4. The confinements of the poor at the licensed houses of the midwives of the town.

The results were: 1st, in the general hospitals 9,298 deliveries, 385 deaths, or 1 in 24; 2nd, in the special hospitals 6,631 confinements, 203 deaths, or 1 in 32; 3rd, home confinements, 28,006 deliveries, 53 deaths, 1 in 528; and 4th, deliveries in the houses of the *sages-femmes* 5,020, 25 deaths, or 1 in 200.

After careful discussion the chief conclusions arrived at by the International Medical Congress at Brussels, to whom the above figures were submitted, were the following:—

1. The urgent necessity of a more or less radical reform in the system of medical relief to the pregnant poor.
2. The complete abandonment of great lying-in hospitals.
3. The replacing of great maternities by small *maisons d'accouchement*, with separate rooms.

But now comes the question, Is it really necessary to dispense entirely with public lying-in wards, or may not most, if not all, of the important defects of the existing system be removed by improved plans of construction and arrangement, aided by the application of those principles which have been so successful in diminishing the dangers of traumatic injuries generally? I certainly think so, and the singular and exceptional freedom from

septicæmic disease of the lying-in wards of workhouse infirmaries in England, indicates the direction in which action should be taken.

In a parliamentary paper, published in 1867,* a remarkable fact was disclosed in the returns to an order of the House of Lords, as to whether recovery from illness was retarded by the existing accommodation and arrangements of workhouses. This was the infrequency of puerperal fever (metria) and the low rate of mortality among lying-in women caused by it in those houses.

In a statement furnished for five years from forty English poor-houses, it appeared that in 11,870 deliveries, 93 deaths occurred, or 1 in 127. In thirteen of those houses no death resulted in 2,459 confinements. In nine of the more crowded lying-in wards, with 6,044 deliveries, the annual proportion in each exceeding 365, and in St. George's, Lambeth, and St. Pancras, and St. Marylebone, exceeding five, eight, ten and twelve hundred respectively, the deaths amounted to 56, or 1 in 107; while in the remaining thirty-one workhouses, with only 5,826 deliveries, or an average of 187 to each house, the deaths were 37, or 1 in 157.

Upon this it was remarked by the Cubic Space Commissioners, that—

"It appears from a minute analysis of the returns laid before the Committee on this subject, that in point of fact a large air space, much exceeding 850 cubic feet, has been enjoyed on an average by each of the parturient women in almost all the workhouses. The comparative freedom of the lying-in wards from disaster may probably have been owing in part to the ample space thus actually shared among the women, though the Committee are conscious that much of the immunity was attributable to other causes."

The statistics specially collected by the Local Government Board, in 1881, for the whole of England and Wales for the ten years 1871-1880, show that the immunity prevails throughout the country, and that the conclusion deducible from it may safely be accepted.

Thirty workhouses in the metropolis, and 614 in the rest of England and Wales, presented returns. They included 87,284 deliveries; 22,817 in the metropolis, and 64,467 in the provinces. In the former there were 200 deaths, 0·87 per cent., or 1 in 114; and in the latter the deaths numbered 559, 0·86 per cent., or 1 in 115.

Of the whole deliveries, 23,820 were first confinements, and 50,240 of the mothers were unmarried. The twin births were 833, the triplets four in number.

In 378 of the provincial workhouses, and five of those in the metropolis, representing 25,210 confinements, there was not a single death in the decade. In 138 others, of which two were metropolitan, there was 1 death in each, among 13,313 deliveries.

The deaths from puerperal fever were 115 in the provinces, or 0·178 per cent., and in the metropolis 30, or 0·13 per cent. The deaths from all causes were chiefly among the diseased on admission—the victims of misery, starvation, and in many cases of vice and intemperance.

From the Registrar-General returns of the statistics of child-birth for the thirty-three years from 1847 to 1879, there were in all 23,953,400 children born alive, and among the mothers in the same period there were 42,647 deaths from puerperal fever, or in the ratio of 1·7 per cent.

* Report of the Committee appointed to consider the Cubic Spaces of Metropolitan Workhouses.

As this included all classes of the population, of whom the destitute or paupers represented only 34·6 per 1,000, the result certainly proves that women may be confined in public institutions without undue risk, provided proper hygienic conditions are observed, as they are in poor-law lying-in wards, and provided large numbers of parturient women are not collected in the same building.

When the question was discussed by the Surgical Society of Paris in 1866,* M. le Fort being one of the chief authorities, the following conclusions were arrived at :—

"1. It has been proved by statistics that the ravages of puerperal fever in lying-in hospitals are greater now than formerly. This can only be referred to the hospital atmosphere; therefore, the infirmaries and hospitals should be reduced in extent, and assistance provided for the poor in their own houses.

"2. Puerperal fever is infectious; and, therefore, hospitals conducted on the best principles may become the seat of great calamities.

"3. Besides the usual sanitary measures which are recommended for hospitals, special precautions should be observed in lying-in institutions.

"4. To avoid importation of disease, strict cleanliness should be observed. Empty wards should be thoroughly cleansed, not only the walls whitewashed, but the beds purified, &c.

"5. To check the spread of the disease the healthy should be removed from the ward where any have been attacked to small rooms for one, or at most four, beds.

"6. The attacked should be removed to a separate building.

"7. If, nevertheless, the remaining females get the fever, the whole building must be emptied.

"8. In cities where lying-in hospitals cannot be dispensed with, they must be small."

The latest expression of skilled opinion on the question is contained in a "*Report on the New Maternities in Paris*," drawn up by M. Thevenot,† and discussed at a meeting of the Society of Public Medicine held in Paris, on the 26th of July 1882.

The conclusions arrived at by the distinguished Commission noted below, were as follow :—

1. The most recent experimental researches, as well as the deductions of clinical observation, permit now of the authoritative statement, that the child-bed disease known as puerperal fever, puerperal infection, puerperal septicæmia, is eminently contagious.

2. The contagion is caused by discharges, by dressings, by instruments, by articles of clothing, by the atmosphere surrounding them; in fact by everything immediately connected with women during and after delivery.

3. The causes of contagion cannot be prevented, except in so far as maternities are not directly connected with general hospitals, and in the maternities themselves, by the rigorous separation of parturient women from the infirmaries (in which the sick from any other cause are treated).

4. Women confined should be isolated for the first six days following delivery.

5. The medical and infirmary staff should be separate, the one to act as accoucheurs solely, the other for the infirmary service alone.

6. The medical staff should abstain from making autopsies, from dissections, from handling anatomical preparations, and from surgical dressings.

7. In maternities all means and methods of disinfection should be practised, and all antiseptic precautions be taken.

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* *Gazette des Hopitaux*, No. 67, 1866.

† *Rapport sur les Nouvelles Maternités*, au nom d'une Commission composée de MM. O. André, Brouardel, Budin, Fieuzal, Léon Colin. L'Afollye, A. J. Martin, Napias, Pinard, M. Rey, Tarnier, E. Trelat, Vallin, Vidal, et Thevenot (Rapporteur). Extrait Annales d'Hygiene Publique. 3ème Serie No. 9, Sept. 1882, pp. 244-261.

8. Buildings intended for parturient women should be isolated, should contain a small number of rooms, each ward a single bed, and should be aërated on all sides.

9. All measures adopted to secure the healthiness of the sites and surroundings of hospitals should *à fortiori* be applied to maternities.

10. Every maternity should contain a disinfecting stove.

The new maternities described were that of the Hôpital Tenon, the isolation pavilion of the Lariboisière Hospital, the New Clinical Maternity of the Faculty, and the Maternity of Paris.

The chief objection to the first mentioned was its undue proximity to the mortuary and post-mortem rooms, and the absence of a separate infirmary. Its chief merit was the isolation of the cases, which, however, was said to be accompanied by defective supervision.

The statistics of this maternity show a mortality of 9 to 240 deliveries, or 3·75 per cent. Of the nine deaths five were from puerperal fever, or two per cent.; but it is not stated whether they were brought to, or originated in, the maternity.

The Lariboisière pavalion is on the Tollet system, and is an adjunct of the great hospital. It consists of eight separate rooms, of which six are for isolation, and one for the superintending nurse, which communicates with a second containing two beds. The rooms were considered to be too closely packed together, and to be too near the water-closets, and while the advantages of the Tollet system were fully recognised, it was considered that it needed greater space for its full development, as in the St. Eloi Hospital at Montpellier. The restriction of space was, however, entirely due to the necessity of the position.

The "Clinique d'Accouchemens" of the Faculty, which overlooks the gardens of the Luxembourg, is a fine two-storied building, with a basement, and serves as a maternity, an infirmary for pregnant women, and a gynecological clinique. It is constructed on the basis of the non-contagious character of puerperal fevers, and, in the words of the Commission, is built as it would have been thirty years ago, when little was known of contagion, and nothing of the germ theory of disease. This fundamental error renders it unnecessary to describe it, inasmuch as although it contains many features of excel lence in its mechanical details, it is altogether behind the age, and undeserving of reproduction, except as a warning, instead of as a guide.

The Maternity of Paris, which was long considered one of the most unhealthy of lying-in hospitals, and of which the mean death rate, even so lately as June 1858-1869, was 9·31 per cent., having oscillated in those years between 3·38 and 23 per cent., has, by the assiduous and successful labours of its distinguished surgeon, M. Tarnier, taken a high place among such institutions from its changed character, its mortality having been reduced from 1870-1882 to the average of 2·30 per cent., of which 3·90 was the highest, and 1·37 per cent. the lowest figure.

This result is due partly to structural changes, giving to each parturient woman a perfectly isolated delivery room, with a special arrangement for her confinement, and in part to the practice of every possible antiseptic precaution, before, after, and during delivery. Should one of the pregnant inmates become seriously ill from any cause, she is treated in a special infirmary, entirely separate from the parturient pavilion.

The structural arrangements referred to were described by Pinard, in the "*Annales d'Hygiène*," 3ème Serie, vol. iii., p. 537, and by St. Germain, in the article "Hospital," of the "*New Dictionary of Medicine and Surgery*," vol. xviii., p. 758.

Since the occupation of the Pavilion Tarnier, in 1,223 deliveries there were six deaths, a mortality rate of less than 1·2 per cent., and in the last three years there have been 608 confinements, without a single death.

I have dwelt at great length upon the question of lying-in hospitals, because they have heretofore been a reproach to our hospital system, and because the true means of making them healthy have now been determined.

Fever and Small-Pox Hospitals.

It would obviously be out of place, and is unnecessary, to discuss the exact nature, origin, and mode of communication of fevers generally, and of the exanthems in particular, so far as treating them in hospitals is concerned. Pathology has by no means said its last word on the subject, nor have sanitary science, and the carrying out of such laws as we have for the maintenance of public health and the prevention of disease, succeeded in tracing all of those diseases to their exact sources, in the manner necessary for their extinction *ab origine*.

For small-pox we have a thoroughly efficient protective agent, which, if applied in due time and in the proper manner, would undoubtedly cause the entire disappearance of the disease. But, so long as ignorance, prejudice, and the baser motives which too often regulate and control human actions prevail in such manner and to such extent in crowded populations as to evade or defy all legislative enactments, we must lay our account with having to treat small-pox in public institutions and private houses, and must make the best provision we can to prevent its spread by mere contagion. The same is true of such fevers and other diseases as are distinctly contagious, and can be communicated to those who are brought in contact with them, professionally or otherwise, whatever their origin or exact mode of extension.

As respects hospitals, then, the question narrows itself as to whether it is best and safest, in the interests of the individual as well as of the community in whose midst he dwells or finds himself, to aggregate them together in large numbers and in special institutions, or to make due and sufficient provision for their treatment in general hospitals, or in smaller institutions scattered about where they seem most to be needed.

So far as reliable data at present exist, the question appears to me to be more one of police than of pathology, for if the means of isolation are as perfect as they can and ought to be, the protection of the community is complete, and the real danger incurred is more or less confined to those in whose care the sick are placed. What, then, are the hospital arrangements best fitted to treat this great question in the manner necessary for the rapid extinction of zymotic disease, whenever and wherever it appears? This divides itself naturally into two heads: the treatment of the sporadic or solitary cases, which constantly occur at all times and seasons, and have no tendency to spread from epidemic or other influences; and the great outbreaks which roll, like waves, over whole communities.

For the former it would undoubtedly be best, in my judgment, to make provision in all general hospitals by separate pavilions or wards, so effectually isolated in structure and arrangement, as to be cut off from direct communication with the rest of the sick in the same institution. The distance and extent to which such diseases are communicable to those not directly in contact with them are, in my opinion, very small; and if broken up into manageable groups and few in number, they can be so effectively dealt with by the agencies known to neutralise, dilute, or otherwise rob of their power of mischief the agent of evil, as not to be a source of danger, even to those in charge of them. I saw a very striking example of this in the City Hospital of Boston last year, when an unmanageable outbreak of diphtheria was ultimately overcome by treatment in tents in the garden of the hospital. If all our future hospitals were so constructed and arranged as to permit of the admission of all classes of disease, accident, and injury, and the proper separation of infectious and contagious diseases, for which such excellent provision is made in M. Tollet's plan of the St. Eloi Hospital at Montpellier, there would not only be no need of massing together any of the communicable diseases, but the danger of their aggregation would be avoided.

Small pavilions in general hospitals I hold, then, to be fully adequate to deal efficiently with the ordinary occurrence of the whole class of infectious fevers, if the hospitals themselves were restricted in the number of their beds, and were arranged strictly on the pavilion plan; and if they were better distributed than they now are, and were proportioned to the ordinary needs of the population in the centres of which they are, or ought to be situated. If additional accommodation in non-epidemic times is required, it should be provided by means of wooden huts, or, at proper seasons, of tents, a sufficient amount of ground in the hospital enclosure being always kept available for these purposes.

For epidemic outbreaks (which would often be prevented if the above-mentioned accommodation existed, and the immediate notification of the occurrence of any case of infectious fever were compulsory), special provision must always be made, and the best manner of accomplishing this would be by wooden pavilions, or, at fitting seasons, and still better, of tents. Experience acquired very long since, as pointed out by Dr. Guy in his admirable Lectures on Public Health, and as illustrated on a colossal scale in the recent wars of America and Europe, has removed this from the arena of controversy and discussion, to that of accomplished fact.

In such a city as London, compulsory powers should be granted by the Legislature for the selection and permanent retention of suitable localities in which to place what may be termed epidemic hospitals; for the immediate notification of all outbreaks of contagious disease; for the compulsory removal of all attacked who cannot be properly accommodated in their own homes, so as to prevent their becoming a source of danger to others; and for the institution of a central authority armed with the power to deal with the whole matter of medical relief, in its personal and public relations, with the promptitude, economy, and unity of action necessary for the common weal.

The excellent reports of Drs. Thorne and Power, on the subjects of fever hospitals and the spread of small-pox in the metropolis, throw a great deal of light upon, but by no means settle, the question. The former has given the only authoritative account we

yet possess of the provisions made by the sanitary authorities all over the country to deal with infectious fevers. His careful record shows how much there is yet to be done for the proper protection of the community, and how imperfect the arrangements, in most cases, are.

Mr. Power's conclusions as to the part played in the supposed aërial spread of small-pox by the Fulham Hospital do not appear to me to be well sustained by the evidence collected by him, with most commendable care and conscientiousness, and by no means satisfy me that the dissemination was not really due to other than atmospheric causes. In any case it needs a much larger induction to determine the very important issue in question.

However, at all times and in all circumstances, epidemic or non-epidemic, I myself strongly prefer temporary to permanent buildings for the isolation and treatment of every type of truly infectious disease, unless the buildings are constructed, as in the Tollet system, so as to admit of complete separation and efficient purification and disinfection whenever they are vacated. The recent advances in the establishment of the germ theory of disease point strongly to the manner in which the germs are produced and propagated, their singular subtlety and microscopically infinite minute subdivision; whilst their tendency to adhere to and conceal themselves in all corners and crevices, and to be called into activity by atmospheric and other causes, which have heretofore eluded discovery, are well established. These conditions clearly indicate the necessity of avoiding all materials which can hold and remove them from observation, and from the antiseptic action of the agencies, fluid or gaseous, which could rob them of their powers of mischief if they could only get at them. Hence costly masonry hospitals, which have not inaptly been termed "Versailles of Misery," are not only a waste of money, but are positively injurious to the sick, when such buildings, from age, chemical changes in the composition of their materials, and the other causes of deterioration to which such structures are liable, and from which none are exempt, should never represent the sick asylums of the future—at all events, in the present state of our knowledge of the subject.

In his able and philosophical article on hospitals, in the "*Nouveau Dictionnaire de Medicine et de Chirurgie Pratique*," M. Charles Sarrazin has the following pertinent remarks. In speaking of masonry hospitals, he says:—

"In summing up, the only rule to adopt is this: when we cannot have pavilions, with only a well-raised single storey, more than two stories of sick wards should never be superposed. The pavilion of the hospital would then consist, besides a basement or cellars, of a ground and a first floor."

In opposition to these ideas, generally admitted, is the *radical view*:—

"No more permanent hospitals; they must be replaced by *hut hospitals*. The permanent hospital is the *sepulchre hospital*; nothing can render it wholesome, and its construction entails extravagant expenditure. The hut hospital, wholly or partially renewed every ten or fifteen years, alone possesses the hygienic conditions necessary for the abodes of disease, and admits of the realisation of marked economy."

These views have been strongly advocated of late years by such distinguished observers as Sir James Simpson, M. Michel Levy, and other equally eminent practical authorities, and have been largely put into practice in the rapid and murderous wars of the past half century.

Long prior to our times, however, they were successfully adopted by an English military surgeon of the last century, whose work has been rescued from oblivion by Dr. Wm. A. Guy, the eminent statist, who wrote as follows :—

" In the year 1758, we made an unprosperous attack on the coast of France, and brought home a great many sick soldiers, who were lodged in old houses, barns, &c., round Newport, in the Isle of Wight. In one of these close hovels a poor soldier of the 63rd Regiment, just landed from a transport, was placed. He was soon seized with malignant sore throat, which carried him off on the third day. Another soldier, who was placed in the same bed (the sheets only being changed), was speedily attacked in the same way, and soon died. A third man was put into the same bed, and shared the same fate. 'Fresh bedding of every sort' was now ordered, and 'the boards all around' were scraped and thoroughly washed with vinegar, and then a fourth soldier was lodged in this house, and died. A second time 'this ill-fated spot underwent a most rational purification,' with abundance of vinegar fumes, burnt gunpowder and burnt resins, and all the contiguous parts were washed, scraped, and fumigated. But, in spite of all this precaution, a fifth man was attacked, and had a narrow escape of his life. Having thus lost four brave men, and with difficulty saved a fifth, Dr. Brocklesby would not suffer another soldier to be lodged in this place till after seven or eight days; but, a sixth soldier having been placed there, he too caught the disease, and had a narrow escape.

" Taught by this sad experience, and finding that the soldiers landed from the transports were more numerous than could be accommodated in all the spare outhouses, barns, and empty cottages which money could procure or humanity supply, it was resolved to erect a temporary shed with deal boards upon the open forest, to thatch it with a coat of new straw, thick enough to keep out wind and rain, and to make it large enough for 120 patients. A country workman did the work (charging for the use of the boards) for £40. Here I quote Dr. Brocklesby's words," says Dr. Guy :—" 'Although the hovel was finished in a fashion the most slovenly, and apparently inadequate to the end proposed, upon trial it was found that, notwithstanding most extraordinary cold as well as moisture, which the sick there lodged had suffered, remarkably fewer died of the same diseases, though treated with the same medicines and the same general regimen, than died anywhere else; and all the convalescents recovered much sooner than they did in any of the warmer and closer huts and barns hired round Newport, where fires, and apparently better accommodation of every sort, could be provided for them.'

" Now this striking fact happened to come to the knowledge of Mr. Adair, Inspector of Regimental Infirmaries, who was in the neighbourhood, and he, 'remarking that this currency of fresh air had such amazing salutary effects upon the men hutted in the forest, procured an order to convert Carisbrooke Castle itself, situated upon the extremity of a very high ridge of land, into one large general hospital, where near 400 sick might, on occasion, be lodged together.'

" 'At first,' says Dr. Brocklesby, 'it was expected that the sick brought to that place would do better than their comrades who were lodged up and down in the miserable huts of the town, or than those upon the wild bare forest near Newport, under that occasional hovel' (meaning the £40 *extempore* hospital), 'Yet the event verified our conjectures only in part, for, though the Castle was more prosperous to their recovery than the small rooms in low-roofed houses, yet more proportionally of the foresters were recovered, and that much sooner than any of the rest; and it evidently appeared that all the damage and inconvenience the men suffered from cold or redundant moisture in that place was much fitter to be tolerated, on the whole, than the mischiefs complicated on the sick by huddling together 300 or 400 men and upwards under one roof, and in the outhouses adjoining to the Castle.'

" But Dr. Brocklesby has still something to tell us about cheap extemporised hospitals and their good effects, for two years later (1760) a dangerous putrid fever made its appearance amongst the sick of the 30th Regiment, at Guildford, in Surrey, which led him to erect other hospitals, with like good results, and at the reduced cost of something above £10 a-piece.

" The sick soldiers were at first taken to their infirmary, about five miles from the camp. As this place was crowded with more than four times the number it ought to have contained, Dr. Brocklesby remonstrated, and obtained from General Cornwallis plenary powers to act. It was 'in the beginning of September 1760, when very unusual numbers from the 30th Regiment,' and a few from other regiments, were daily falling sick of putrid petechial fevers, and when proper accommodation for the sick could by no means be procured in the town of Guildford, that the doctor made his second experiment.

"He 'pitched upon the dryest and most airy spot,' on a rising ground in the field behind the camp; hollowed out as much of the dry sandy soil as he required, and near the edge of the hollowed ground drove in upright stakes, about six feet high from the surface, and placed wattles between them, coated on the side next the weather with fresh straw. Rafters were laid over in a workmanlike manner, and coated thick like the sides. This made the hollow 'spacious and airy overhead, and yet abundantly warm and dry.'

"This structure cost the public ten guineas, added to £5 for straw, and gratuities to the bricklayers, who built a large chimney and set a kitchen-grate. So that probably this hospital, for 40 patients, did not cost more, from first to last, than £20. Now, Dr. Brocklesby tells us 'that though several soldiers were admitted into this "repository," ill of a true petechial jail-fever, only one or two, at most, died in it;' and he adds, 'I candidly ascribe their fortunate escape more to the benefit of the pure, keen air they breathed therein every moment than to all the medicines they took every six hours or oftener. For, on account of the nature of this sandy soil, there was an opportunity to remove, as oft as necessary, the whole inner surface of the floors and walls, which might be suspected to imbibe and retain any infectious matter proceeding from the patients, and the sand so scraped off was, every three or four days, ordered to be thrown out of doors.'

"Dr. Brocklesby had still another and another opportunity of trying this happy expedient of cheap extemporised hospitals, in 1761 and 1762. In the first of these years there was a Militia camp at Winchester, and much sickness there. The soil was chalk; and he proceeded to dig three pits, 31 feet long, 19 wide, and 5 deep; at a foot from the edge of these pits he drove stakes, six feet apart, formed his wall with wattles and thatch, and his roof of the same materials. A brick chimney, and boards fastened along the line of the men's heads, completed these 'mansions for the sick.' Air-holes in the thatch, to be occasionally opened, served as windows and ventilating apertures; and steps, cut in the chalk, gave access to the interior. To these three mansions the fever cases from the 'close infirmary at Winchester, as well as from the camp,' were admitted; and in less than a fortnight the numbers were reduced in the proportion of four to one, the number of sick to the end of the campaign were much fewer than ever before, and all the men admitted, 'except three at most,' were cured. The following year, 1763, the same plan was adopted on the chalky ground of a different encampment, a large airy porch being added before each door. A regiment encamped there lost not a man during the whole encampment; while 'some other regiments of the brigade, who had invincible prejudices against the above practice, lost several of their sick in that and the previous year. And all that time,' says the worthy doctor, 'the Militia themselves were known to give ten guineas or more for a good recruit to supply the place of the deceased.'" *

I have retained the whole of this lengthened account, because it is of infinite historical interest, and teaches several valuable lessons. Dr. Thorne's report shows how much the lesson of economy is needed, and that finished cabinet-work, as expensive as masonry, is in no way necessary or desirable.

There is no need for extravagance in the construction of hospital huts, beyond their being raised sufficiently above the ground on masonry supports, being ventilated throughout at the ridge-pole, and each hut being self-contained, with its little kitchen, scullery, nurses' room, water-closet, bath, and day-room.

There ought to and need be no difficulty in warming them; and, if constructed of properly seasoned and Kyanised wood, they would last as long as it would be desirable to let them live.

In the summer and autumn, nothing is so good and so inexpensive as properly constructed double-roofed tents, against which an unaccountable prejudice exists, founded solely upon a want of experience of their real value. They are easily warmed, lighted, and rendered proof against weather; can be stored cheaply, and transmitted speedily wherever the need for them may suddenly arise.

* "*Public Health*," by W. A. Guy, M.B., F.R.S. Lond., 1874; pp. 312-317.

Special Hospitals.

This is an extremely difficult class to deal with, and so little that is reliable is known of many of them, as to increase the difficulty of determining their *raison d'être*. With a few exceptions, they have been unsparingly condemned by Dr. Oppert in his work on hospitals, who thought that even then (1867) they had increased so largely in number, and in so alarming a manner, that it was high time for public attention to be directed to them, for as soon as they multiplied in such manner that for almost every disease one would be called into existence, they would become a nuisance and an absurdity.

Some are undoubtedly needed in so large a city as London, for purposes of instruction and scientific research, and in dealing with classes of diseases for which adequate and fitting accommodation cannot be found in general hospitals. These are few in number, and regarding some of them, grave doubts are now entertained as to whether it is desirable to gather considerable bodies of sick in them, on the supposed ground of their danger to the communities in the midst of which they are placed.

The principle of construction of hospitals by subdivision, with detached and separate pavilions, which admit of a complete classification of disease, and the separation of those which need special arrangements for their treatment, render the provision of special hospitals less necessary than they may have been at any former period. It is idle to suppose that any one part or organ of the human body can be so entirely detached from the rest as to demand for its treatment measures so special as to require an institution to itself. Those in which a high order of mechanical skill, to be attained only by special training and practice, is essential for effective treatment, may be, and are, rightly constituted special branches of practical medicine; but for the great majority of the special institutions in existence, no such plea can be urged. For most of these a separate ward in a general hospital would be best and safest in the interests of the sick poor.

For cancer and consumption in very large communities special accommodation is desirable, because the cases are usually too protracted to admit of their occupying beds in a general hospital; but, even for such diseases, room should be found in all hospitals which are in any way used as instruments of instruction and scientific research.

In the construction and arrangements of such hospitals the general principles already laid down are strictly applicable, with such modifications of detail as are required for their particular purposes, such as the careful regulation of the light in ophthalmic institutions, a complete system of baths in those devoted to the treatment of skin diseases, &c.

While it is necessary that what are at present considered to be more or less incurable diseases should not occupy beds in clinical and general hospitals to such extent as to cripple the resources of those institutions, and so far diminish their usefulness, they should not be entirely excluded from them.

As time goes on, physiology and pathology extend their boundaries in ascertaining the causes, progress, and effects of disease, and art enables us to remove them, it is necessary that careful provision to a limited extent for their study should be made, at all events in hospitals devoted to medical instruction and scientific research.

When collected in special institutions devoted to cancer, consumption, and some forms of disease of the brain and nervous system, the hygienic arrangements of such places should be, as they usually are, of the most perfect description as regards essentials, which sanitary science has devised. All such cases require ample space, and some of them special mechanical and other contrivances, for the comfort and safety of the sick and afflicted. For the destitute and incurable poor, however, their best refuge is the workhouse infirmary; more carefully restricted in numbers than is sometimes at present the case, and with better arrangements for nursing, as from the absence of proper medical supervision in most of the workhouse infirmaries throughout the country, the ignorance and incapacity of the ill-paid surbordinate agency employed, is a scandal and a reproach to the administration of the Poor Laws.

As respects mental alienation in all the forms which need restraint, and are more or less amenable to treatment, or which only require separation, as congenital idiocy and dementia, the various asylums in different parts of the country are monuments of the humanity and liberality of the nation in taking care of those who are irresponsible, and unable to take care of themselves. They are also specially cared for by the Legislature, in a manner of which some of the features might with advantage be applied to the general hospital system of the country. As special hospitals, they scarcely fall within the limits of my contention.

Neither do pay hospitals, which are now attracting much attention. In principle they differ from no others, and with them are liable to misuse if not wisely conducted, a question more of medical ethics than of medical practice.

Cottage Hospitals.

Cottage hospitals for country places are now accomplished facts; their necessity and usefulness have been acknowledged and established, and they have been so fully and carefully discussed, described, and illustrated in Mr. Burdett's excellent work on the subject, as to need little more than their mere mention here. The general principles to be observed in their construction and arrangements are the same as those which require to be considered in relation to larger institutions of similar character, modified to such extent only as the smaller numbers to whom they are applied demand. In some of those which I have seen there has been a somewhat too literal assimilation to a cottage, and a tendency to ornamentation which, however praiseworthy on æsthetic grounds, is not quite consistent with their healthiness and use. It must never be forgotten that however few in number are the sick placed under the same roof, they need exceptional care in the regulation of their cleanliness, ventilation, conservancy, washing, cooking, clothing, and all other accessories of sick rooms; that the different rooms or wards should not intercommunicate with each other, so as practically to have one atmosphere common to all; that all kitchens and closets should be detached, and that arrangements should be made for the convalescent to be as much in the open air as possible, when the season and weather permit. By a neglect of these principles, which are universal in their application, small may, *mutatis mutandis*, become as unhealthy as large hospitals.

Convalescent Hospitals.

The need of some healthy means of removing persons recovering from sickness in towns to places where they can entirely shake off the effects of disease, and return quickly to their ordinary avocations, without danger to themselves or to others, has long been acknowledged, and to some extent acted upon. The hospital day-room and garden are the first step in this desirable direction, and wherever practicable should never be overlooked in all plans of construction for such institutions. For the wealthy, and for those in moderately easy circumstances, many such exist; and there is now a cry for convalescent hotels, for which the existing conditions of active life seem to justify the necessity. The last move in this direction at Bournemouth, is deserving of all support and success. But I am writing of the poor, for whom there is still greater need than for the rich, inasmuch as if they are allowed to return to their unhealthy abodes too soon, they are tolerably sure to relapse and die, whilst it is impossible to retain them in hospitals until complete recovery takes place, even if that be practicable in such places, of which there is more than sufficient doubt. For the poor, convalescent hospitals should be a compromise between a home and a hospital, with as much of the former as can fit easily into the latter.

An excellent example of what such a place should be exists at Cheadle, near Manchester. The late Mr. Robert Barnes, for many years one of the trustees of the Manchester Infirmary, a man of large views and well-directed benevolence, placed £26,000 at the disposal of the Infirmary Committee to build a Convalescent Home for those patients who could be removed to a healthy locality, to enable them to recover their health more speedily than was possible in the Infirmary itself. The outcome of this munificence has been a Convalescent Home at Cheadle in Cheshire, with accommodation for 140 patients, and with a suitable staff of nurses. The building was designed and executed by Mr. Lawrence Booth, of Manchester, in conjunction with Dr. Reed, the then resident medical officer of the Infirmary, and a ground-plan and elevation of it was published in the *Architect* of December 2nd 1876. It consists of a number of small rooms with three beds in each, and four larger rooms, each containing six beds, with an abundance of space for cases that may relapse after removal. It has day-rooms, a large dining-room and chapel, and all other accessory buildings—and, above and beyond all, a summer and winter garden, elegant in design, 100 by 61 feet in extent, and with a gallery on the first floor to accommodate those patients who are still too weak to get up and downstairs. It cost about £120 a bed, exclusive of site and furnishing, and stands on a large area of ground, originally of 23 acres, to which considerable additions have subsequently been made. Since its completion it has been largely and beneficially used in relieving the Manchester Infirmary of other cases besides convalescents.

The most perfectly organized Convalescent Hospitals that I am acquainted with are those of Vincennes and Vesinet, near Paris, the former for men, the latter for women.

The "Asile of Vincennes" was established by a decree of the Emperor Napoleon III. in 1855, to enable workmen to return to their work without danger, when recovering from sickness. He endowed it richly, and made provision at the same time for a

monthly or annual subvention to those convalescent workmen who preferred to return to their own home.

Besides 522 beds for convalescents, it contains the necessary offices and residences for the administrative staff.

It is situated on the borders of the Forest of Vincennes, close to the great lunatic asylum at Charenton, and is placed in the centre of a large plot of ground permanently detached from the Forest. The buildings, with the courts and gardens, occupy a superficies of 24,000 metres, and cost 2,500,000 francs.

The conditions of admission, government, length of residence, which averages 21 days, and all other arrangements, are carefully regulated, and it has an infirmary for the treatment of all cases of relapse. From 1857 to 1866, 57,844 convalescents were admitted, of whom 37,824 were from medical and 20,020 from surgical affections, amongst whom there were 242 deaths.

The alimentary regimen is of the most liberal character, and excellent arrangements are made for the outdoor exercises and indoor amusements of the inmates, gambling being strictly prohibited.

The Vesinet Convalescent Hospital, originally intended for workmen mutilated in their occupations, was afterwards, in 1858, changed into an asylum for convalescent work-women, and contains 350 beds and 50 cots for infants. The average duration of residence in this Asile is 23 days; and from 1859 to 1866, 22,504 convalescents and 2,263 infants were admitted. The dietary is ample, the means of occupation and amusement carefully regulated. A large proportion of the convalescents consists of women recovering from their confinements.

The deaths among the inmates above-mentioned, in the time specified, were 76 women, but the mortality of infants was much higher.

The above are noble institutions, and deserving of all commendation. In addition to them, there is an admirable institution for the scrofulous offspring of the poor of Paris at Berck-sur-Mer, near Boulogne, which has, however, more of the characteristics of a hospital proper, than of a convalescent establishment.

There are many small convalescent homes scattered about England and Wales, mostly private charities, of which little is known generally. Much as centralisation is out of favour amongst us, it would be well if they could be subjected to some kind of supervision, in no way to interfere with the fullest exercise of private benevolence, but to secure that the cardinal conditions of all such institutions are fairly observed in their construction, arrangements, and management. I have seen more than one which left much that was to be desired in all those respects.

Every general hospital in the country should have a convalescent home attached to it.

A portion of this Section appeared in the *Lancet* in 1881, and, with the sanction of the Editor, is reproduced here.*

* In pp. 25-28 is an account of M. Layet's method of determining the co-efficients of aëration. Since this was in type, a further examination of the question has shown that additional calculations and researches are necessary, before a simple and reliable method of determining this point can be accepted as conclusive.

SECTION II.

TYPICAL EXAMPLES OF THE GENERAL HOSPITALS OF VARIOUS COUNTRIES.

BY

H. SAXON SNELL, F.R.I.B.A.

Hospital Construction and Management.

Section II.

By H. SAXON SNELL, F.R.I.B.A.

INTRODUCTION.

IT is proposed in this Section to examine in some detail the design and construction of the most noted hospitals, of various countries, erected since the introduction of what is known as the Pavilion system.

It was intended that the types selected for illustration should be generally those representative of the rules for hospital construction laid down by the most eminent experts of each country.

An examination of these types will, however, shew that there are comparatively few buildings, if indeed there are any, that embody in all their details the conditions set forth by the best authorities.

An endeavour will, therefore, be made, in the description of the buildings, to indicate the deviations from a perfect standard according to the theoretic view.

It will also be apparent, that while most of the generally accepted principles of hospital construction are nearly identical in all countries, yet in the practical application of them to matters of detail considerable diversity exists.

On the other hand, there are a few important points—such, for example, as the question of aspect—upon which no two authorities appear to be in entire accord. It would not be a very hazardous conjecture to make, that from amongst all the best pavilion hospitals now existing, an axis could be found for every two points of the compass.

Then, with regard to the even more important question of the cubic space requisite for sick wards, we find this varies in general hospitals of admittedly good type from 1,300 to 2,500 feet per bed, and the floor space from 90 to 150 superficial feet per bed. This divergence is apparently due to the different views entertained upon the question of what is perfect ventilation.

Similar disparity will be found to exist in numerous other equally important details of hospital construction, and the time has come, therefore, to attempt to gather together, for general information, systematic data as to these points of difference with a view to the formulization of rules that it may be hoped will be more universally accepted and adopted than those now prevailing.

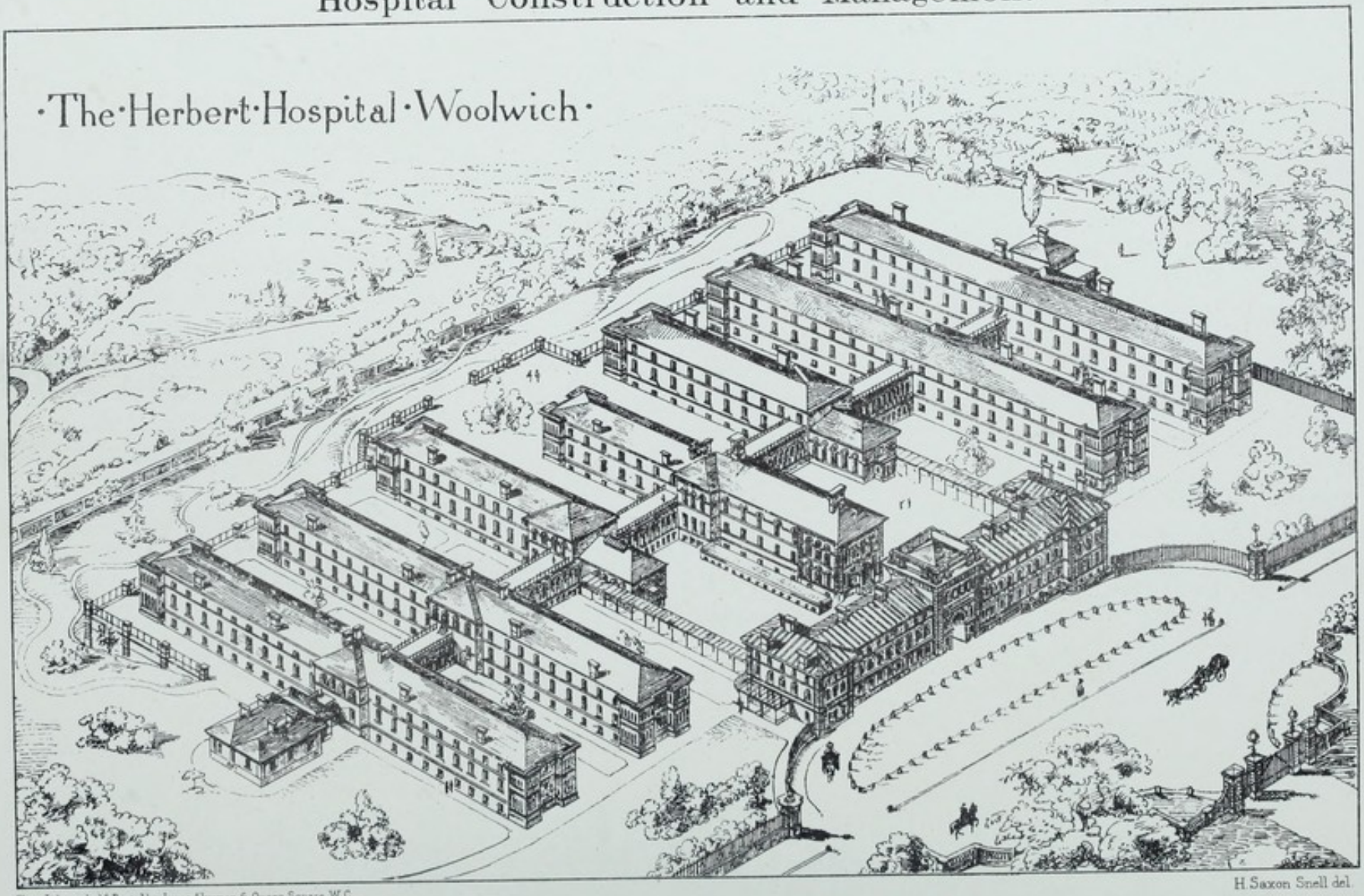
To this end the differences in the details of the various types illustrated in this Section have been summarized under various heads, and in such a manner as to admit of easy comparison between them.

The details given of the buildings illustrated have, in nearly all cases, been taken from actual observation and measurement, it having been found that in many instances the accounts of them already published are not strictly accurate or are misleading.

Many, however, of the chosen types, the foreign examples especially, have not previously been published in this country, and some of them have never, it is believed, been published at all.

The buildings chosen for illustration are not all of them necessarily good specimens of hospital construction; indeed, it must be acknowledged that the details of some, such for example as the "Hôtel Dieu," are irretrievably bad, but they have become famous buildings in consequence of their prominent positions in important capitals, their palatial appearance, and the large sums expended upon their erection; or, as in the case of the Blackburn Infirmary, because undetailed illustrations of them have, from some cause or another, found their way into most of the works recently published in various countries, and treating of hospital construction.

From such and similar causes, many persons have been led to suppose that these buildings are recognised as good types of hospital arrangement, and it has, therefore, been thought desirable to scrutinize them closely, and to indicate wherein they are faulty, with a view to the prevention of a recurrence of the errors committed in their construction.



H. Saxon Snell del.

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

HERBERT MILITARY HOSPITAL,

WOOLWICH—ENGLAND.

THIS Establishment was erected between the years 1860-64, for the reception of invalided soldiers of the Woolwich Garrison; consequently, it is for the accommodation of one sex only. The principles upon which it is constructed are those laid down by the "Report of the Commissioners appointed to Enquire into the Regulations affecting the Sanitary Condition of the Army," published 1858, and the "General Report on the Sanitary Condition and Improvement of Barracks and Hospitals," published 1861.

The designs for the building when prepared were examined in detail by Lord Herbert, and submitted by him to Miss Nightingale, whose practical experience was found to be of much assistance. They were further submitted to, and received the concurrence of the Director-General of the Army Medical Department and of the Barrack and Hospital Improvement Committee. The immediate superintendence of the construction of the building was delegated to Captain Newsome, R.E., Mr. Ware, Mr. Parry, and Mr. Tait, all of whom acted first under Colonel Ford, but latterly under Colonel Hawkins, Commanding Royal Engineers. The design and construction of the reservoirs for softening water were entrusted to Mr. Homersham, C.E. Messrs. Myers and Sons were the contractors for the erection of the buildings.

If we consider that this was one of the first hospitals erected in England upon the pavilion principle, it will not be wondered at that some of the details of its construction and arrangement are not in all respects so perfect as our increasing knowledge of sanitary science has since shown to be necessary. It is, however, remarkable that this building, having professedly been taken as a model for the design of most other hospitals subsequently erected in this country, was nevertheless, until recently, pronounced by one of the highest authorities "to be one of the best examples of a pavilion hospital."* No attempt would appear to have been then made, in the many hospitals subsequently erected, to avoid the few errors so apparent in this design, but, on the contrary, in many instances these errors have been faithfully reproduced, and more often intensified.

Site.—The site upon which the buildings stand is described by the architect † as being "on the southern slope, and a little below the summit level, of a ridge of ground extending from Shooter's Hill along the Dover Road in the direction of Blackheath, at an elevation of 235 feet above Trinity high-water mark. The ground has a fall, not only towards the south-west, but also towards the west, and as it was of

* *Encyclopædia Britannica*, Ninth Edition, Art. "Hospital," by Prof. F. de Chaumont, F.R.S.

† *Report on Herbert Hospital*, by Captain Douglas Galton, F.R.S. 1865.

great importance to keep the corridor communication on the same level throughout this building, it was necessary to lower the ground at the north-eastern angle of the site, hence the level of the plateau thus formed is 14 feet below the original surface of the ground at the point where the Dover Road joins the Eltham Road, but the north-eastern pavilion is 150 feet from that point, and the ward floor on the ground storey is nearly on a level with the part of the Dover Road opposite to the end of the pavilion, and is four feet above the actual level of the ground. Shooter's Hill rises to the north-east and east of the plateau, but the plateau itself is protected from any possibility of wet from the higher ground by a deep drain carried round behind the enclosure wall on the northern and eastern sides, which effectually isolates the plateau on which the hospital stands from all surrounding levels. The plateau itself is drained by agricultural drains, placed in some parts at intervals of 15 feet, and in some parts at much closer intervals. The natural site had a rapid inclination down from east to west; the plateau has, therefore, been formed on two levels. The ward floors situated on the eastern or upper part of the plateau are raised four feet above the level of the plateau; the basements, which afford a minimum height of eight feet from floor to ceiling, are partially sunk below the level of the plateau. At the western or lower level of the plateau, the ward floors on the same level stand considerably, and the basement oor somewhat, above the original ground surface. A damp-proof course of glazed perforated brick, placed just above the ground level, is carried round the whole of the buildings, and a granite surface drain channel is carried close round all the walls. The water from the roofs is led away by close drains into a soft water tank. The surplus rain water from the roofs, and the natural drainage from the site, passes into a watercourse to the south of the site, which carries it into the Ravensbourne River. The foul water drainage, on the other hand, is carried through a sewer three feet high and two feet wide, from the north-west angle of the hospital site, into the sewers of the town of Woolwich." The whole of the main front is open to Woowich Common.

The extent of the site is about 755,212 superficial feet, or 17 acres 2 roods nearly, being about 1,162 superficial feet per bed.

Subsoil.—No information is recorded as to the nature of the subsoil, but, from the geological maps published by the Ordnance Department, the ground immediately below the surface mould would appear to consist of London Clay.

General Arrangement.—The general arrangement of the buildings, together with plans and details of the principal sick wards, is shown upon the accompanying plates.

The principal entrance is situated in the central block A, which also contains upon the basement floor—officers' kitchens, orderlies' dining-rooms, and stores; on the ground floor—administrative offices, medical officers' and surgeons' rooms, examination rooms, governor's, registrar's, captain of orderlies', paymaster's, and clerks' offices, and sergeant-major's quarters; on the first floor—apartments for the governor, orderly medical officers and dispenser, nurses' dormitories and day-rooms; on the second floor—dormitories for 92 orderlies, and four officers' rooms.

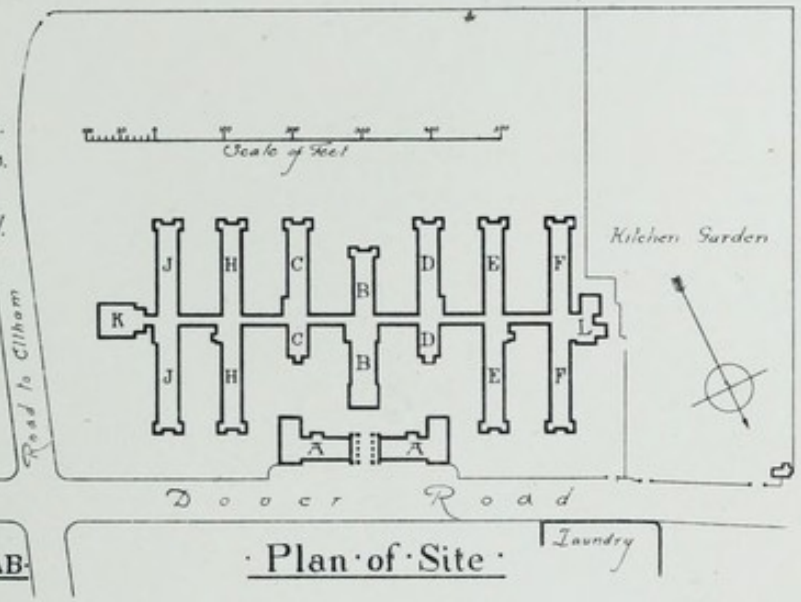
The rear central block B contains on the basement the principal kitchen, scullery, larders, and stores; on the ground floor a general library and day-room, and steward's,

· The · Herbert · Hospital ·

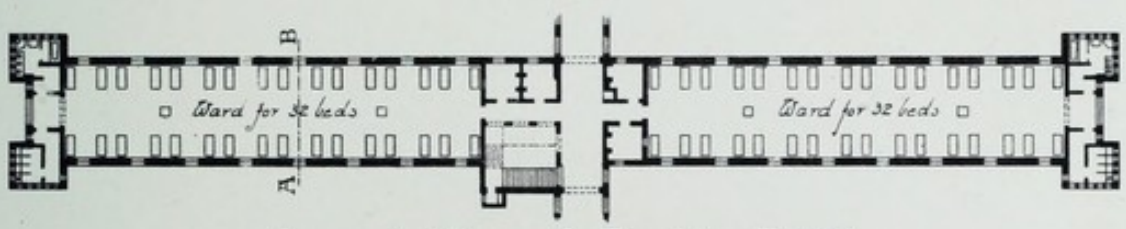
A. Administrative Offices.
J.H.C.D.E.F. Sick Wards.
B. Kitchen, Library, Day-Room, Chapel.
K. Separation Wards
L. Mortuary, Operating-Room & Theatre



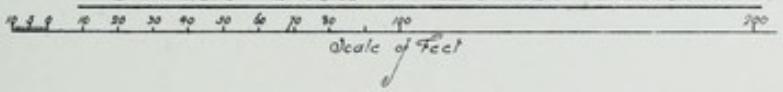
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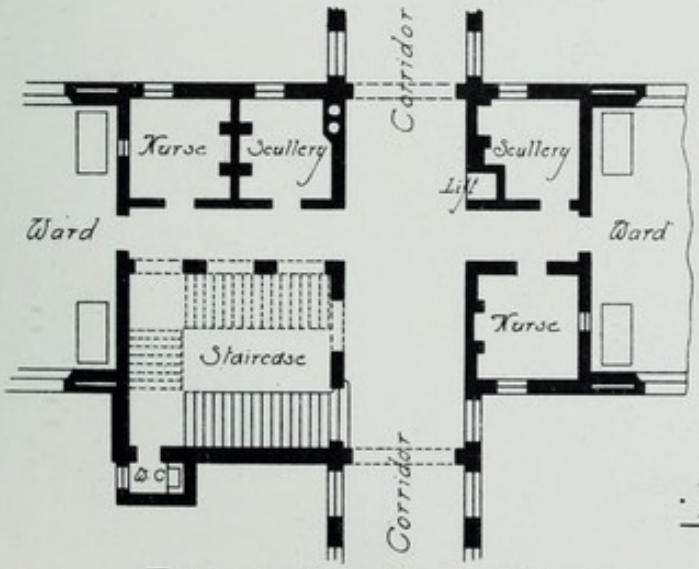


· Plan · of · Site ·

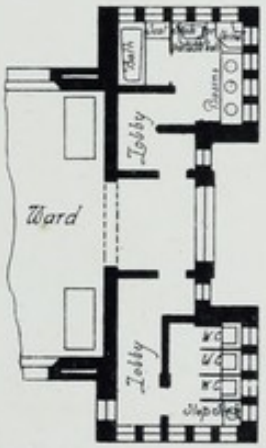


· Ground · Plan · of · Double · Pavilion ·





· Detail · of · Central · Offices ·



· Detail · of · End · Offices ·

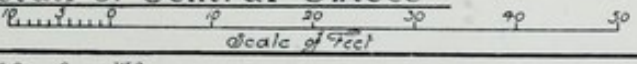


Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H Saxon Snell del.

purveyor's, and clerks' rooms; and on the first floor a chapel calculated to hold 300 convalescents, with chaplain's rooms, and a sick ward for 20 beds, with attached offices.

Block C contains, on the basement and the ground floor of the front portion, a dispensary, drug stores, pharmacy, and dispenser's room. The rear portion of this block has on the ground and first floors two sick wards, each for 28 beds, with the usual attached offices.

Block D contains on the basement a boiler and engine room, store rooms, and non-commissioned officers' rooms; on the front portion of the ground floor there are seven warm bath rooms, with dressing room, and in the rear a sick ward for 28 beds, with attached offices.

The basement floor of block E contains store rooms, non-commissioned officers' rooms, and a ward for the separation of itch cases; and on the ground and first floors there are four sick wards, each for 32 beds, together with their attached offices, as hereafter described.

The basement floor of block F contains store rooms, non-commissioned officers' room, a board room, a museum, and an officers' library; and on the ground and first floors there are four sick wards, each for 32 beds, with attached offices.

Owing to the rapid fall of the ground from east to west, the rooms of the so-called basements of the blocks E, F, and L are really on a level with the ground; while the blocks H, J, and K have no use made of the basements excepting for the purposes of pipe ducts.

Block H contains on the ground and first floors four sick wards, each for 32 beds, with attached offices, as described hereafter.

Block J is similar to block H, excepting that the front portion of the ground floor is planned as a prison ward, for 28 beds only, but with the addition of a guard room.

Block K contains on the ground floor six separation rooms, each for one bed, with the necessary attached offices.

Block L contains on the basement (though, as before explained, this floor is here entered from the ground level) a dead house and post-mortem room; on the ground floor an operating theatre; and on the first floor three operating wards for one patient each, with attached offices. This contiguity of the dead house and dissecting room to the main building is not a good arrangement.

The laundry and wash-house occupies a site upon the opposite side of the Dover Road.

Total Accommodation.—Accommodation is thus provided for about 650 sick inmates—viz., 15 wards for 32 beds each, 5 for 28 beds each, 1 for 20 beds, and 8 for 1 each, besides the prison ward for 28 beds, and a small ward in the basement for cases of itch. It would not, however, appear that the building is fully occupied; during the years 1880-81, for instance, the average daily number of patients was only 303.

Connecting Corridor.—The main corridor connecting the various blocks of buildings together is 12 feet wide; it runs through the centre of each double pavilion, and has passages 4 feet wide leading off it to the various wards. The main corridor is enclosed with glazed sashes, and it is so roofed as to form a terrace or ambulatory for the use of

the patients. The floor beneath this corridor forms a subway for conveying food, coals, &c. to the lifts.

Water Supply.—The water used in this hospital is supplied by the Kent Waterworks Company. It is obtained from the chalk, and is delivered into reservoirs standing at a level of about 90 feet above the roof of the hospital, and situated on the western side of Shooter's Hill, about one-third of a mile in an easterly direction from the hospital. As delivered by the company, it was found to contain 28·38 grains of solid matter per imperial gallon in the following proportions:—

Carbonate of Lime	15·95
Carbonate of Magnesia	2·10
Sulphate of Lime	6·12
Chloride of Sodium	3·21
Organic Matter	1·0
	28·38

The water is consequently extremely hard, amounting according to the soap test to 21°, and it was therefore found necessary to submit it to Dr. Clark's softening process, before being used, for the hospital. For this purpose, two large depositing reservoirs have been erected each 16 feet 6 inches wide, 35 feet 3 inches long, and 11 feet 3 inches deep, and beneath them are two service reservoirs of the same lateral dimensions, but 15 feet in depth. From these reservoirs the water is conveyed by a six-inch cast-iron main to the hospital, and continued through the subways of the building by a four-inch pipe to the various fire cocks and standpipes. Smaller branches are carried off at intervals for the supply of the various services.

In the preliminary experiments with the water supplied to this building, it was found that its hardness, when examined directly it became clear, was reduced by Dr Clark s process from 21° to 9°, but when the softened water was left undisturbed for 12 to 24 hours the hardness was reduced to 7° or 8°. This difference is due to the circumstance that a small proportion of carbonate of lime separates gradually from the water in a crystalline form. The cost of the reservoirs was £5,351.

This process of softening water has been by an additional patent much simplified of late years, and the necessity for large settling tanks and reservoirs obviated. The new system is known as the Porter-Clark process.

Drainage.—The drainage of the establishment is effected by means of glazed earthenware pipes. Sewage is carried into the main sewer by pipes 4 inches diameter leading from urinals, sinks, baths, &c., and 6 inches diameter from soil pipes, and these, ultimately, are carried outside the grounds by pipes 9 inches and 12 inches diameter. All rainwater is carried by a separate system of pipes, 4 and 6 inches diameter, into a large rainwater tank situated at the north-west corner of the building. Surface water is carried into an adjoining water-course by means of pipes 4 inches diameter.

Area Covered.—The area covered by buildings is 74,450 superficial feet, being about one-tenth of the site, and 115 superficial feet per bed.

Cost.—The cost of the land was £6,394, or £9 16*s.* 9*d.* per bed. The buildings appertaining to the hospital proper, including the laundry, cost £209,139, and the

reservoirs for softening water £5,351 in addition, so that the total cost of the buildings and their appurtenances, exclusive of land, was at the rate of £330 per bed; but this was during the years 1860-64, when materials and labour were much less expensive than at the present day.

Principal Sick Wards.

The main sick wards of this building are planned as pavilions, in pairs, connected together, in each case, by a staircase and nurses' rooms. Each double pavilion contains two floors of wards: a plan of one floor is shown upon the accompanying plate at page 4.

Aspect.—The architect of the building considers it advisable that the axis of hospital pavilions should lie as nearly as possible north and south. In this instance they lie N.N.E. and S.S.W.

Relative Position of Pavilions.—The height of these pavilions, as measured from the lower floors of the sick wards to the junction of the upright lines of the outer front walls with the sloping lines of the roofs, is 32 feet, and the distance between each pavilion is 65 feet, or about twice the height.

Size of Wards.—Each ward is of parallelogram shape, contains 32 beds, and is 117 feet 4 inches long, 26 feet wide, and 13 feet 6 inches high; there is a recess at one end 9 feet wide and 7 feet 6 inches deep. The total superficial floor space is, therefore, 3,118 feet, or about 97 feet per bed, and the cubic contents 42,095 feet, or 1,315 feet per bed.

Bed Space.—The average lineal wall space per bed is 7 feet 4 inches.

Windows.—There are eight windows in each side wall, and the total area of their effective glazed surface is 544 feet, or 17 feet per bed. Captain Galton's report states the proportion of window space per bed to be about 24 feet, but this refers to the size of the window openings, as measured between the outside reveals and the heads and sills, whereas the actual glazed or effective lighting surface is as stated above. If, however, the window situated in the end recess is taken into consideration, the effective glazed area is 603 feet or 19 feet per bed. When all the windows are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 340 feet, or about 10⅝ feet per bed. All the sashes are glazed with plate-glass three-eighths of an inch thick; they are generally ordinary double-hung windows, but those at the ends of the wards are casements, with circular-headed top sashes hung on the lower rail, so as to open by pulling inwards.

Warming.—Each ward is warmed by two single open fire stoves, standing centrally between the beds, and having iron flues encased with fire-brick and sand. The flues first descend, and then run horizontally under the floors to upright flues in the side walls, and it is so contrived that the channels through which the horizontal portions of these flues pass shall form ducts for the admission into the wards of the outside fresh air, warmed in its passage by impinging against the sides of the flue and stove. "In order to prevent any chance of smoke when a fire is first lighted, a spare flue is provided close to the ward flue, from a fire in the basement, and by means of which a vertical

ward flue can be heated and a draft obtained. This can be used, if wanted, to assist ventilation in summer."* These stoves are the invention of Captain Douglas Galton, the architect of the building, and they are well designed, but in this instance their heating capacity has been much over-estimated, the consequence being that, in order to keep the wards bearably warm in winter, the ventilating flues for bringing in fresh air have to be stopped up, and other contrivances for providing additional warmth resorted to.

Ventilation.—The ventilation of the wards is effected in summer, mainly by the windows, which (as before stated) can be opened to the extent of about 32½ superficial feet per bed, and in winter by the introduction of fresh air through the central stoves already referred to; but, in addition, small "Sherringham's" ventilators are introduced between the windows on each side of the ward, close to the ceiling, and there is a shaft for the escape of foul air at each angle, carried up from the ceiling to above the roof, and terminated by louvred outlets. The united area of these shafts is stated to afford from 10 to 14 square inches per bed, accordingly as the wards are situated upon the ground or upon the first floor.

Lighting.—The lighting of the wards is effected at night by four gas pendants, having three burners to each. These burners were originally enclosed in glass globes, 15 inches diameter, open at the bottom for the admission of air from the room, and with tubes 2½ inches diameter from the upper parts, leading to the ceiling, and thence horizontally to the side walls up which they are carried into the outer air. It is intended by this means to ensure the carrying away not only the products of combustion but likewise the air from the upper part of the room. The globes have, however, since been removed, and replaced by inverted conical basins, presumably because it was found impossible to prevent a down draught in the tubes occasionally extinguishing the lights.

Floors.—The flooring of the pavilions is in all cases formed on the fireproof principle known as "Fox and Barrett's," the ceilings are plastered, and the finished surface of the floor is of 1½-inch ploughed and tongued oak battens, oiled and beeswaxed, "so as to be maintained clean by rubbing without the necessity for frequent washing, which renders the wards damp."* A perforated oak skirting, quarter round and three inches radius next the walls, provides the necessary ventilation to the wood-work of these floors, and also prevents the beds from being pushed close up to the wall.

Walls.—The two outside walls of the wards are of brick, 26 inches thick, and are so constructed with Jennings' bonding bricks that there is a space of three inches in the centre. The outer surface is finished with white Suffolk bricks. All other walls are of ordinary construction, but similarly faced on the outside.

The interior face of the walls of the wards and the water-closets, bath rooms, and lobbies adjoining them are finished with polished Parian cement, and distempered. The nurses' rooms, staircases, and corridors generally are finished with ordinary plaster.

* Captain Galton's Report.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated at the extreme corners of each pavilion, and the passages leading to them are entered from the recesses situated at the end of each ward. These passages are ventilated by windows at either end of them, and it is contended that by this arrangement, whichever way the wind is blowing, any effluvia from the sanitary appliances will be carried away from the ward. It will, however, be quite obvious, on reference to the plan of these passage-ways and the position of the openings into them, that foul air from the sanitary appliances is much more likely to be blown into the wards through the door openings than that it would be carried round a corner and out of the small window situated at the shorter arm of each passage. In addition to the ventilation afforded by the windows, each compartment has a shaft for the escape of foul air, and a "Sherringham's" ventilator for the admission of fresh air, and there are also fresh air ducts leading from the outside to coils of hot-water pipes so placed as to give to the lobbies and all parts of each compartment a supply of fresh warmed air independently of the adjoining ward, and so it is believed that "every precaution has been taken to prevent the smell from the water-closets and sinks being drawn into the wards in cold weather."*

The compartment on the right hand side of each ward contains three water-closets, each about 2 feet 5 inches by 4 feet, and a recess for a slop sink, 2 feet 2 inches by 4 feet. The water-closet apparatus is of the kind known as "Jennings' Patent Valve Closet;" the seats are of oak. The slop sink is formed of a similar apparatus, but has a lead safe all round and sloped into it.

The compartment to the left of the ward contains three lavatory basins, an urinal, a sink for emptying a portable bath, and a small bath room, or cubical.

The lavatories consist of white earthenware basins sunk in white marble slabs, and they have hot and cold water laid on to them.

The urinals are of two kinds. One is on a principle somewhat similar to that of Jennings' water-closet last described—that is to say, the pan holds a fixed quantity of water, and any excess passes into the drain through an overflow pipe. The standing water is let off periodically, by raising a valve, and an arrangement is provided by which, at the same time, a fixed quantity of fresh water is admitted to the pan after it has been emptied. The other form, which has been more generally adopted, as being more economical of water, has a treadle, which admits the water only while the man using it stands at the urinal. Both descriptions are fitted with slate floors and sides.

The sink for emptying a portable bath is fixed nearly level with the floor; it measures 2 feet by 18 inches, is dished 5 inches deep, and has a brass grating placed centrally over the waste pipe. Hot and cold water cocks, for emptying and filling the bath, are placed directly over this sink.

The bath room is a simple cubical, 6 feet long, 5 feet wide, and is far too small, for patients, after leaving the bath, must of necessity stand to dry and dress themselves

* Captain Galton's Report.

in the adjoining lavatory and urinal room. The baths, which are manufactured of terra cotta and glazed inside, were supplied by Messrs. Rufford and Finch.

The soil and waste pipes are four inches diameter on the first and six inches on the ground floor; they run down recesses left in the inner parts of the walls, and these recesses are cased with deal framings, so as to be easily accessible. The main soil and waste pipes are trapped at the bottom before they enter the drain, and are carried up to above the level of the roof, and left open at the top, but covered with a conical zinc capping, "so that every precaution has been taken to prevent any drain smell from entering the building."* It would have been better had these soil pipes been taken down the outside of the walls instead of inside, and the conical zinc cappings on the top of the pipes had better have been omitted.

Day Rooms.—It is to be regretted that day rooms are not attached to each pair of wards; there is one, however, and also a library, containing together about 3,900 superficial feet, or six feet per patient, situated in the centre of the building, for the general use of the patients; a somewhat similar arrangement to that of the Blackburn Hospital.

Duty Rooms.—The nurses' duty rooms have each an area of about 90 feet, and are provided with ranges for warming food, sinks for washing plates, teacups, &c., and closets heated by hot-water coils are provided for airing the ward linen, but these do not appear to be used for this purpose.

Nurses' Rooms.—The nurses' rooms and staircases are situated in the central portion of each pavilion, so as to command the entrance to the wards. Each nurse's room has an area of about 90 feet, is fitted up as a sleeping apartment, and has an inspection window overlooking the adjoining ward.

Lifts.—At the side of the main corridor adjoining each pavilion there is a lift, 3 feet long and 2 feet 6 inches wide, for conveying coals, food, &c., from the basement. These lifts are worked by hydraulic power from a high pressure steam engine of 15-horse power, and an accumulator, with a ram 7 inches diameter and a stroke of 12 feet.

Staircases.—The pavilion staircases generally occupy an area of 384 feet, and are constructed with oak treads and cast-iron strings and risers. The steps are 5 feet long, with a tread 12 inches wide, and a rise of rather more than 4⅝ inches.

Basement.—All the double pavilions have basements of varying heights; those marked on block plan E, F, L, being partially above ground, are utilised in the manner described under the head of "General Arrangement," whilst those of the H, J, and K are unoccupied.

Total Area of Pavilions.—The total area covered by each floor of the principal double pavilions, including the surrounding walls, is 9,985 feet, or 156 feet per bed.

* Captain Galton's Report.

BLACKBURN AND EAST LANCASHIRE INFIRMARY,

ENGLAND.

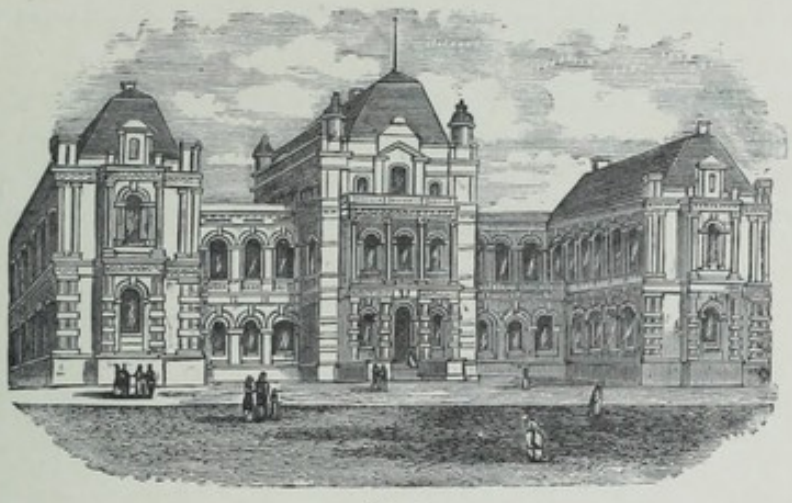


Fig. 1.

The foundation stone of this building was laid by the Mayor of the town of Blackburn, Mr. William Pilkington, on the 24th of May 1858. The ceremony was attended by the aldermen and other civic authorities, and the architects, Messrs. Smith and Turnbull. Owing to the long continuance of the great cotton famine, the completion and opening of the building was delayed until the year 1865.

Scarcely any important work has been written of late years upon the subject of Hospital Construction without reference being made to this building. The interest attaching to it appears to arise from the fact that it was the first hospital erected in England planned upon the pavilion principle, but more especially, perhaps, because of the peculiar position of the pavilions in reference to one another; they alternately jut out at right angles from the main corridor of communication, first to the right and then to the left. It is difficult to conceive, and I have heard of no attempt to explain, what is the supposed advantage of this plan. Certainly, the currents of air round and about the buildings cannot so freely circulate as they would if the pavilions had been placed end to end, as in the Herbert or St. Marylebone Hospitals.

Nevertheless, this building, not having been before represented in detail, has, from the peculiar disposition of its parts, been prominently noticed in the writings of all countries, and in consequence others, like myself, have, no doubt, been erroneously led to suppose that it is a design worthy of imitation, hence I have thought it useful to illustrate it in detail. The main sick wards are light and airy, and a large cubic and superficial space is given to each patient, but the general distribution of the buildings is objectionable, and the bad planning of the sanitary offices is only equalled by some of the worst Continental examples. Then, again, the distribution of the patients in small

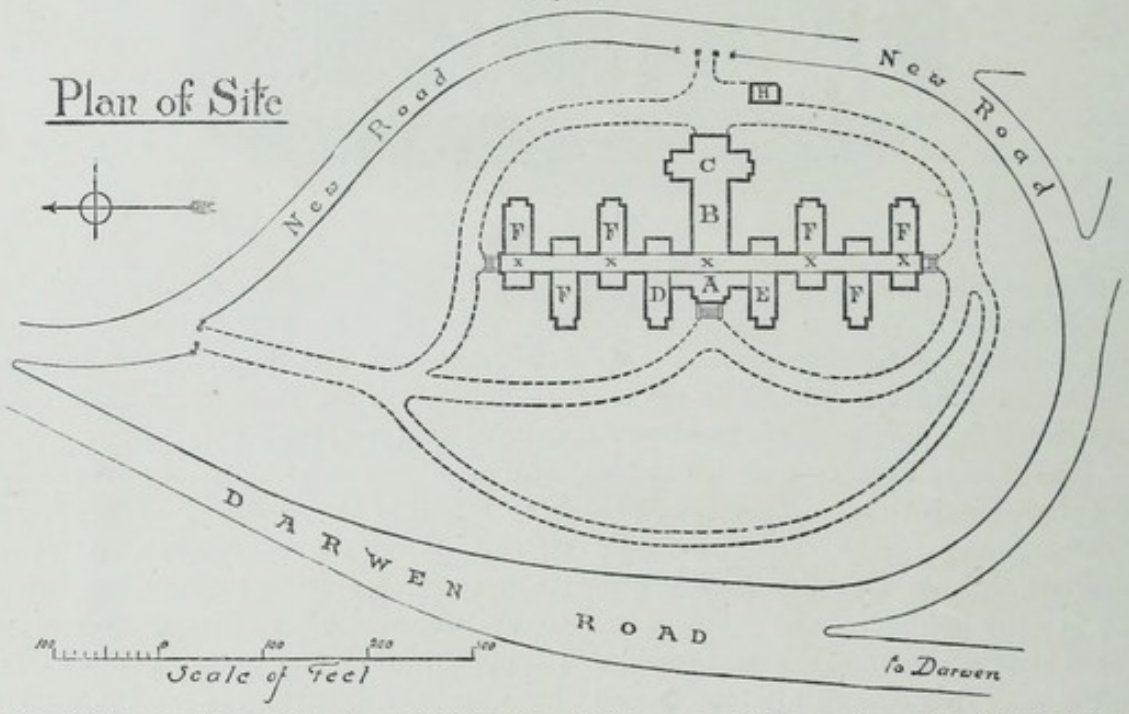
wards (the largest number in each does not exceed eight), however desirable in other respects, is uneconomical both in first cost and in management.

Site.—The building is situated on the outskirts of the town of Blackburn, and upon the eastern side of the Darwen Road. The extent of the site is about 348,330 superficial eet, being about eight acres, or nearly 2,262 feet per bed.

Subsoil.—The subsoil of the site is clay, and the bricks used in the building were made upon the ground.

General Arrangement.—The general distribution of the buildings is shown upon the plan below; this supposes them to be completed in accordance with the original design, but this it is to be hoped may not be. Up to the time of my visit to the building, in February 1882, the central administrative block and two of the pavilions only had been erected.

Fig. 2,



A, Principal Entrance, Offices, and Chapel over; B, Administrative; C, Out-patients; D, Offices on Ground Floor, Sick Ward above; E, Board Room on Ground Floor, Sick Ward above; F, Sick Wards; x, Main Corridor; H, Stabling.

The principal entrance to the building is on the ground floor of the central block, marked A on plan; two rooms on either side of the entrance hall are intended to be used respectively for the house dining-room and a students' room. The main connecting corridor x x runs at the back of this block. The central portion of the first floor of block A is designed as a chapel, the parts between it and the blocks D and E serving as open balconies for the use of patients. The top or second storey of this block, including the front portion of block B, contains sleeping accommodation for nurses and domestics. Block C and the rear portion of block B contains on the ground storey the out-patients' department (entered from the east side), with waiting room, consulting rooms, dispensary, and an accident ward for six patients. The portion of block B nearest the main corridor

is intended to be used as a matron's store-room, porter's bed-room, &c. The first floor of these two blocks B and C is planned for use as an operation room, with two small attached surgical wards, each for the accommodation of six beds; there are also two wards for three beds each, and two for one bed each.

Block D contains on the ground floor the matron's and the resident surgeon's apartments, and on the first floor a ward for eight beds.

Block E is designed to contain on the ground floor a board-room and other offices, and on the first floor a ward for eight beds.

Blocks F F, &c., when erected, will each contain on the ground floor a ward for eight beds, with another similar ward over it on the first floor (*see* Fig. 3); but, inasmuch as staircases will not be required in all these blocks, the spaces opposite the large wards will in each case be utilised as separation wards for two patients each, excepting two on the ground floor, both on the male and female sides, which are to be used respectively as convalescents' dining-rooms and reading-rooms.

Block H is a coach-house and stabling.

Total Accommodation.—Accommodation would thus ultimately be provided for 154 patients, viz., fourteen wards for eight patients each, three for six each, eight for two each, two for three each, and two for one each. At present the building accommodates 62 patients, but then the chapel, board-room, and other offices are used as sick wards. The average number of beds occupied daily throughout the years 1880-81 was 60.

Basement.—The basements of the portions now built will be devoted to the kitchen and laundry departments, stores and other administrative offices, but the ultimate distribution of the various portions is not at present settled upon.

Connecting Corridor.—The main connecting corridor marked x x on general plan is 10 feet wide and averages 14 feet in height. It is two stories in height above the basement.

Water Supply.—The water used in this establishment is supplied from the Corporation Waterworks.

Drainage.—The drainage of the buildings is effected by earthenware piping discharging into the town sewers.

Area Covered.—When all the proposed buildings are completed, the area covered will be about 25,000 superficial feet, being about one-thirteenth of the site, and 162 feet per patient.

Cost.—The sum paid for the land was £3,200, or £20 15*s.* 7*d.* per patient, and the building, so far as it has been erected, cost £20,800. This includes £1,800 as the cost of the boundary road, walls, &c. Assuming, however, that the building is completed at the same rate per foot cube, the cost would be £44,085, or £286 per patient; and for the land and buildings together, £306 15*s.* 7*d.* per bed.

Principal Sick Wards.

When the building is completed all the main sick wards will be situated on the ground and first floors of the pavilion blocks marked D, E and F on the general block

plan. An enlarged plan of the pavilions D and E now built is shewn at Fig. 3. The staircase shewn on this plan will not be repeated in the pavilions to be built hereafter, as the corridor runs along the two storeys; these spaces will, in the other blocks, generally be utilised as separation wards, but four of them on the ground floor will be used as dining and reading rooms for the patients of both sexes.

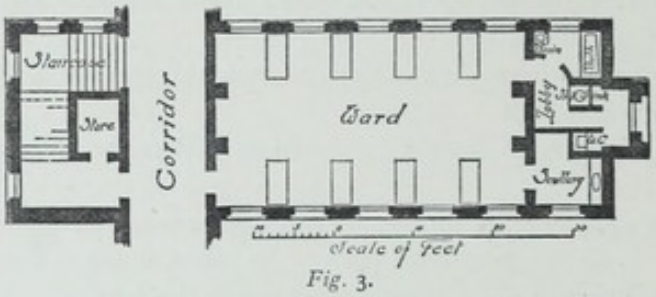


Fig. 3.

Aspect.—The axes of the sick pavilions all run east and west, so that the windows on either sides of the wards face north and south.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the lower sick wards to the top of the parapet walls of the roof, is 37 feet, and the greatest distance between each pavilion is about 62 feet, or about $1\frac{5}{8}$ the height; but a portion of one pavilion overlaps the other, and here the distance apart does not exceed 18 feet, or about half the height.

Size of Wards.—The wards are of parallelogram shape, and each contains eight beds only. The length is 39 feet, the width 22 feet 6 inches, and the average height 16 feet, and, deducting projecting fire-places, the total superficial area is 848 feet, or 106 feet per bed, and the cubic contents average 13,568 feet, or 1,696 feet per bed.

Bed Space.—The average lineal wall space per bed is 9 feet 9 inches.

Windows.—There are five windows in each side wall, and the total area of their effective glazed surface is, on the ground floor 271 feet, or about $33\frac{7}{8}$ feet per bed; and on the upper floor 211 feet, or about $26\frac{1}{3}$ feet per bed. They are ordinary double-hung sashes with circular heads, and, when opened to their fullest extent, the total area through which air can be admitted by them into the lower wards is 187 feet, or about $23\frac{1}{2}$ feet per bed, and into the upper wards the total area is 150 feet, or $18\frac{3}{4}$ feet per bed.

Warming.—Two ordinary open fire-places are placed at either end of the ward, so that there should be ample provision for heating.

Ventilation.—Ventilation is effected in summer-time mainly by the windows, but there are, in addition, two inlet shafts in each side wall, about 10 feet above the floor line, and an upward direction is supposed to be given to the current of air by means of vertical pipes 10 inches diameter; there are also openings over the windows and next the ceiling, 2 feet 6 inches long and 6 inches wide, so constructed that they may be opened or closed by "hit or miss" gratings.

Lighting.—The wards are lighted at night by three ordinary gas pendants, each having double arms; no provision is made for carrying off the products of combustion.

Floors.—These are of ordinary construction, viz., timber joists, deal flooring, and plastered ceilings.

Walls.—The outside walls are built of brickwork, faced with red bricks and stone dressings to the quoins. The walls are all finished on the inside with plastering and painted.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated at the ends of the wards, and no precautions have been taken to prevent the intercommunication of foul air. The slop sink is placed in a lobby having no external wall, and entered directly from the ward. The bath-room and lavatory is about 8 feet 6 inches long by 6 feet 4 inches wide, fitted with an earthenware wash-hand basin and an enamelled metal bath, with a shower bath over one end of it. The water-closet is an ordinary valve closet apparatus. The ward scullery is entered directly from the ward. It has an area of about 68 feet, and is fitted with a large slop sink about 6 feet 3 inches long by 1 foot 9 inches wide, lined with pewter in the centre, and dipping below it is a glazed earthenware basin. The soil and waste pipes are carried down chases on the insides of the outer walls, and it is stated that they are respectively 6 inches and 4½ inches diameter, and that they are properly ventilated. There are grated openings for the admission and exit of air in all the compartments.

The arrangement of these offices is certainly worse than any others I have seen in England, and it is to be hoped it will not be repeated in the blocks to be erected hereafter.

Day Rooms.—Day rooms are not attached to each principal ward, but on the ground floor of four of the pavilions to be built hereafter the staircase spaces will be used as reading and dining rooms, each having an area of 304 feet, so that it may be said that the 128 patients occupying the pavilions will have day-room accommodation averaging 9·5 superficial feet each.

Separation Wards.—Each of the remaining staircase spaces in these pavilions will be utilised as separation wards for two patients, and so each patient will, in these cases, have 152 superficial, and 2,432 cubic feet of space.

Duty Rooms.—There are in reality no duty rooms, but opening directly out of each principal ward there is the compartment about 68 feet in area, fitted with a large slop sink, dresser, and other duty room appliances. This arrangement forms part of the badly-contrived sanitary offices before referred to.

Staircases.—The staircases in the present pavilions each occupy an area of 304 feet, and are constructed of stone steps 6 feet 2 inches in width, with 12 inches tread and 6 inches rise. It will hardly be thought necessary to build similar staircases to each block, and so two staircases only being required, the corresponding spaces in the other blocks will be utilised as before described.

Basement.—The basement floors of the pavilions now built are 10 feet high, and are utilised as store rooms and administrative offices.

Area of Pavilions.—The total area covered by the floor of each pavilion now built, including its surrounding walls, is 1,987 feet, or an average space of 248 feet per bed, but if, when the building is completed, the distribution of the patients is such as I have indicated, then the average space per bed will be 217 superficial feet.

LEEDS GENERAL INFIRMARY,

ENGLAND.

This Infirmary was erected for the reception of patients, from the town of Leeds and the country immediately surrounding it, requiring surgical or medical treatment and suffering from diseases of a non-infectious character. The foundation stone was laid on Easter Tuesday, March 29th 1864, by Mr. James Kitson, the Chairman of the Building Committee. The works were completed and the building opened for the reception of patients in the month of June 1869. No formal opening took place, but a few months previously a Fine Art Exhibition was held in the building, and this Exhibition was opened by His Royal Highness the Prince of Wales. From the accounts handed down to us, it would appear that the moving spirits in the carrying out of the work were Mr. James Kitson and Dr. Charles Chadwick. The latter gentleman gave a very interesting account of the building, when President of the British Medical Association, on the occasion of its annual meeting at Leeds in the year 1869.*

It will be seen that, like the Herbert Hospital, this was one of the early attempts in England to improve upon the old system of hospital construction. When this building was commenced, the Herbert Hospital, planned upon the pavilion principle, had just been completed; the Lariboisière, also a pavilion hospital, had been erected many years; and there were many good examples to shew what should be principles of the design and construction of buildings intended for the reception of the sick. The authorities charged with the erection of this building appear to have been perfectly aware of the features of many of the principal hospital buildings erected in this country and abroad, and Dr. Chadwick believes this one "to be in exact accordance with the most approved principles of hospital construction."* Under these circumstances, it is with much regret that I shall have to point out some very serious defects in the arrangements of the building—defects which should be noted by those seeking for good types of hospital construction. Detailed plans, sections, and elevations of the buildings were published in the *Builder* of February 13th and 27th 1864.

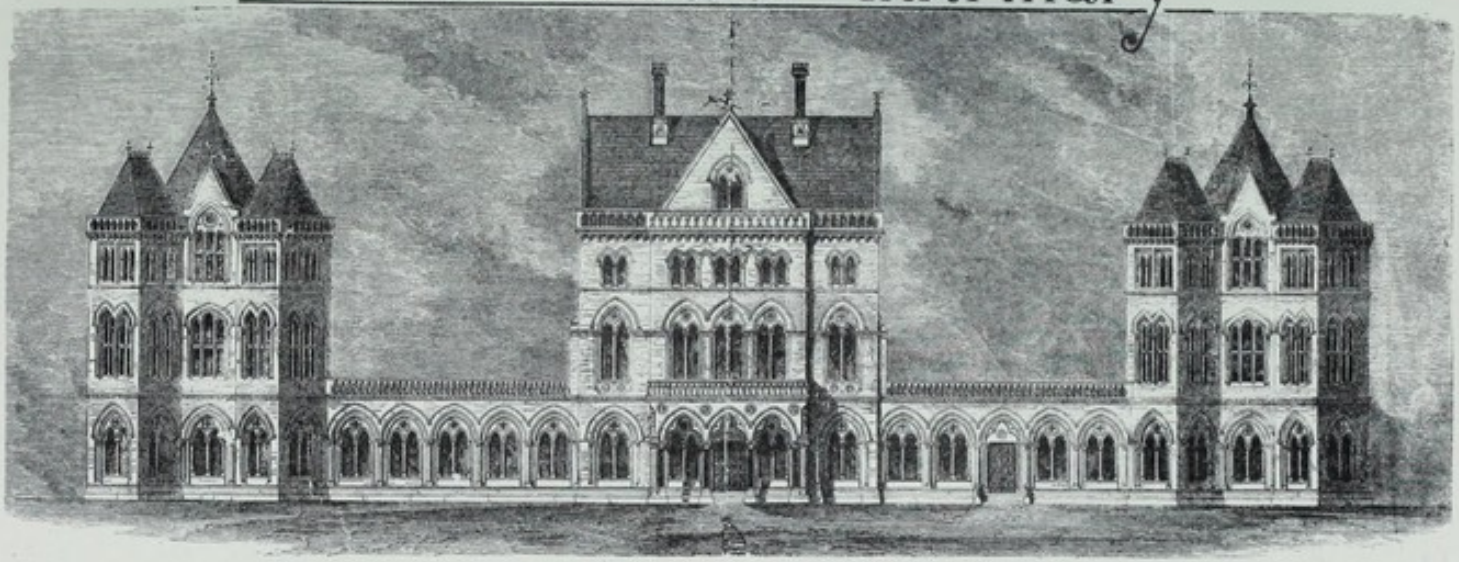
Site.—The building is situated within the precincts of the town, upon land facing the northern side of Great George Street, and it is surrounded by four other roads. There is a rapid declension of the ground from north to south. The extent of the site is 168,000 superficial feet = 3 acres $3\frac{3}{8}$ roods nearly, or about 512 superficial feet per bed.

Aspect.—The main entrance front of the building faces the south, but the axis of the pavilions runs north and south, so that the windows of the principal sick wards face east and west.

Subsoil.—The foundations of the structure rest upon a bed of clay shale.

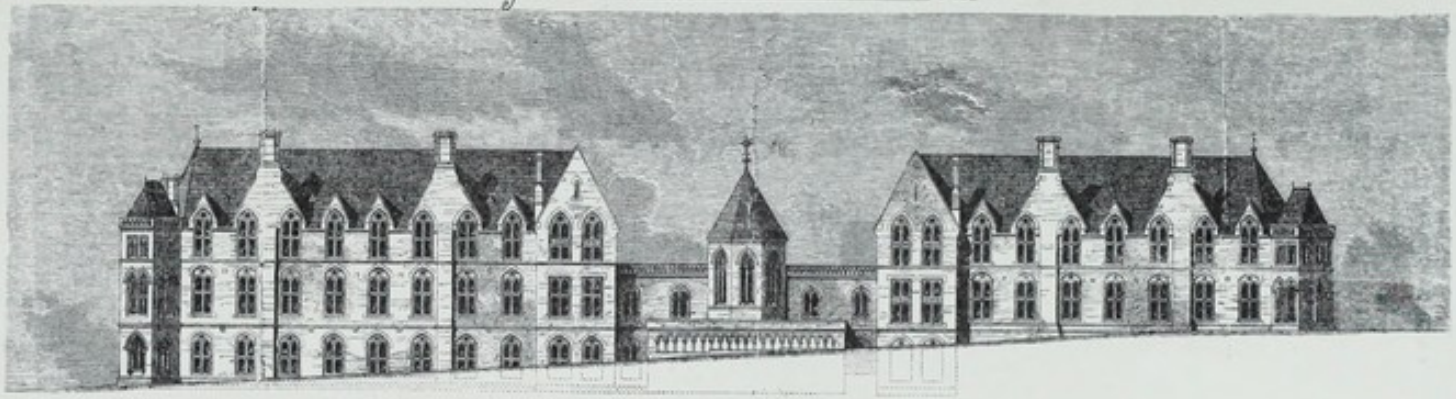
* *British Medical Journal*, July 31st 1869.

Leeds General Infirmary



Front Elevation

Scale of 0 10 20 30 40 50 60 70 Feet



Side Elevation

Scale of 0 10 20 30 40 50 60 70 80 90 100 110 Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

From "The Builder"

General Arrangement.—The general arrangement of the buildings, together with the plans and details of one of the principal sick wards, is shewn upon the accompanying plate.

Owing to a great fall in the ground (nearly 20 feet from front to back), it has been arranged that the principal entrances to the various departments of the building shall be from the lowest level in Great George Street; the floor so entered contains the out-patients' department, together with the kitchen and most of the other administrative offices. By reason of this, it occurs that the upper stories are almost entirely devoted to the accommodation of the sick inmates, and in such manner that while nearly the whole of the area of the lower storey is covered with building, the upper portion forms a series of pavilion wards, each two stories in height.

The ground floor of the main building is continued from front to back only about two-thirds of the entire depth of the superstructure. Upon this floor is placed the entrance offices, waiting rooms, medical officers' rooms, assistants' and students' rooms, dispensary, kitchen offices, stores, laundry, engine and boiler room, *dead house* and *post-mortem room*. Immediately at the back of the entrance hall there is a receiving ward for accidents, with attached offices. To the right of the entrance hall there is a large waiting-room, with an additional and separate entrance for out-patients.

It is always an undesirable arrangement that the kitchen offices should be situated, as they are here, beneath the sick wards; but where the situation is confined, this cannot always be avoided. In this building, however, it will be seen that not only is the kitchen placed in the basement, but so also is the laundry and the dead house and post-mortem room, and as if to insure every precaution being taken for the conveyance of the offensive odours and foul gases emanating from these departments being undoubtedly carried to the sick wards, all of them open on to a corridor having staircases and lift holes ascending from it to the various floors of each pavilion. It is the more extraordinary that this arrangement should exist, because at the time the building was erected £15,000 worth of "surplus" land was "disposed of;" but even then there was in the rear of the building ample room for the erection of a detached kitchen, laundry, and dead house. Nurses' rooms have, however, lately been built upon this ground. (*See* Block M on general plan of site.)

The Blocks A, B and C are two stories in height, and they contain on each floor a sick ward for 28 beds, with attached offices and a private or separation ward for four beds.

The Blocks H and I are three stories in height, the lower floors (as previously explained) forming part of the administrative offices of the building. The two upper floors are on the same level as those of blocks A, B, C; and each floor comprises a sick ward for 32 beds, with attached offices and a private or separation ward for four beds.

Block D is one storey only in height and contains a ward, with attached offices, for six patients suffering from ophthalmic and other eye diseases.

Block E is similar to the last, but has, in addition, a padded room.

Block K contains the principal staircase, and on the first floor there is an operating theatre with the usual attached offices.

Block L contains on the first, second and third floors a board room and other administrative offices.

The central portion of Block F forms a large and handsome hall, originally intended as a winter garden for the recreation of the patients; but it is not used as such; the only purpose it now serves is that of preventing the free circulation of air around the adjoining pavilions containing the sick patients. The space it encloses appears to have been found so useless, that a temporary wooden erection has been placed in the centre and devoted to the purposes of a carpenter's shop and store. It is difficult to conceive why this excrescence is not taken down, thereby doing away with the confined spaces next the sick wards where the air now stagnates. A closed corridor encircles this hall and forms a means of communication between the several blocks of sick wards. This corridor, on the topmost floor, is uncovered, and is available as an open-air ambulatory for the patients. The west end of this central block is devoted to nurses' sitting and bedrooms, and at the east end there is a chapel, with vestry, and general bath rooms for male and female patients.

Block M has only recently (1881) been erected, and it is fitted up with rooms and offices for the separate accommodation, away from the main building, of the nurses of the establishment.

Total Accommodation.—The building provides for the total indoor accommodation of 328 patients, viz., four wards for 32 beds each, six wards for 28 beds each, five separation wards for 4 beds each, and two ophthalmic wards for six beds each. It would not, however, appear that the building has at any time since its opening been occupied by more than 240 patients.

Connecting Corridors.—All the five pavilions are connected together upon the lower floor of sick wards by a corridor 10 feet wide encircling the large central hall previously described.

Water Supply.—The water used in the building is supplied by the Corporation, and is received directly from the mains, excepting in the cases of the water-closet supply, which is intercepted by small cisterns.

Drainage.—The drainage of the building is by means of glazed earthenware pipes, which discharge themselves into the town sewers.

Area Covered.—The area covered by buildings is 78,634 superficial feet, being about 2⅛th of the site, and 240 superficial feet per bed.

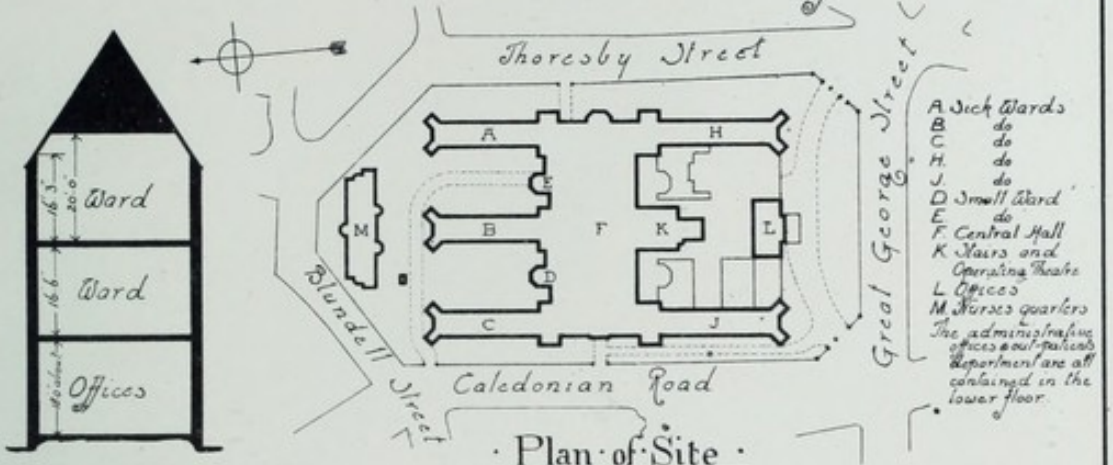
Cost.—The net cost of the land was £9,205, or about £28 per bed. The buildings, including the nurses' rooms lately erected, cost £97,774, or about £298 per bed. Therefore, the total cost of both land and buildings was £326 per bed.

Principal Sick Wards.

The main sick wards and their offices are self-contained in five pavilions, situated on the two upper stories of the buildings. Each pavilion contains two floors of wards connected together by large and handsome staircases. A plan of one floor is shewn upon the accompanying plate.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the lowest sick wards to the junction of the upright lines of the outer front walls with the sloping lines of the roof, is 32 feet, and the least distance between any two pavilions is 72 feet 6 inches, or 2¼ times the height.

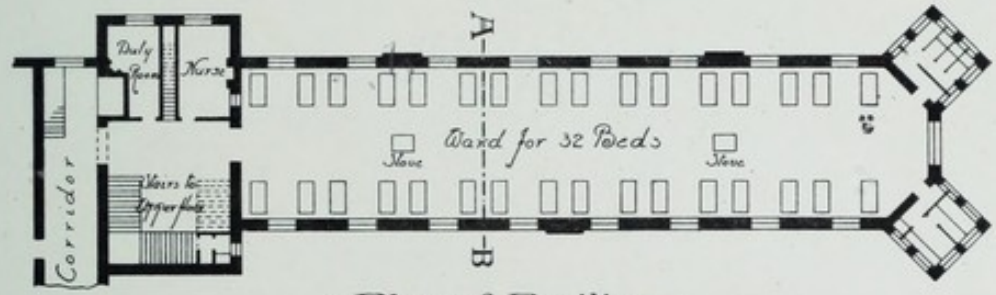
· Leeds · General · Infirmary ·



· Section on Line AB ·

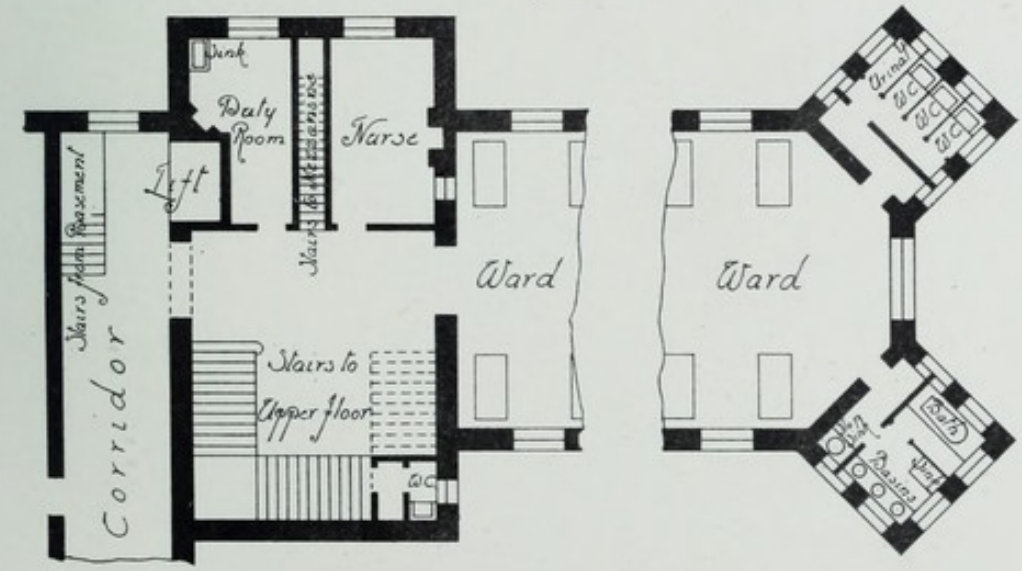
· Plan of Site ·

Scale of Feet



· Plan of Pavilion ·

Scale of Feet



· Detail of End Offices ·

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Size of Wards.—All the sick wards are of parallelogram shape; the four larger ones in the front contain 32 beds each, but the six in the rear each contain 28 beds only. The extreme length of the larger wards is 126 feet 6 inches, and the width 27 feet 6 inches; but those in the rear are 112 feet only in length. The height of the wards situated upon the lower floor is 16 feet 6 inches, and those upon the upper floors 20 feet; but, as this storey runs partially into the roof, the average height may be taken as about 19 feet 6 inches only. The total superficial floor space in the front wards is, therefore (after allowing for the canted ends), 3,419 feet, or about 107 feet per bed. The cubic contents of the lower wards is 56,414 feet, or about 1,763 feet per bed, and of the upper wards 66,670 feet, or about 2,083 feet per bed.

Bed Space.—The average lineal wall space per bed is 7 feet 5 inches, the canted ends not being available as bed space.

Windows.—There are eight windows in each side wall, and the total area of their effective glazed surface is, on the lower stories, 661 feet, or about 21 feet per bed. If, however, the end windows are taken into account, the superficial effective glazed surface is 22 feet per bed. In the upper wards the windows are larger, the total area of their effective glazed surface being 780 feet, or about 24 feet per bed; but about 26 feet per bed if the end windows be included in the calculation.

The construction of the windows is generally such that each pane of glass is fixed in a sash hung on its lower end, the whole of them being made to open when required as louvres, and suchwise that air is then only admitted at their upper parts. When the windows are opened to their fullest extent, the total area through which air can be admitted through them into the lower wards is 106 feet, or about $3\frac{1}{4}$ feet per bed. The contrivances by which it is arranged that these windows should open only to this ridiculously small extent were, however, I was glad to learn, about to be removed. The sashes in the upper parts of the windows of the top floors are somewhat differently constructed from those beneath them, and give a greater ventilating area when opened. These windows are also larger than those of the lower wards, and it results that the total area through which air can be admitted by them into the upper wards is 254 superficial feet, or about 8 feet per bed.

Warming.—Each ward is warmed by two single open fire stoves, standing centrally between the beds, and having flues first descending and then running horizontally to the outer walls, up which they are then carried. As originally constructed, it was intended that fresh air should be drawn from the outside through these stoves into the wards, but at the time of my visit this means of ventilation appeared to be disused. The heating by these stoves is now, "as funds will permit," being gradually supplemented by steam pipes carried round the wards next the outer walls. This want of proper heating arrangements is a grave defect; not only does it affect the comfort of the patients, but it leads to deficient ventilation, consequent upon the necessity for closing all available openings for the admission of the outer fresh and cold air.

Ventilation.—The ventilation of the wards is effected mainly by the windows, but there are in addition inlet flues in the outer walls, continued by tubes terminating under the floors between each pair of beds, and covered with brass gratings, but

these inlets, at the time of my visit, were and had been for some years stopped up, and, therefore, out of use. No doubt this arises from the deficiency of the heating arrangements. In the ceiling of each of the lower wards there are eight openings, covered with gratings, having an airway of about eight square inches each, with tubes carried from them horizontally through the floors and outer walls, and intended for exit shafts for the foul air of the wards, but in practice they are found to act as inlet shafts.

The properties of air in relation to the cure of disease appear to have been quite ignored in the construction of this building, and that the death rate has been kept so low is only to be accounted for by exceptionally good management, evidences of which are shewn throughout the whole of the establishment. Moreover, the number of beds actually occupied is much less than the building was designed for, and the cubic space per inmate is thereby considerably increased.

Lighting.—The lighting of the lower wards is effected at night by fourteen gas brackets affixed to the outer walls, and generally between the beds. The upper floors are lighted with three coronæ pendant from the ceilings, and having four burners to each ; they are all of them unprovided with any kind of ventilating arrangement.

Floors.—The flooring of the wards is formed of joists and concrete; the ceilings are plastered, and the covering is of inch ploughed and tongued oak battens, oiled and beeswaxed.

Walls.—The outside walls of the wards are generally twenty-three inches thick, the outer surface being finished with pressed red bricks, and the quoins and dressings of the windows with stone. The interior face of the walls of the wards and the water-closets and bath rooms and lobbies adjoining them are covered with Parian cement ; originally this was finished with a polished surface, but lately it has been painted.

Baths, W.C.'s, &c.—The water-closets, baths, and other sanitary appliances are situated at the extreme corners of each pavilion ward, and the passage-ways leading to them are entered from the canted ends. These passages are ventilated by windows at either end of them. No provision is made for heating the sanitary offices, and, consequently, the air from them tends to be drawn towards and into the warmer atmosphere of the adjoining sick ward.

The compartment on the right hand side of each ward contains a bath room, 7 feet 6 inches by 5 feet, fitted with a fixed porcelain bath, and in another compartment there are three " Jennings' tip-up " lavatory basins, and a lead sink, 3 feet by 2 feet. The bath and sink are supplied with hot and cold water, but the lavatory basins with cold water only. At one end of the lobby of communication there is fixed a large lead-lined basin or sink, fitted with hot and cold water taps, and chiefly used for the washing and emptying of bed-pans and other slops. This most extraordinary arrangement could never surely have been contemplated when the building was erected, for the cross ventilated passage-way was undoubtedly designed with a view to disconnecting the sinks and closets from the ward, and now we see that the foulest apparatus of all, the bed-pan sink, is placed in this passage-way. The compartment on the left hand side of the ward contains three water-closets, 2 feet 8 inches by 4 feet 9 inches, separated from each other

by slate divisions, and fitted with "Jennings' patent valve closet apparatus;" there is also a recess corresponding in size to one of the water-closets, in which is placed a "Jennings' lipped urinal." These urinals are, however, never used. The soil and waste pipes are carried down in a recess formed on the inside of one of the outer walls of each compartment, and are cased over. It is stated that those from the slop sinks are four inches diameter, and are ventilated at top with a pipe two inches diameter carried above the levels of the eaves of roofs, but that all others are unventilated.

Day Rooms.—No day room accommodation is provided for the use of the patients.

Duty Rooms.—The duty rooms have each an average area of 118 feet, and they are provided with an ordinary open fire-grate, having a trivet for holding a kettle or saucepan. There is also a stone sink, with hot and cold water taps, for washing up crockery.

Nurses' Rooms.—The nurses' rooms and staircases are situated at the entrance ends of the wards. Each has an area of 165 feet, and they were originally fitted up as combined sitting and sleeping rooms, but, now that the new building for the accommodation of nurses is in use, these rooms are unappropriated, and it is contemplated to use them as additional separation wards.

Attendants' Sleeping Rooms.—The height of the nurses' rooms and duty rooms last described is only about half that of the adjoining wards, and the space over them forms two rooms for the accommodation of the ward attendants and other officers of the establishment.

Lifts.—Leading off the corridors, next each duty room, there is a lift, 7 feet 6 inches long and 4 feet wide, worked by hydraulic power, with a ram 6 inches diameter descending into a well a depth equal to the height travelled by the lift.

Staircases.—The pavilion staircases occupy an area of 608 feet, and are constructed with stone steps carried upon cast iron girders. Each step is 6 feet long, with a tread 11 inches wide, and a rise of 6 inches.

Basements.—The basements of the front pavilions are variously occupied for administrative purposes, but there are no basements to the rear pavilions.

Area of Pavilion.—The area covered by each floor of the larger pavilions, including the walls surrounding them, is 5,636 feet, or 176 feet per bed, and the corresponding area of each floor of the three smaller pavilions is 5,169 feet, or 185 feet per bed, so that the average area of all is 180 feet per bed.

My best thanks are due to the General Manager, Mr. Thomas Blair, for much valuable information, and for the facilities afforded myself and assistant in taking detailed particulars of the structure. Mr. Thomas Hewson, the Borough Surveyor, also very kindly assisted my enquiry.

ST. THOMAS'S HOSPITAL,

LONDON—ENGLAND.

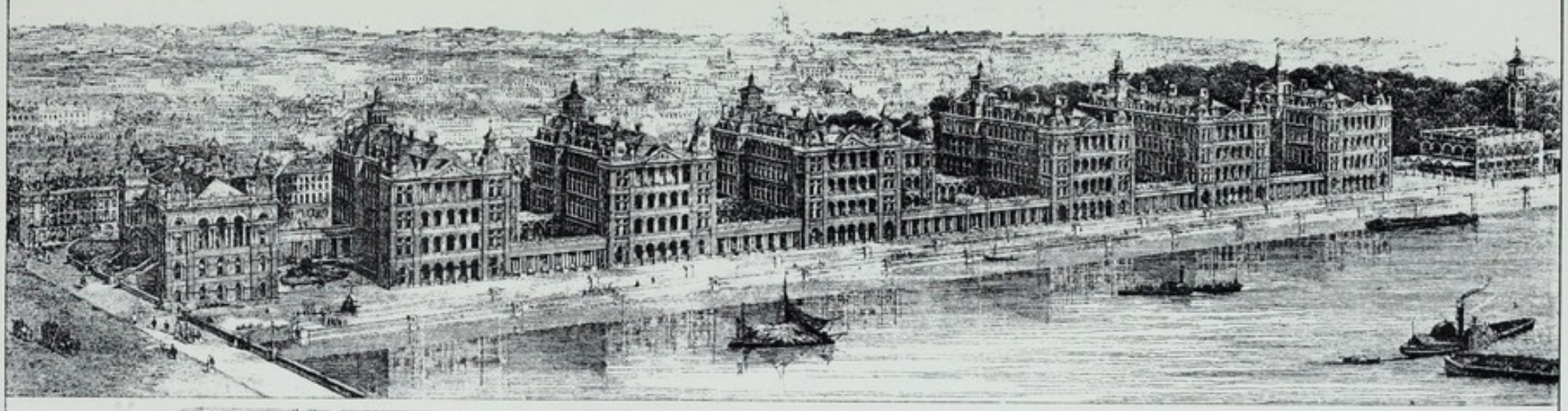
THE old St. Thomas's Hospital, situated at the southern end of London Bridge, adjoining the South Eastern Railway terminus, was removed for the purposes of the Charing Cross Railway, now running through the site of the building. Pending the erection of a new structure, the patients were transferred to the Surrey Gardens,* where buildings were prepared for their temporary occupation. It was then necessary to obtain an Act of Parliament, enabling the Governors to purchase land for the site of a new Hospital. This having been done, advertisements for offers of sites were inserted in the public papers, and out of seventy-seven, the following six were selected for special consideration :—

1. That occupied by Bethlehem Hospital.
2. A plot of land in Walworth Road.
3. The Surrey Gardens (with additional land if desired).
4. A plot of land near Newington Church.
5. Myatt's Garden Ground, Camberwell.
6. Southern Thames Embankment.

The site of Bethlehem Hospital was thought to be the most suitable, and an offer was made to the Governors of that establishment for procuring them another site and erecting a new Lunatic Hospital, at a cost (including the site) not exceeding £150,000. These terms the Governors of Bethlehem Hospital did not, however, feel themselves at liberty in the interests of that Charity, to accept, and the negociation consequently came to an end. It is to be regretted that the amount of the offer was not increased, for the cost of the present site, including its expensive foundations, approached £160,000, and its area is nearly three acres in extent less than that of the Bethlehem Hospital ground. Then, again, the latter site was capable of almost indefinite extension, whereas the building as now placed is hemmed in on all sides by roads, and enlargement is out of the question. Last, and certainly not least, the building would have been free from the deleterious effects of the fogs and damp which prevail on all parts of the river's bank. Negociations were, however, next entered into for the acquisition of the present site upon the Albert Embankment, adjoining the southern side of Westminster Bridge, and ultimately, the land was agreed to be purchased, subject to the approval of the Court of Chancery; this application was opposed by the Corporation of the City of London, but in February 1864, the contract was approved, and afterwards, upon appeal, confirmed. Then, after various additional negociations with the Archbishop of Canterbury and other adjoining proprietors, resulting in the acquisition of additional ground and an alteration of the boundaries, the agreements for the purchase of the site as it at present exists, were adopted by the General Court and approved by the Vice-Chancellor.

* These gardens are now removed, and the site devoted to building purposes.

·S[T]· Thomas's·Hospital·



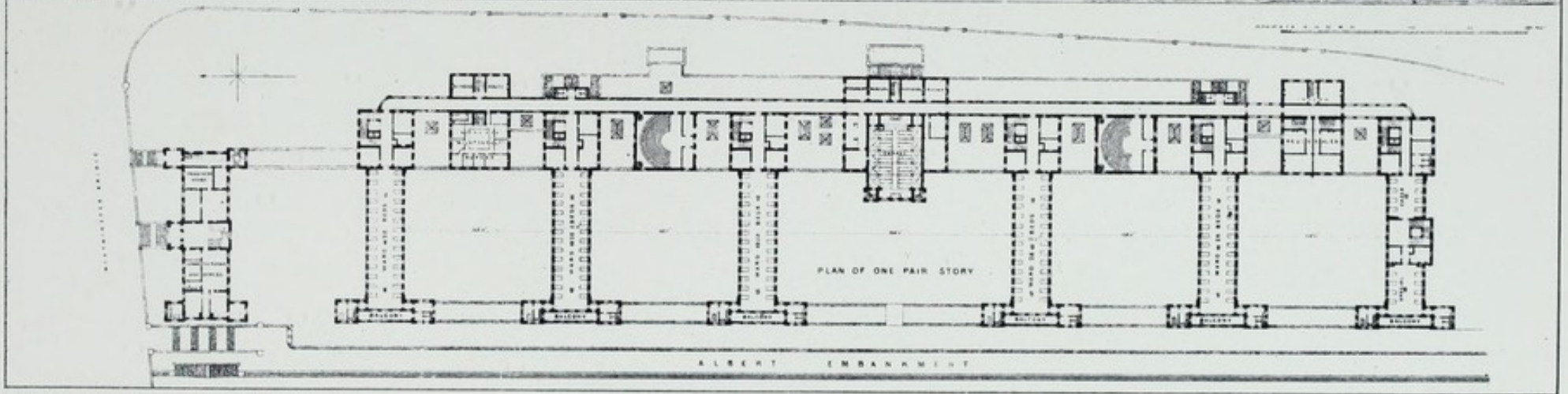


Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

During the time these negociations were going on, steps were taken for obtaining information which might be useful in determining the design and plans of the proposed new buildings. A deputation, consisting of the Treasurer, Dr. Leeson, two of the Governors, and the Architect (Mr. Currey), visited the principal hospitals of Paris, Brussels, and Rotterdam, and their observations and suggestions were afterwards embodied in a report, and communicated to the Grand Committee of Governors. Then the Medical and Surgical Staff of the hospital were requested to furnish their suggestions for the internal arrangements of the new hospital. Ultimately, they were invited to depute three members of their body to advise on the arrangements relating generally to their department, and Dr. Peacock, Dr. Bristowe, and Mr. Simon consequently assisted the committee in the consideration of the plans.

In July 1865 the plans were laid before the General Court, and on the 18th of that month it was resolved unanimously that they should be carried out under the direction of the Architect and a Sub-Committee of the Governors.*

The foundations, owing to the peculiarities of the site, were of a very extensive, and consequently expensive character, and these were first executed under a contract entered into with Mr. Webster, who was also the contractor for the adjoining new embankment. Then the plans of the new building having been approved by the Vice-Chancellor, specifications and forms of tender for its erection were prepared, and twenty leading building firms invited to send in tenders on the 15th July 1867. That of Mr. Perry (being the lowest) was accepted, and the contract sanctioned by the Vice-Chancellor on the 27th of the same month.

Building operations were commenced in the latter part of 1867, and the first stone of the new hospital was, on the 13th May 1868, laid by Her Majesty Queen Victoria, in the presence of their Royal Highnesses the Prince and Princess of Wales, the Prince Leopold, the Princess Louise, the Prince and Princess Christian, the Duke of Cambridge, Her Majesty's Ministers, a large number of Peers and Members of Parliament, representatives of the medical profession, and of various learned and scientific societies, the Governors, the Architect, the Medical Staff, &c., &c.

On the 21st June 1871 Her Majesty again visited the site for the purpose of opening the new building, and she was accompanied, as on the former occasion, by other members of the Royal Family, and attended by the Governors and the principal officers of the establishment.

The propriety of erecting palatial structures for charitable purposes has recently been seriously questioned by some of the most eminent authorities on the subject of hospital construction, and this building, which has been designed upon a grander scale than, perhaps, any other hospital in the world, has frequently been pointed to as an

* The Sub-Committee consisted of the Treasurer (Mr. Bagallay), Sir William Tite, Mr. Du Buisson, Mr. Edgington, Mr. Vaughan, Alderman Sir Sills Gibbons, Mr. Alderman Stone, and Mr. John E. Johnson; and they were advised as to the internal arrangements by Dr. Peacock, Dr. Bristow, and Mr. Simon. Subsequently, when the erection of the building was decided upon, there were added to this Committee, Mr. Alderman Finnis, Mr. Robert Pott, and Mr. Ware; and, as vacancies occurred during the progress of the works, Mr. John Bagallay, Mr. C. L. Francis, Mr. Laurence, Mr. Silver, and Mr. Tomkins became members.

exemplification of this error. It ought not, however, to be forgotten that a very large proportion of its total cost was due to the treacherous nature of the ground upon which it stands, rendering unusually expensive foundations necessary, and that this was probably a contingency impossible to have been foreseen at the time the erection of the building was determined upon. Perhaps, too, its apparent grandeur is due more to the effective grouping of its various parts, and to the architect's skilful treatment of the external details, than to an undue employment of costly material. Its comparative proportions and cost, in relation to other similar establishments, will be shown in a later part of this work.

Shortly before my last visit to the building, it had been determined, as want of funds had necessitated the closing of many of the wards, to try the experiment of fitting some of them up for the admission of persons of the upper and middle classes able and willing to pay for the benefits of medical attendance and nursing therein. In order to carry this into effect, the Governors have appropriated two wards situated in the block marked B on the general plan, and these are approached by a separate gate and entrance. The following is the description given by the hospital authorities of the accommodation provided, and the regulations under which the patients are admitted and treated:

"The two wards have been fitted up and furnished expressly for the purpose of accommodating patients of the classes above mentioned. Each patient has a separate sleeping compartment, curtained off with thick impervious linen curtains from the others, and each compartment is lighted by a large window and is appropriately and comfortably furnished. The ward on the ground floor, which has sixteen of these compartments besides two small rooms, is for females. The ward on the first floor, which has twenty-four of these compartments besides a small ward or room, is for males. Both wards have a large day or sitting room distinct from the wards, and which are well and comfortably furnished and thoroughly warmed and ventilated. There are warm and cold baths, and every requisite of the best description.

"As the hospital is situate in a large garden facing the River Thames and the Albert Embankment, and is also in close contiguity to Lambeth Palace, the occupants of the Home have the advantage of these open spaces and good air.

"The patients in the Home will be under the professional charge of a resident officer of superior medical and surgical qualifications, and of him exclusively, for their ordinary treatment; but every patient will have the option of employing at his or her expense any legally qualified medical practitioner in consultation with such resident medical officer.

"The minimum charge for each patient will be 8*s*. a day, but the Governors reserve to themselves the right to take into consideration the state, position in life, and circumstances of each patient, and the nature of the case, and to require a higher daily charge when necessary. Patients having the use of one of the separate small rooms will be charged according to the circumstances. Such payments will entitle the patients to their board, medical and surgical attendance, medicine, and appliances, and also to be nursed and attended by trained and experienced nurses selected from the nursing staff of the hospital, and who will be under the immediate supervision and control of the matron.

"It is not intended to admit as patients any persons suffering under any incurable or infectious diseases.

"Regulations for Patients therein.

"1.—In all cases where possible applicants for admission should apply personally to the resident medical officer at the Home at 12 o'clock on any day except Sunday.

"2.—When personal application is not possible, the application must be accompanied by a certificate from the patient's medical attendant, stating fully the nature and facts of the case.

"3.—Patients may employ at their own expense, in consultation with the resident medical officer, under the ordinary usage of consulting practice, any qualified medical or surgical practitioner, whether attached to St. Thomas's Hospital or not.

"4.—Patients are held responsible for the orderly and proper behaviour of all persons (whether medical practitioners or friends) who visit them, and the House Committee reserve authority to themselves and to

the Treasurer to exclude or remove any such person who does not conform to the Rules of the Home and to the direction of its authorized officers.

"5.—Patients may be visited by their friends any day, including Sunday, between the hours of 3 and 5 p.m.

"6.—In the event of any case of an infectious nature arising, the Resident Medical Officer shall transfer the patient to the part of the hospital set apart for the treatment of such cases.

"7.—No article of food or drink shall be brought into the Home without the express permission of the Resident Medical Officer.

"8.—The hours for the daily meals shall be fixed and determined by the Resident Medical Officer, and all other domestic matters shall be arranged and carried out under the direction and authority of the Steward and Matron of St. Thomas's Hospital."

Site.—The buildings are situated southwards of and adjacent to the western end of Westminster Bridge, and they therefore stand in the parish of Lambeth, in the county of Surrey. The site is entirely enclosed by roads, the Embankment of the River Thames running on the western, and Westminster Bridge Road on the northern side, whilst Palace Road forms the southern and eastern boundaries.

The extent of the site is about 378,507 superficial feet, being 8 acres, 2 roods, 30 perches, or nearly 660 superficial feet per bed.

Subsoil.—The following is a description given by the architect of the subsoil and the construction of the foundations of the buildings:*

"The building stands partly on land reclaimed from the river and partly on the shore. Foundations on the river portion are carried down to the London clay. Those on the shore stand on a sound bed of gravel, which overlays the London clay, the difference in level being obtained by wide steppings, as shown on the sections. The ends of the blocks next the river have a solid foundation of about 22 feet deep over the entire surface, and the same depth 22 feet up to the old river wall. The concrete is then stepped up, and a platform of concrete, about five feet deep, is laid over the whole surface of the remaining portion of the building. The land or spring water stands at a level of about four feet above the clay. A drain was laid along the whole length of the hospital at the back of the river wall to a sump, and the excavations were all pumped dry before the concrete was put in. The whole of the concrete is composed of blue lias lime and clean Thames ballast up to a little above the land water line in the proportion of six to one; all above that in the proportion of eight to one. The strata on the shore consisted of made ground, then gravel varying in compactness, resting on the London clay, which rises gradually up from the river. The strata on the river portion consisted of loose and sandy gravel down to the clay."

General Arrangement.—The plate at page 26 illustrates the ground plan of these buildings, together with the details of the larger of the sick wards.

The principal entrance to the building is on the ground floor of the main central block at the point marked G on plan.

The whole of the ground floor of the main central building is occupied by the out-patients' department, waiting rooms, coroner's inquest room, dispensary, steward's and matron's offices, kitchen, stores, and other administrative offices. In the Block marked B, there are on this floor two wards, for the accommodation respectively of one and of twenty ophthalmic patients; in each of the Blocks D and K there are two similar wards for ordinary cases, and there is also a ward in Block M for eight "special cases."

The basement beneath the floor last described contains store rooms, furnace rooms, dining rooms for nurses and other like offices, and there is a corridor running

* Transactions of the Royal Institute of British Architects; London, 23rd January 1871.

the whole length of the building, with a subway continued to Block N for the conveyance of dead bodies to the mortuary.

Block C has three stories above the ground floor, and contains accommodation for the matron and also apartments for the "Nightingale" nurses.

The ground floor of Block E contains the applicant's waiting rooms and other offices, and on the first floor an operating theatre.

The ground floor of Block G contains the entrance hall and the steward's and other offices, and on the first floor a chapel and medical officers' rooms.

The ground floor of Block J contains the out-patients' department and consulting rooms, and on the first floor another operating room.

Block L has three stories above the ground floor, and contains the steward's and other residential offices.

The parts marked R R R are not carried up beyond the ground storey.

Blocks B, D, F, H, and K each contain on the first, second, and third floors, the principal sick wards hereafter described. Each floor has one large ward for the accommodation of twenty-eight patients, and one smaller for two patients.

Block M contains on the ground floor a ward for eight beds only, on each of the first, second and third floors; there are also two wards each for the accommodation of eight patients, and, in addition, two smaller wards each for two special cases. All the wards in this block are devoted to the reception and treatment of special or infectious diseases.

The whole of the top or fifth floors of the Blocks B, D, F, H, K, and M are devoted to the accommodation of the ordinary nurses and servants of the establishment.

There is a closed corridor marked x x x x on plan, running the whole length of the building, and forming on the first floor a means of communication between the several blocks, and on the second floor an open air ambulatory.

Block A contains board room, committee room, clerks' and other administrative offices, and the treasurer's residence.

Block N contains the school department, with its anatomical, medical and chemical theatres, laboratories, materia medica museum, library, dissecting room, mortuary and post mortem room.

Block P contains workshops and gardener's residence.

I am informed that a very complete separate bathing department, with a well-appointed Turkish bath, was originally provided for the use of the patients, but it has latterly been converted to other purposes.

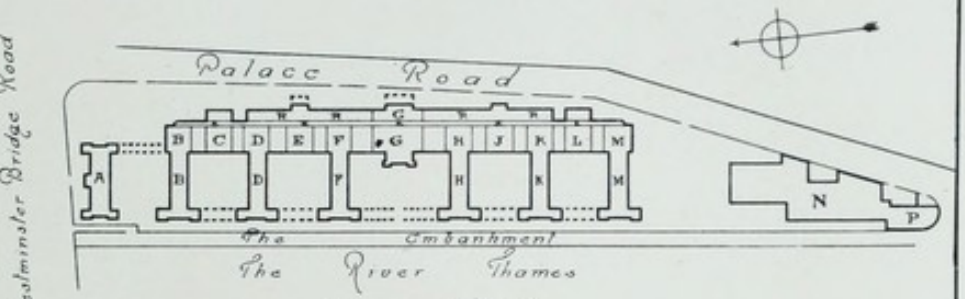
There is no laundry.

Total Accommodation.—Accommodation is provided for 573 inmates, viz.:—15 wards for 28 beds each, 3 for 20 each, 7 for 8 each, 17 for 2 each, and 3 for 1 each. Owing to want of funds, the building has not been fully occupied; during the years 1880-81, for example, the average daily number of patients was but 362.

Connecting Corridors.—The main corridor connecting together the various blocks of buildings contained between the six pavilions is 13 feet 9 inches wide on the ground floor, and on the first floor 9 feet wide. The roof of the upper corridor is so constructed

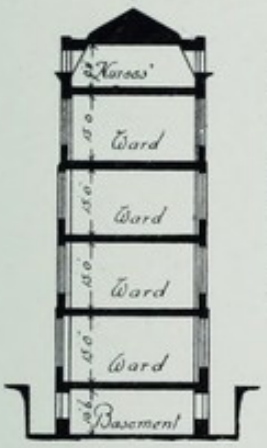
St. Thomas's Hospital

G. Entrance Hall, Offices, Chapel.
BDEHKM. Sick Wards.
C. Matron & Nurses.
E. Waiting Rooms, Operating-Theatre
J. Out Patients, Operating Rooms
L. Officers Apartments.
A. Board Room, Offices Treasurer's Residence
N Mortuary, Laboratories, School Department.
P. Workshops, Gardiners-Residence.

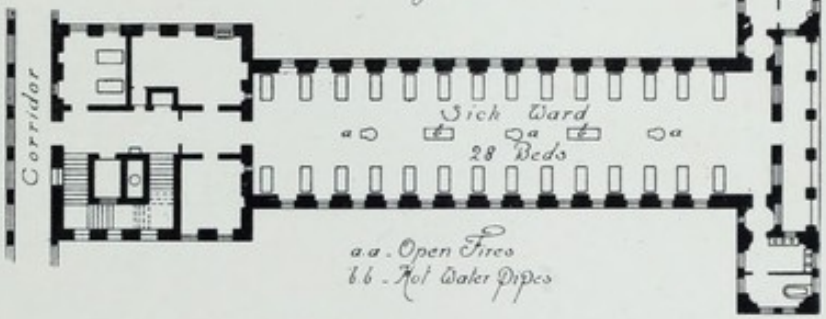


Plan of Site

Scale of Feet

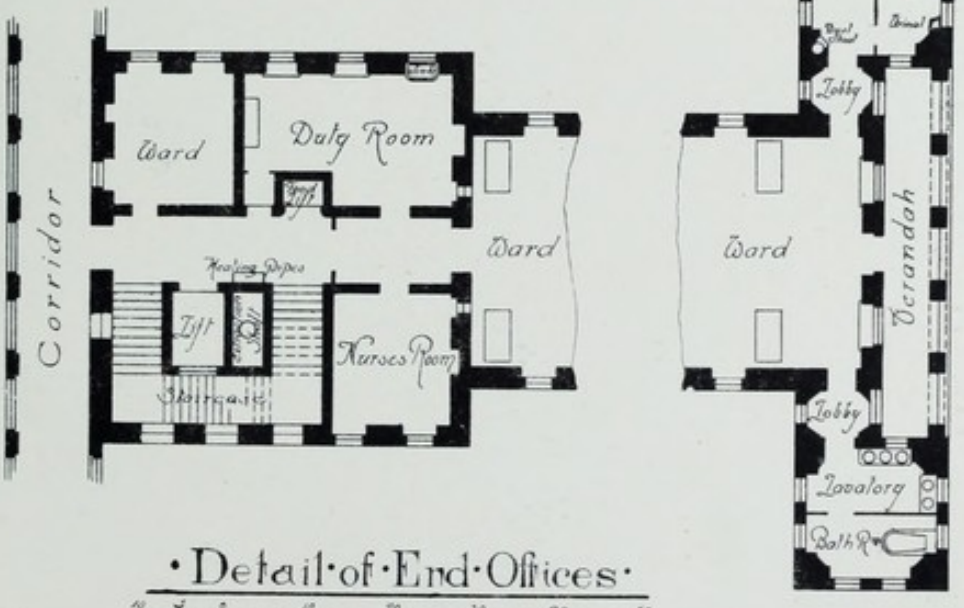


Section on line AB



First Floor Plan of one Pavilion

Scale of Feet



Detail of End Offices

Scale of Feet

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H. Saxon Snell del.

as to afford a means of external communication between the several pavilions at the second floor level, and it may also be used by the patients as an ambulatory.

Water Supply.—The whole of the water used in the establishment is supplied by the Lambeth Water Company, and delivered into cisterns distributed over various parts of the building.

Drainage.—The drainage of the building is effected by earthenware pipes, discharging into a main sewer.

Area Covered.—The area covered by buildings is about 153,366 feet, being nearly two-fifths of the site, and 268 superficial feet per bed.

Cost.—According to a report of the Building and Sub-Committee, dated July 2nd 1873, the sum paid for the land and the cost of erecting the building was as follows :—

LAND.	£	s.	d.
Sum originally paid for land	95,000	0	0
Subsequent exchange of land to improve boundary, and the acquisition of 1,660 yards additional ground	13,000	0	0
For new wall to Lambeth Palace Gardens, consequent upon the above alteration of boundary	1,995	0	0
	£109,995	0	0

So the total cost of the site was at the rate of about £192 per bed.

BUILDINGS.

A contract was entered into with Mr. Webster for the execution of the necessary concrete and brick foundations (including the area retaining walls) at a schedule of prices, and resulted in an expenditure on these works of £48,545.

Tenders for the erection of the buildings were invited from eighteen leading building firms, and the following table shows the amount of the estimates for four alternative modes of construction :—

NAME OF BUILDER.*	Stocks and Red Bricks with Stone Dressings.	Gault and Red Bricks with Stone Dressings.	Stock Bricks and Stone Facings.	Gault Bricks and Stone Facings.
	£	£	£	£
Ashby and Horner	382,100	384,960	400,400	402,450
Hill and Keddell	381,050	383,950	400,300	402,150
Piper and Wheeler	377,060	379,784	395,106	397,637
Brass	367,021	381,617	383,826	397,334
Lee	364,000	371,000	390,000	392,700
Gammon	362,664	366,755	395,566	398,276
Thorne	353,745	353,745	362,645	362,645
Webster	353,654	353,654	375,306	375,306
Higgs	349,260	352,909	367,276	370,653
Mansfield	347,168	350,132	364,173	366,918
Holland and Hannen	344,252	348,995	364,488	368,878
Myers	340,946	344,996	362,540	366,370
Lucas	339,160	342,443	357,455	360,494
Perry	332,748	334,596	356,780	358,409

* Messrs. Baker, Messrs. W. Cubitt & Co., Mr. Downs, and Messrs. Trollope, were also invited to submit tenders, but did not do so.

Mr. Perry's tender was accepted for the erection of the building with stocks, red brick facings, and Portland stone dressings, for the sum of £332,748. The following account, however, shews what was the ultimate total expenditure :—

	£	s.	d.
Mr. Webster's account for the foundations	48,545	0	0
Mr. Perry's general building account, architect's and surveyor's fees, and clerk of works' salary	359,409	18	3
Mr. Perry's additional account for sundry wood fittings	6,500	0	0
For warming, ventilating, and hot-water services and ward stoves	11,345	0	0
For hydraulic lifts	5,229	12	9
For gas mains, pipes and fittings	3,765	0	0
Carried forward	£434,794	11	0

	£	s.	d.
Brought forward	434,794	11	0
For cooking apparatus in the principal and other kitchens	875	9	6
Lavatory and bath fittings	1,667	9	0
Stoves and chimney pieces	1,721	15	9
Electric communication and bells	946	9	0
Engineers' works in the dispensary and other laboratories and fittings in the chemical laboratory	1,788	8	3
Fire appliances	313	0	10
Laying-out grounds and planting	2,820	14	0
Sundries	597	5	10
Total	£445,525	3	2

The total cost of the buildings, exclusive of the site, was therefore at the rate of about £777 per bed. But it should be borne in mind, that of this sum nearly £85 per bed was expended upon the foundations, which, owing to the peculiarities of the site, were unusually costly. The total cost, including the land, was £969 per bed.

It may be also interesting to note here the cost of the furniture which is given in the report referred to, as follows :—

	£
For bedsteads supplied to wards, sisters' rooms, nurses' dormitories, probationers', nurses' home, and College house	838
For bedding, for ditto, ditto, ditto	1,119
For blankets, counterpanes, sheeting, linen, &c., for ditto	1,397
For locker seats for wards, £550, included in Mr. Perry's account	
For tables for wards and ward kitchens	215
For chairs and seats for wards, out-patients' rooms, dormitories, gardens, &c.	405
For furniture in rooms for residential medical staff	236
For ditto for sisters' rooms, nurses' dormitories, and probationer nurses' home	1,059
For ditto in out-patients' and dispensary departments	301
For ditto in medical school	172
Carried forward	£5,742

	£
Brought forward	5,742
For furniture for court, committee, treasurer's and almoners' rooms, counting-house, steward's office, &c.	406
For carpets and druggets for sisters' rooms, committee and court rooms, &c.	496
For kamptulicon in out-patients' department, counting-house, steward's office, probationers' home, library, &c.	593
For blinds in wards, out-patients' department, and officers' residences	807
For screens for wards	128
For turnery, cutlery, earthenware, and kitchen requisites	643
For dispensary, glass and earthenware scales, weights, &c.	195
For fenders and ironmongery throughout buildings	462
For chapel furniture	42
For sundries, including adapting and renovating furniture for hospital generally	570
Total	£10,084

The cost of the furniture here enumerated, was therefore at the rate of £17 12s. per patient.

Principal Sick Wards.

The main sick wards are contained on the first, second and third floors of Blocks B, D, F, H, K, and they are connected together by staircases, and also on the ground and first floor by corridors running the wholel engtth of the main building. A plan and details of one floor are shown on the plate at p. 26.

Aspect.—The axes of the sick pavilions all run east and west, so that the windows on either side of the wards face north or south, whilst the balconies overlooking the river face the west.

Relative Position of Pavilions.—The height of the pavilions as measured from the lower floor of the sick wards to the junction of the upright lines of the outer front walls with the sloping lines of the Mansard roof is about 78 feet, and the least distance between each pavilion is 125 feet or about 1⅗ths of the above height.

Size of Wards.—Each main sick ward is of parallelogram shape, contains twenty-eight beds and is 120 feet long, 29 feet 4 inches average width, and 15 feet high. The total superficial space is therefore 3,520 feet, or about 126 feet per bed, and the cubic contents 52,800 feet, or about 1,886 feet per bed.

Bed Space.—The average lineal wall space per bed is eight feet. This does not include the spaces at ends containing the doors leading to w.c.'s, bath, &c.

Windows.—There are thirteen windows in each side wall, and the total area of their effective glazed surface is 808 feet, or about 29 feet per bed. If, however, the windows and the glazed door opening at the end of the ward overlooking the balcony be taken into consideration, the effective glazed area per bed is 32 feet 6 inches. All the sashes are glazed with plate glass. The side windows are each in two divisions, the lower portion being ordinary double-hung sashes, and the upper portion having a sash constructed to drop only a few inches. The two end windows are ordinary double hung sashes, with circular heads. The door opening from the ward to the balcony is glazed, and has a large fanlight over it.

When all the windows are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 418 feet, or nearly 15 feet per bed.

Warming.—Each ward is warmed by three open fire-places, standing centrally between the beds, and these are supplemented in very cold weather by two coils of heated hot-water pipes, placed on a line with the stoves. The stoves are formed with an air chamber at the back of them, having a large heating surface of metal standing in a pan of water somewhat similar to the Gurney stove. Vertical smoke flues of wrought iron, fifteen inches in diameter, are carried from the basement to some feet above the roof, and pass behind and are connected to the stoves on each floor, so that each of these flues forms a general smoke shaft for each tier of stoves. Each stove is provided with a valve to close its connection with the flue when not in use. These smoke shafts are surrounded by castings of cast iron, to prevent the atmosphere of the wards coming in direct contact with the heated metal, and they are put up in pieces and bolted together, so as at any time to be easily removed when necessary for repairs. In the upper storey a casing of brickwork, built on the concrete floor, is substituted

for that of iron, as being in that position more suitable for conducting the smoke tube through the roof into the outer air. The spaces between the smoke flues and the castings are used as foul air extraction shafts as described below under the head of ventilation.

Ventilation.—The ventilation of the wards is effected in summer time mainly by the windows, but each pavilion has an extraction shaft running from the basement through the well hole into the outer air above the roof of the staircase. The tendency of foul air to rise up this shaft is promoted by a cast-iron flue pipe from the basement furnaces being carried through the centre of it, and in the upper part there is placed a hot water circulating cistern, which also tends to assist the upward draught. When this shaft reaches the underside of the roof, it is met by a trunk running towards it horizontally along the line of the pavilion, and this trunk gathers together all the ventilating flues that rise from the wards below it. These ventilating flues from the wards consist of the large casings previously described as surrounding the smoke flues from the fire-places, and also of four flues running up the side walls and having openings into the wards at both ceiling and floor levels. It would appear that the ventilating openings in the wards pass directly into these upright shafts, and that no precautions have been deemed necessary to provide against the possibility of foul air from the lower wards being drawn on occasions into the upper ones.

Lighting.—The lighting of the wards is effected at night by means of four gas brackets fixed round each of the three ventilating shafts last described, at a height of 6 feet 6 inches above the floor.

Floors.—The flooring of the wards is constructed on the fire-proof principle known as "Dennett's," the ceilings being formed with a flat surface and plastered. The finished surface of the floors is of wainscott ploughed and tongued with hoop iron, the nail holes stopped with coloured putty, and the whole waxed and polished.

Walls.—The walls are built of stock bricks faced with red Fareham bricks and Portland stone dressings, and the thickness of the main ward walls varies from 3 feet on the lower to 2 feet 3 inches on the upper floors.

The walls of the wards, w.c.'s, bath rooms, sculleries, sisters' rooms, small wards, staircases, &c., were originally finished with polished parian cement, but most of them are now painted in all colours.

Baths, W.C.'s, &c.—The water-closets, baths, and other sanitary appliances are situated at the extreme corners of each pavilion ward in compartments projected from the main building, and connected thereto by lobbies opening directly into the wards. Cross-ventilation is obtained to these lobbies by means of windows in either side wall. There are also windows on all four sides of the projected rooms containing the water-closets, &c. In addition to the ventilation afforded by the windows, each compartment has small outlet shafts next the ceiling for the escape of foul air, and fresh air is admitted from the outside and passed over coils of hot water pipes. The projected compartment on the left side of each ward is divided into two by a framed partition, the upper portion of which is glazed. In that division which is entered directly from the lobby, there is placed the slop sink, about 4 feet 6 inches by 1 foot 6 inches, and the foul

linen and dust shoots. The other division entered from the last contains on the men's side an urinal and also two water-closets, one being about 3 feet 10 inches by 7 feet 9 inches and the other somewhat less. The water-closet apparatus is of the kind known as "Jennings' patent valve closet," the seats are of deal. The urinal is also "Jennings' patent," and has a treadle at the floor level which admits the water to flush the pan only while the person is using it. The slop sink is all of slate, with a drainer at one end; both cold and hot water is laid on to it; the taps being placed at such a height from the bottom of sink as to admit of a pail being placed underneath. The projected compartments to the right of each ward contain the bath and the lavatory basins. A dwarf-framed partition divides the bath cubical from the lavatory, but in some cases this partition has been removed to provide sufficient space for the performance of small surgical operations. The lavatory is furnished with "Jennings' patent tip-up" basins, of white earthenware sunk in slate shelves, and both hot and cold water are laid on to them. The bath cubical is about 15 feet 9 inches long by 7 feet 10 inches wide, and is fitted with a "Finch's" porcelain bath and hot and cold water supply. The soil and waste pipes run down recesses in the inner parts of the walls, and these recesses are cased with deal framing, so as to be easily accessible. The pipes are all trapped at the bottom before entering the drain, and the soil pipes are carried up to the roof and capped at the top, but have perforations around the sides.

Day Rooms.—No day-room accommodation is provided for the use of the patients.

Verandah.—From the extreme end of each of the larger sick wards, glazed casement doors lead on to a verandah about six feet wide and forty-five feet in length, where the patients might with advantage, if the water-closets did not adjoin it, enjoy the fresh external air and the cheering and enlivening view of the River Thames which runs beneath.

Separation Wards.—On the left of the entrance to each of the pavilion wards on the upper floors there is a small ward, for the accommodation of two patients, containing 240 superficial and 3,600 cubic feet.

Duty Rooms.—The duty rooms have each an area of about 360 feet, and they are provided with an ordinary cooking range and a glazed earthenware sink for washing crockery, fixed in one of the window recesses, the other window recesses are fitted with low cupboards, and there is a large cupboard by the side of the food lift continued up to the ceiling.

Nurses' Rooms.—Nurses' rooms and staircases are situated between the wards and the corridor connecting the several pavilions. Each nurse's room has an area of 248 feet, and is fitted up as a sleeping apartment, and being contiguous to the ward, it has an inspection window for overlooking the patients.

Lifts.—There is one passenger lift for patients, 7 feet by 6 feet 6 inches to each pavilion, partly occupying the centre of the staircase. It is constructed upon the hydraulic ram principle, and is worked by the fall of water from a tank fixed in the roof at a height of 104 feet above the level of the basement floor. This tank contains 2,500 gallons, and the water in it exerts a pressure upon the lift ram of 45 lbs. on the square inch. The ram is nine inches diameter working in a cylinder eleven inches diameter, the stroke is sixty-

three feet, and the lift is calculated to raise six persons at one time. The overhead gear is placed at the sides in a chamber especially provided for it, so that in the event of any fracture no damage would arise to the cage.

There is also an hydraulic food lift to each pavilion, constructed upon the rack and piston principle, the machinery for this being placed in the basement. The weight intended to be raised is one hundredweight; the height is 63 feet; and it is worked from the same tanks as the passenger lifts.

Staircases.—The pavilion staircases each occupy an area of 625 feet; the treads are 6 feet in length, 12½ inches wide, and the risers 5⅞ inches. The well holes which are included in this area are occupied by the passenger lift and the ventilating extraction shafts previously alluded to. There are coils of hot water heating pipes on each landing.

Basement.—The basement floors of the pavilions are generally about 10 feet 6 inches high, and they contain dining rooms and such like offices for the nurses, also furnace and store rooms, and general domestic offices, and all parts are connected together by a corridor running beneath the one above. Of course, this arrangement, and the position of the kitchen offices, would be quite subversive of all the rules of good hospital planning, if the limited area of the site had not rendered any other scheme an impossibility.

Area of Pavilions.—The total area occupied by each pavilion floor, including its surrounding walls, is 7,292 feet, or 243 feet per bed.

The foregoing account of this magnificent building does not agree in many important particulars with others previously published, and it may be well, therefore, to say that all the statements here given are the result of my own personal investigation. The detailed plans have been made from careful measurements of the building itself, but the illustration at page 22 is copied from an engraving in "*Transactions of the Royal Institute of British Architects*" for the year 1871.



NEW ROYAL INFIRMARY — EDINBURGH

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

ROYAL INFIRMARY,

EDINBURGH—SCOTLAND.

THIS building has been erected by public subscription for the medical and surgical treatment of the sick poor of the city of Edinburgh, and it contains one of the largest medical schools of Great Britain, a school which is said to date from the appointment of Alexander Monro *primus*, to the Chair of Anatomy in 1720.

The foundation stone of the building was laid by His Royal Highness the Prince of Wales, in October 1870, and the building was opened on the 29th October 1879 by the Lord Provost, assisted by the Magistrates and Council of Edinburgh, together with other corporate bodies of the city and neighbourhood. Representatives from the University and Extra-mural Schools also attended.

It is certainly one of the most important buildings of its kind, and great credit is due to the architect, the late Mr. Daniel Bryce, for the able manner in which he grappled with the constructive difficulties of the site, and so designed his building as to produce, without the sacrifice of skilful arrangement, a really handsome structure, well illustrative of the Baronial style of Scottish architecture. It must not, however, be supposed that this building is in all respects a model for the future designing of hospital buildings, for already a very large amount is being expended in the reconstruction of some details that have been found by experience to require alteration. The existence of some objectionable features in the general planning of the building is to a great extent due to the fact that the architect had to utilise an old structure standing centrally upon the site, and now appropriated as the administrative department of the establishment.

A very exhaustive and ably-written description of this building was published in the *Lancet* about a twelvemonth after it had been opened, and the editor concludes his criticism in the following words, which equally apply to my own observations upon the various details of the buildings:—

"Many of the points to which we have taken exception are not peculiar to the Edinburgh Royal Infirmary, but are common to most pavilion hospitals which exist at present. The Edinburgh Royal Infirmary is certainly one of the finest and best hopitals in this country; but it would be a mistake to regard it as perfection, and for future hospital builders to be content with merely imitating it.*

Site.—The buildings stand upon a plot of ground bounded on the south by the public park known as "The Meadows;" on the north by the grounds of George Heriot's Hospital; on the east by Meadow Walk; and on the west by Lauriston Place. It is situated upon a hill, having a rise from the southern to the northern boundary of 40 feet. It is not far from the centre of the city, and the proximity of the buildings to those of the University is advantageous to the students by reason of the facilities it at all times affords for transit from their academical to their clinical studies. Greater part of the

* The *Lancet*, September 4th and 18th 1880.

central building is old, and was originally occupied by "George Watson's Hospital.' It has, however, been adapted to the purposes of this institution, though at great expense, and, probably, with no advantage beyond the creation of a pleasing economical delusion in the minds of the subscribers to the institution. It is, perhaps, now unnecessary to speculate as to whether the general arrangement of the buildings might not have been improved had this building been removed. The extent of the site is about 520,740 superficial feet, or 11 acres 3 roods 32 poles, being about 888 feet per bed.

Subsoil.—The buildings on one side stand upon the upper stratum of old red sandstone, and on the other upon the solid rock.

General Arrangement.—The accompanying plate shews, by a block plan, the general arrangement of the buildings upon the site, plans of one of the medical and one of the surgical wards, and a detail of the ward offices. A perspective view of the exterior is also illustrated at page 33.

The establishment is divided into the medical, the surgical, and the pathological departments, the administrative offices, the laundry, engineering department, &c.

Owing to the very great fall of the ground (forty feet) from Lauriston Place to Meadow Walk, it will be somewhat difficult to clearly understand the arrangement of the various buildings in their relation one to another, without first referring to the small section on the accompanying plate. It will there be seen that the ground floor of the buildings next Lauriston Place is placed below the level of the entrance roadway, and that the principal entrance to the building is upon the first floor; then, that the ground floor level of these front blocks becomes the first floor level of the central block; and lastly, it will be seen that the ground floors of the rear buildings are, again, at a considerably lower level than those of the central block.

The pavilion wards contained in the buildings, shewn upon the block plan as facing Lauriston Place, are devoted to the surgical, and those in the rear facing Meadow Walk to the medical treatment of patients. The buildings lying midway between these two departments are principally of an administrative character.

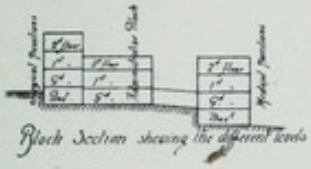
The establishment is entered by the gates adjoining the porters' lodges, A and R on the plan of site. The entrance A is for the use of visitors, and R for patients. A flight of steps leads to the entrance hall at B, and a porter's room and the treasurer's and other offices adjoin this entrance hall.

Blocks C C are pavilions containing on their ground, first and second floors respectively a large ward for the treatment of fourteen surgical cases, and a smaller or separation ward for two patients. Enlarged plans of these pavilions are shewn upon the accompanying plate. Block D has similar accommodation on the two upper floors, but the ground floor of this pavilion is devoted to the treatment of twelve patients suffering from delirium tremens, and for whose accommodation one ward is provided for eight, and two others for two beds each, with padded room, nurse's room, and other attached offices. The upper floors of block E are also similar to those of blocks C C; but the ground storey is used as an accident ward for six patients, and there is another smaller or separation ward for the accommodation of two patients. The remaining ground floor space of this block consists of a patients' entrance and waiting room, doctors' and

A.R. Entrance Lodges. B. Entrance Hall & Offices. C.D.E.K.L. Surgical Wards. M. Operating Theatres. F. Administrative Offices. H. Medical Wards. N. Nurses Rooms. G. Lecture Theatres.

ROYAL INFIRMARY EDINBURGH

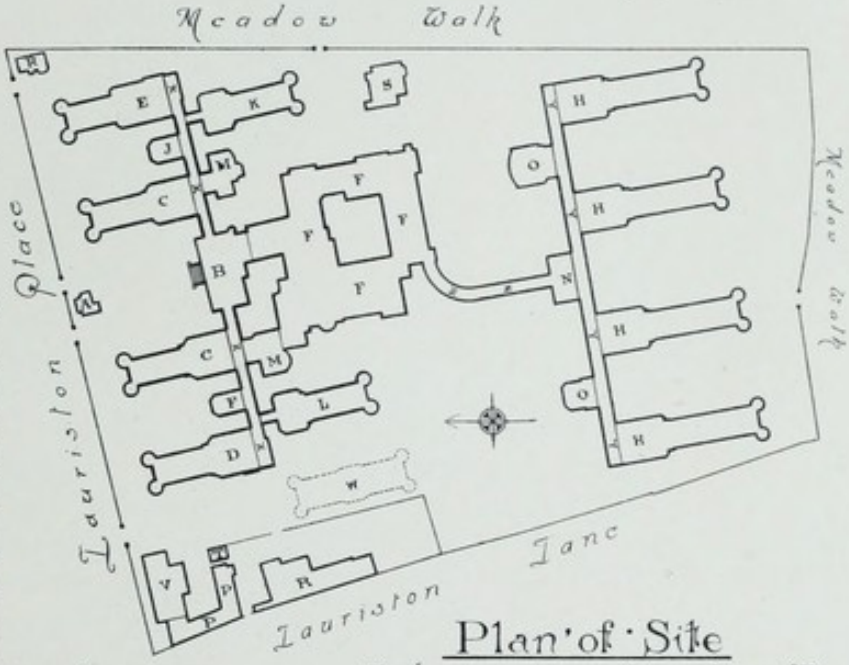
S. Superintendents Residence. W. Infectious Wards. P. Workshops. V. Pathological Department. R. Laundry & Engine Room. T. Mortuary. x.y.z. Corridors.



Block Section showing the different levels

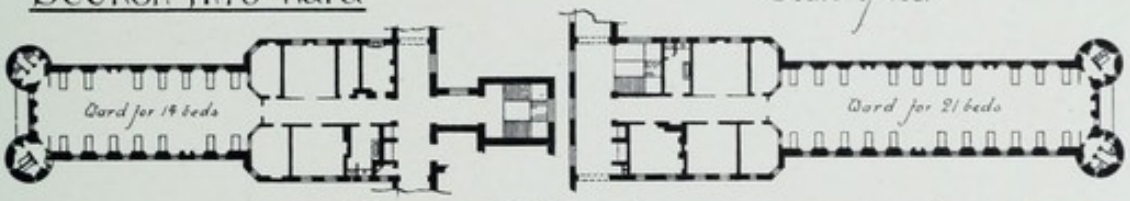


Section thro' Ward



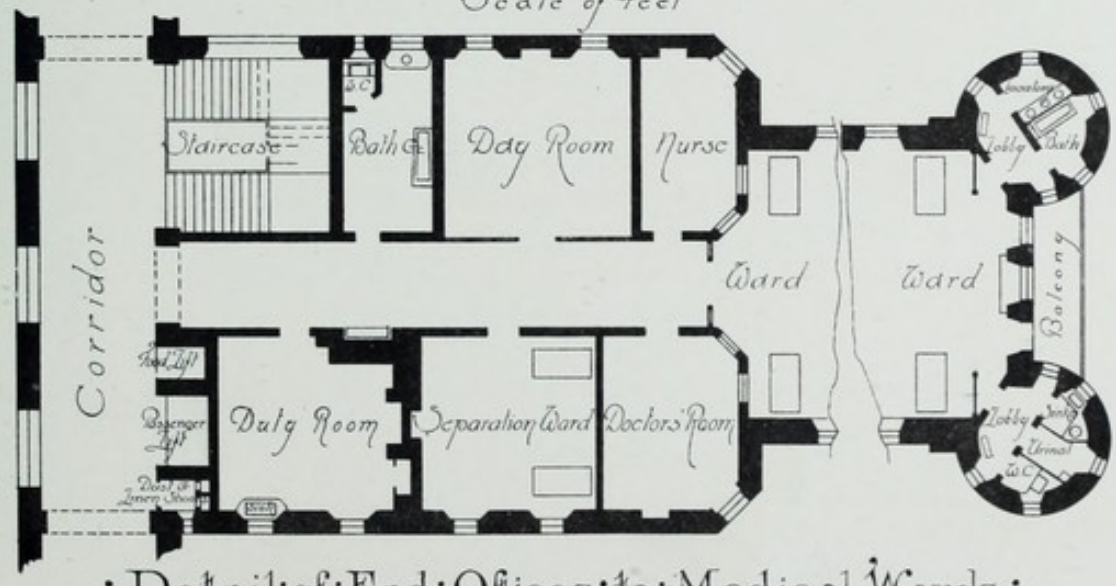
Plan of Site

Scale of Feet



Surgical Wards — Plans of Pavilions — Medical Wards

Scale of Feet



Detail of End Offices to Medical Wards

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

nurses' rooms, and a convalescent day room. Basement store rooms are contained under part only of these four pavilions nearest to the connecting corridor, but not under the space occupied by the large wards. The wider parts of each pavilion next the main corridor are carried up to form a third storey, and planned to contain the ward assistants' and the night nurses' sitting and bedrooms. Another accident ward for six beds is placed in block F, which is one storey only in height.

Block J is an entrance hall and hat and cloak room for the use of students.

The pavilions K and L have on each of their two upper storeys two wards for the accommodation respectively of fourteen and two patients, and there is in each of these buildings, on the lowest floor, a ward for ten patients, besides in K one, and in L two separation wards. Each floor has a day room, duty room and attached offices, as described for the other pavilions. In pavilion K this ground floor contains, besides the wards just mentioned, the waiting and examination rooms for ophthalmic patients. There are basements under these two pavilions devoted to the uses of the chief porter, the engineer and the laundry women; there is also a ward in block L containing accommodation for six "doubtful cases."

Blocks M M are two small operating theatres, one storey only in height above the ground floor level. The basements are used for storeage purposes.

The upper floors of the principal entrance, block B, contain one ward for six patients, and two wards each for eight syphilitic or "lock" patients, all having appropriate offices attached; there are also in this block rooms for the use of students.

It will be remembered that owing to the rapid fall of the site the first floor of block F corresponds to the ground floor of the front building last described. This block F contains, then, on the ground floor, the general kitchen offices, the stores, steward's quarters, dispenser's apartments, laboratory and drug room, the housekeeper's rooms, nurses' kitchen and dining room, the general medical waiting room, and general male, female, private, and students' examination rooms. On the first floor accommodation is provided for the lady superintendent and the resident physician and surgeon, a chapel for the general use of the patients and officers, and registrar's and clerks' offices. There are also on this floor cubicles for nurses and domestics. On the upper or second floor there is a large operating theatre and additional cubicles for nurses, as also the treasurer's clerk's, and superintendent's offices, and the board room.

The pavilions H H H H are devoted to the treatment of medical diseases, and are each three storeys in height, above the basements. On each of the upper floors there is a ward for twenty-one beds, and a separation ward for two beds, and at either end of these buildings there are the usual ward offices. The wider portion of these pavilions next the connecting corridor are carried up an additional storey for the accommodation of ward assistants, night nurses, &c.; but the basements of these portions are at present unappropriated. The basements of the narrower portions beneath the large wards are available for use as day rooms by the convalescent patients, and they are entered from the outside.

Blocks O O are two lecture theatres, each one storey only in height above the basement.

Block N contains two porters' rooms on either side of the corridor connecting the medical department with the central administrative offices.

The building marked S is the superintendent's residence, three storeys in height.

The laundry and washhouse is situated in block R, the engine and boiler room being placed beneath the adjoining yard.

Block T is the mortuary.

Block V contains the pathological theatre, with its adjoining preparation and demonstration rooms, and a surgeon's private room. There is a subway communication between this department and the medical and surgical pavilions.

Blocks P P contain a coffin store and the carpenter's, upholsterer's and joiner's shops; also stores with joiner's residence over.

According to the original plan for this building published in the *Builder*, it appears to have been intended to erect on the block indicated by dotted lines and marked W an isolated building specially adapted for the reception of patients suffering from infectious and contagious complaints; but at the time of my last visit, in the latter part of the year 1882, this portion of the hospital had not been erected. The original plan referred to would also seem to have contemplated the erection of an out-patients' department and dispensary; also receiving rooms.

Total Accommodation.—The total number of patients provided for is therefore 586, viz., twelve wards for twenty-one patients each, fourteen for fourteen each, two for ten each, three for eight each, five for six each, and thirty-two for two each; but some of the private rooms are occasionally occupied by more patients than was originally intended. The average number of beds occupied daily during the year 1880-81 was 495. The greatest number at any one period was 576, and the lowest 453.

Connecting Corridors.—The surgical pavilions fronting Lauriston Place are connected together on the ground and first floors by closed corridors, x x on plan, 11 feet 6 inches wide, 14 feet high; the roofs also form a means of open-air communication between the various blocks, and ambulatories for the use of the patients on the top floor. In the basement beneath these corridors there is a subway level with the ground floor of the central block.

The medical pavilions in the rear are connected together on the ground floor by a closed corridor, y y on plan, 12 feet wide, 13 feet 3 inches high, the roof of which forms an open-air communication and an ambulatory for the patients upon the first floor. This corridor communicates with the central block by another enclosed and inclined corridor, z z on plan, 11 feet wide, and an average height of 12 feet 3 inches. The roof forms an open-air communication between the first floors of the medical pavilions and the central administrative blocks. The whole of the corridors in the building are heated by coils of hot-water pipes placed at regular distances apart.

Water Supply.—The water used in the institution is supplied gratuitously from the Corporation works, and is distributed throughout the building in cisterns situated principally in the various turrets at the angles of the pavilions.

Drainage.—The drainage of the establishment is effected by means of glazed earthenware tubes, which converge on the outside of the building, and enter a conduit running

through the adjoining "meadows," and ultimately joining the town sewer in its progress towards the outfall.

Area Covered.—The area covered by buildings is 137,905 superficial feet, or about one-fourth of the site, and 235 feet per bed.

Cost.—The cost of the land, including Parliamentary expenses, was £64,453 15*s.* 0*d.* or about £110 per bed. Although the building has now been opened for some years the whole of the work is not completed, and it is estimated that, including the alterations found requisite to the heating apparatus and other engineering works, it will be necessary to expend a further sum of £20,000.

The items of expenditure up to the end of September 1881 are as follows:—

	£	*s.*	*d.*
Excavations and levelling site	9,878	9	4
Ditto, foundations	6,794	5	6
Medical hospital	62,885	18	1
Surgical hospital	91,508	7	6
Administrative department	29,126	10	0
Pathological department	22,485	17	2
Superintendent's house	3,843	19	1
Entrance lodges	1,252	0	3
General works	8,872	10	11
Drains	1,553	12	1
Carried forward	£238,201	9	11

	£	*s.*	*d.*
Brought forward	238,201	9	11
Fittings	1,077	16	6
Architect, clerk of works, laying foundation stone, and other miscellaneous expenses	20,323	13	4
	£259,602	19	9
Estimated amount required for the completion of the building and engineering works	20,000	0	0
	£279,602	19	9

The total cost of the buildings and their appurtenances, exclusive of the land, will, therefore, when they are completed, amount to £279,603, or £477 per bed, but inclusive of the land, £587 per bed.

Principal Sick Wards.

The following description refers more particularly to the medical sick wards. The surgical wards are almost similarly planned, but that they are shorter, and accommodate fewer patients. Plans and sections of the Medical Wards are illustrated at page 34.

The principal medical sick wards, with their offices, are self-contained in four pavilions, situated at the rear of the site; they are each three storeys in height above the basement. The Surgical Wards consist of six pavilions next Lauriston Place; these also are generally three storeys in height above the basement.

Aspect.—All the pavilions run nearly north and south, so that the windows of the wards face east and west.

Relative Positions of Pavilions.—The height of the medical pavilions, as measured from the floors of the lowest sick wards to the junctions of the upright lines of the outer side wall with the sloping lines of the roofs, is forty-four feet, and the minimum distance between the walls of the pavilions is ninety-nine feet, or two and a-quarter times the height.

Size of Wards.—The medical wards are of parallelogram shape; they contain each twenty-one beds; their extreme length is 115 feet, and their width 28 feet. The height of the lower floors is 13 feet 6 inches, the intermediate floors 14 feet 9 inches, and the upper floors (partially rising into the roof) average 15 feet. The superficial floor

space in each case, after allowing for the canted ends, is 3,134 feet, or about 149 feet per bed; and the cubic contents on the ground, first and second floors are 42,309, 46,226, and 47,010 feet, or 2,015, 2,201, and 2,239 feet per bed respectively.

It is singular to observe in this, as in many other buildings, that the lower floors which, from their position, would seem to require the greatest cubical contents, in reality contain the least.

Bed Space.—The average lineal wall space per bed is nine feet, the canted ends and the fireplaces being deducted.

Windows.—There are eleven windows in each side wall, and their total effective glazed surface is, on the lower, intermediate, and top floors, 660, 732, and 558 superficial feet, or 31½, 35, and 26½ feet per bed respectively. If, however, the end windows be taken into account, the effective glazed surface is 734, 816, and 634 feet, or 35, 38¾, and 30¼ feet per bed respectively.

When all the windows and the balcony door are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 281, 348, and 241 superficial feet, or 13⅓, 16½, and 11½ feet per bed respectively. Each window is divided into two heights by a wooden transom. The upper part consists of a sash hung on its lower rail, and opens inwards; the lower part is an ordinary deal cased sash and frame, but the bottom sash only is hung to open; the central portion of the window is therefore fixed.

Warming.—The medical wards are each warmed with three open fire-grates next the side and end walls. The outer fresh air is admitted into the wards through the back of these grates, and, becoming warmed by impingement against the heated sides, passes into the wards through iron gratings fixed on the inner face of the walls at a height of about 5 feet 6 inches above the floor level. The admission of air by these means can be regulated by hinged flaps hung at the back of the gratings, and this is necessary, for the fires are not found to give sufficient warmth; and, moreover, it is stated that the heat they do give out does not appear to distribute itself equally, the temperature in various parts of the wards being found to vary considerably. In consequence of these defects, works are now in progress for providing additional heat by means of steam pipes running down each side wall.

Ventilation.—The ventilation of the wards can be effected by means of the windows principally, but also to a very large extent by a system of inlet and outlet apertures constructed in the side walls. Under each of the side windows, and, therefore, between each pair of beds, there is an inlet aperture, having an iron grating flush with the outer face of the wall; and at the back of it, next the ward, there is a hinged iron flap, with a rod to open and shut it, for the purpose of regulating the quantity of air to be admitted into the ward. The window recess above the top of this grating is fitted up as a cupboard, the air passing beneath it and being still further controlled by a sliding door flush with the inside face. At the back and below the head of each bed there is a grating in the wall about eight inches square, intended as an outlet, and communicating, therefore, with extraction flues formed in the side walls. There are, also, at the ends of the side walls of each ward at the floor and ceiling level, eight large grated openings

twenty-two inches square, communicating with six flues intended to act as outlets, and a flue with a similar grated opening 40 inches by 14 inches, is placed over the entrance door. All these outlet and inlet flues, excepting those under and at the backs of the beds, are provided with doors to close or partially close as may be desired, the admission and exit of air to or from the wards. This precaution will be less a matter of necessity when the wards are provided with sufficient heating power.

The extraction flues referred to, generally ascend in the thickness of the walls to the level of the under side of the roofs, and from thence they are continued by horizontal ducts to the towers, wherein are placed the hot-water service cisterns. The heat from these cisterns is supposed to induce an upward current sufficient for the extraction of all foul air from the wards. These extraction flues are entirely disconnected one from another until they enter the tower, and the air from them when carried past the cisterns passes upwards into the outer atmosphere. The flues from the opening over the door entering the wards are carried up the walls directly into the open air. It will thus be seen that an unusual amount of ventilation is provided for in these wards. Theoretically, the system by which the foul air is supposed to be extracted from the wards is good; but it must not be supposed that the comparatively small amount of heat given off by the hot-water cisterns in the towers is sufficient to produce more than an infinitesimal, if at times it produces any, effect upon the extractive power of the foul air shafts. The openings communicating directly with the outer air are, when the temperature enables them to be opened, the best aids to ventilation in these wards.

Lighting.—The lighting at night of each of the wards is effected by means, first, of three central gas pendants, each having four jets, at a height of seven feet four inches above the floor level. These burners are each enclosed in a clear glass globe fitted into the conical-shaped mouth of a tube two and a-half inches diameter, which passes horizontally through the floor and then up the side walls into the outer air, for the purpose of carrying off the products of combustion, and also the vitiated air from the upper part of the wards. Besides these central pendants there is a single burner bracket fixed by the side of each bed, five feet ten inches above the floor level, and these have over them inverted conical-shaped metallic dishes, with tubes carried from the upper end of them into the walls, and then through upright flues as before into the outer air. These brackets and their ventilating tubes are so contrived as to be capable of swinging round together. No doubt these gas burners, when alight, ought to be found powerful allies to the other ventilating appliances.

Floors.—The flooring of the wards is constructed of timber joists resting upon iron girders; the upper covering is of pitch pine, ploughed and tongued boarding varnished. There is a rounded oak skirting 3½ inches by 3 inches next the walls. The ceilings are plastered.

Walls.—The outer walls are throughout 2 feet 9 inches in thickness, and are so built that a space of three inches is left in the centre. The outside work is rubble stone, with dressed stone finishings to the windows. The inside is lined with brick, with a polished parian cement face. The walls of the sanitary offices in the towers at the ends of the wards are lined with glazed white tiles to a height of 6 feet 6 inches.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated in towers, circular on plan, jutting out from the angles of the extreme ends of the wards, and the passages giving access to them are cross ventilated by windows at either end, and under these windows there are ventilating openings similar to those described as existing beneath the ward windows. Each lobby is warmed by a length of steam pipe.

The tower in the left hand corner of the ward contains, on each floor, an irregularly-shaped bath-room about thirty-six feet, and a lavatory about thirty feet in area, separated from each other by a deal partition about 6 feet 6 inches high. The bath is of glazed terra-cotta (Rufford and Finch's patent), with a shower bath above. The lavatory is fitted with three of Jennings' "tip up" white enamel basins, sunk in an enamelled slate shelf; hot and cold water is supplied to them and to the bath. Both compartments are ventilated with openings under the windows, as before described.

The tower to the right hand of the ward has three compartments, for a w.c., urinal, and slop sink respectively, separated by deal partitions 6 feet 6 inches high. The w.c., which is about 5 feet by 3 feet 6 inches, is fitted with a "Jennings' patent valve closet;" the urinal compartment, about 5 feet 9 inches by 3 feet 7 inches, contains a "Jennings' lipped treadle urinal," with a hooded cover over it, having, at its upper part, a metal pipe for conveying away any effluvia into the outer air. This compartment in the women's ward is fitted with a porcelain bidet supplied with hot and cold water. The third compartment is fitted with a large circular porcelain slop sink, eighteen inches radius and fourteen inches deep, fitted into a slate shelf. The waste plug of this sink is worked by a lever handle, so constructed that each time it is brought into use a valve is opened at the side of the basin, and so a flush of water effectually cleanses it. Besides this slop pan there is a smaller oblong porcelain sink about twenty inches by eleven inches, fitted all round with a wooden capping, and supplied with hot and cold water.

All these offices are ventilated in a manner similar to those of the tower situated on the opposite side of the ward, and before described.

Each floor has its own separate cold water supply cistern placed in the depth of each floor, and there are valves for shutting off both the hot and cold water from any compartment when requisite for repairs or other emergencies.

The soil and waste pipes are of lead four inches diameter, and they are conveyed down recesses formed on the insides of the walls. It is stated that "they are ventilated at the top."

In addition to the sanitary offices at the ends of the wards above described, there is in each case a bath-room leading off the entrance corridor, fitted with a porcelain bath and shower bath over a lavatory basin and a water-closet apparatus as before. The water-closet is partitioned off one corner of the bath-room. The total area is 165 feet.

Day Rooms.—Adjacent to the corridor leading to the entrance of the large ward, and divided from it by a low glazed partition, there is a day room for the use of convalescent patients. It has an area of 358 superficial feet, which is at the rate of about 17 feet per patient occupying the large ward. The walls are lined with wood five feet high.

These day rooms are but little used in the surgical division, as the recovering patients are early sent away to a convalescent hospital belonging to the Institution, and situated at Corstorphine, about three miles distant.

Verandah.—A door, situated at one side of the fire-place at the end of the large ward, gives access to a covered verandah, averaging seventeen feet in length by five feet wide, and this is intended to be used as an airing place by the patients; but, supposing the adjoining ventilating passages leading to the sanitary offices to perform the function allotted to them, this verandah must at times be redolent of foul effluvia.

Separation Wards.—There are separation wards leading off each of the corridors, giving access to the large wards. Each is intended for the accommodation of two patients, and has an area of 324 feet, and an average height of 14 feet, so that the occupants would each have 162 superficial, and 2,268 cubic, feet of space.

Duty Room.—The nurses' duty room adjoining has an area of 303 feet, and is fitted with a large range and oven, a lead-lined sink, supplied with hot and cold water, a dresser and cupboards.

Nurses' Room.—In addition to the duty room last described there is a nurses' sleeping room adjoining the large ward, and entered from the corridor. It has two windows overlooking the ward, and its area is 170 feet.

Lifts.—At the side of the main corridor adjoining each pavilion there is a passenger and a food lift, the former six feet long and four feet wide, and the latter three feet six inches long and two feet nine inches wide.

Doctor's Room.—Leading off the entrance corridor, and adjoining and overlooking the large ward, there is a room 242 feet in area, for the "use of a doctor." The purpose to which this room is put is not apparent. It is not, and ought not, to be used as a bedroom, and any conceivable operation to be performed here could quite as well be carried out in either the large or the separation ward adjoining it.

Staircases.—The pavilion staircases generally occupy an area of 324 feet, and they are constructed with stone steps 6 feet 2 inches in length and with treads 12¾ inches wide, and risers 6 inches high.

Basements.—The basements generally are about eleven feet in height, and are variously occupied; but under each of the medical ward pavilions there is a large room that can be entered only from the airing yard outside, available as a recreation ward for convalescents.

Total Area of Pavilions.—The total area covered by each floor of these medical pavilions, including its surrounding walls and the piece of main corridor immediately adjoining it, is 7,943 feet, or about 346 feet per bed.

The Superintendent of the Institution, Mr. Charles H. Fasson, Deputy Surgeon-General, and the Treasurer, Mr. James S. Trainer, have both of them kindly afforded me every facility for carrying out my investigation of the architectural details of this great work, and I have, accordingly, much pleasure in recording my thanks to them.

GLASGOW WESTERN INFIRMARY,

SCOTLAND.

It would appear, from a Report of the Building Committee of this institution, that the project of an Infirmary in the Western district of Glasgow was originated so early as the year 1846, when, under the parliamentary powers obtained by the Glasgow, Airdrie and Monklands Junction Railway Company, it was proposed to erect new buildings for the University at Woodlands, nearly on the spot now occupied by the houses of Park Terrace, and when, in connection with that enterprise, ground in the neighbourhood was purchased for an hospital site. The railway crisis, however, of 1849 having intervened to prevent the railway company fulfilling their engagements, the attempt to establish a new hospital was abandoned along with that of the University removal. The renewal, in 1864, of the proposal to remove the University buildings was necessarily accompanied by the project of a Western Hospital, and, accordingly, the subscription then set on foot in aid of the University scheme was designed to be applicable in part to the erection of an hospital.

The objects proposed in the erection of the new hospital were to provide for the wants of the sick and hurt poor in a district where such an institution was much required, and to supply the means, till then afforded by the Royal Infirmary, of clinical instruction for the medical practitioners educated at the University.

Notwithstanding the large size and admirable management of the Royal Infirmary, it had for some time been generally acknowledged that the rapid and enormous increase in the extent and population of Glasgow urgently demanded additional sick hospital accommodation; and the large number of manufactories and shipbuilding works in the western part of the city, so remote from the Royal Infirmary, clearly pointed out that district as the one in which hospital extension for Glasgow should first be undertaken.

The site first selected for the new hospital was the property of Clayslaps, purchased for £17,389, but that property was subsequently exchanged at cost price with the Corporation of Glasgow for a portion of the lands at Donaldshill. This ground, of which about nine acres were available for hospital purposes, was considered to possess the advantage of moderate elevation, proximity to the open grounds of the University and Western Park, and good accesses from the surrounding districts. In addition to the above-mentioned ground, the committee subsequently purchased about three and a-half acres of land lying to the north and west, at a price of £8,990, for the purpose of improving the site, and with the view of more fully securing open space, and of controlling the nature of the buildings in the neighbourhood of the hospital. The price, therefore, of the whole ground acquired amounted to £26,379. Part of

Hospital Construction and Management.



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H. Saxon Snell del.

this sum, however, has been recovered by the sale, for building purposes, under proper restrictions, of a portion of the outlying lands.

Having regard to the future wants of the district, and to the inexpediency of too great an enlargement of single hospital buildings, it was determined to plan a hospital fitted to accommodate from 300 to 400 beds, but, as it appeared that funds might not be immediately forthcoming to provide for the erection of the whole building as designed, the architect was directed to prepare modified working plans of a part of the hospital, which, though containing fewer beds, might serve in the meantime the purposes originally intended, and admit of the completion of the whole buildings at a later period.

It will be seen, then, that these and the new University buildings were erected adjoining one another, at about the same period, with a view to affording the students better facilities than usually attain for the joint prosecution of their academical and clinical studies. The same object appears to have been aimed at in the erection of the new Royal Infirmary at Edinburgh, and these two great capitals of medicine have cause for congratulation for the far-seeing policy that guided the Managers in this and other important details of their arduous and philanthropic undertaking.

The buildings first erected were for the accommodation of about 220 patients only, the blocks E and G on the accompanying plan of the site being deferred until a future period.

The blocks of buildings first erected were commenced on 17th March 1871, and the foundation stone was laid on 10th August in the same year, with Masonic honours, by Walter Montgomerie Neilson, Esq., of Queenshill, Grand Master Mason for Lanarkshire, in the presence of a large and distinguished assembly.

The central portion and the left hand wing of the building was completed in the year 1874, and was formally opened by a Conversazione, at which the Lord Provost, Dr. Cameron, Sheriff Dickson, Dr. Fergus, and Mr. James A. Campbell explained to the assembled company the objects of the Institution and the steps which had so far been taken to accomplish its erection.

The completion of the main structure did not take place until 1st June 1881, on which date the blocks E and G, having then been erected, were formally opened by the Lord Provost, and at the ceremony, which was conducted in the clinical theatre, it was made known that this addition to the building was due to the munificence of the late Mr. John Freeland, who left by his will the sum of £40,000 to be devoted to this purpose. The wash-house, lodge, and erysipelas wards have since been erected; the latter were not quite completed at the time of my visit, but the total cost, as stated hereafter, includes the estimated value of these additions.

The plan of the building, taken as a whole, is quite opposed to the principles laid down by all modern authorities upon hospital construction, for, instead of the wards being detached as far as possible from one another and from the administrative department, they are connected not only vertically but horizontally, and no precaution whatever is taken to prevent the air from any one ward being carried into that of another. The kitchens and scullery are also objectionably situated in the basement, adjoining corridors which communicate, by means of lift-holes and well staircases, with the sick wards above. It cannot, however, be doubted that this system of planning a hospital is less

expensive in construction than that by which the buildings are detached, and the management must be more economical, by reason of the greater facilities afforded for communication between the various departments. The wards themselves are well designed, lighted, ventilated, and heated, and the details of the arrangements of the building are generally excellent, and reflect great credit upon the architect, Mr. John Burnet. Nevertheless, it is quite evident that, if the present views entertained by all enquirers into the subject of hospital construction be maintained, this must not be regarded as a model for the design of other hospitals. The departments devoted to clinical purposes are especially worthy of study.

My thanks are due to the Superintendent of the institution, Dr. John Alexander, for his great courtesy in affording me facilities for obtaining the following details of construction, and for providing me with particulars as to various other matters of interest. I am also especially indebted to the Architect, who kindly gave me much valuable information, and specially prepared for my use a photograph and a carefully measured block plan of the site and buildings. The detailed plans have been measured by me from the building as executed.

Site.—The buildings are situated at Donaldshill, an outskirt of the city of Glasgow, and the site is bounded on one side by the Dumbarton Road and on the other by the open grounds of the University and the Western Park. The ground has a considerable inclination from east to west, and also from north to south. The extent of the site is about 537,850 superficial feet, or 12 acres 1½ roods nearly, being about 1,386 superficial feet per bed.

Subsoil.—The western end of the building is said to occupy the site of an old stone quarry, and, having been filled up with loose earth, this portion had to be built on piles; the remainder stands upon a bed of hard blue clay.

General Arrangement.—The general arrangement of the buildings, together with plans and details of the principal sick wards, are shewn upon the accompanying plates.

The establishment is entered by the porter's lodge, marked N on the block plan of the site, and this lodge also affords access to the adjoining University buildings. There is an additional entrance at the rear, adjoining the lodge at M.

The principal entrance to the main building is the central block A, upon the basement floor of which are the stores, larders, kitchen, and sullery. On the ground floor there is the entrance hall, a board room, superintendent's office, staircase to upper floors, housemaids' pantries, doctors' dining room, housemaids' rooms, and the upper part of kitchen. The mezzanine floor contains housemaids' bed and sitting rooms. On the first floor there are six doctors' rooms, with an adjoining bath room, head nurses' bed and sitting rooms, a sick ward for 16 beds, with attached offices, and a separation ward for two beds. On the second floor there is a ward for 16 beds, with attached offices, a separation ward for two beds, and a theatre for surgical operations and lectures, with dressing rooms attached.

Block B contains on the basement a dispensary, porters' rooms, and a drug store, and on the ground floor nurses' parlours, and rooms for the use of the superintendent. The whole of the first floor of this block is occupied as a ward for 16 patients, with attached

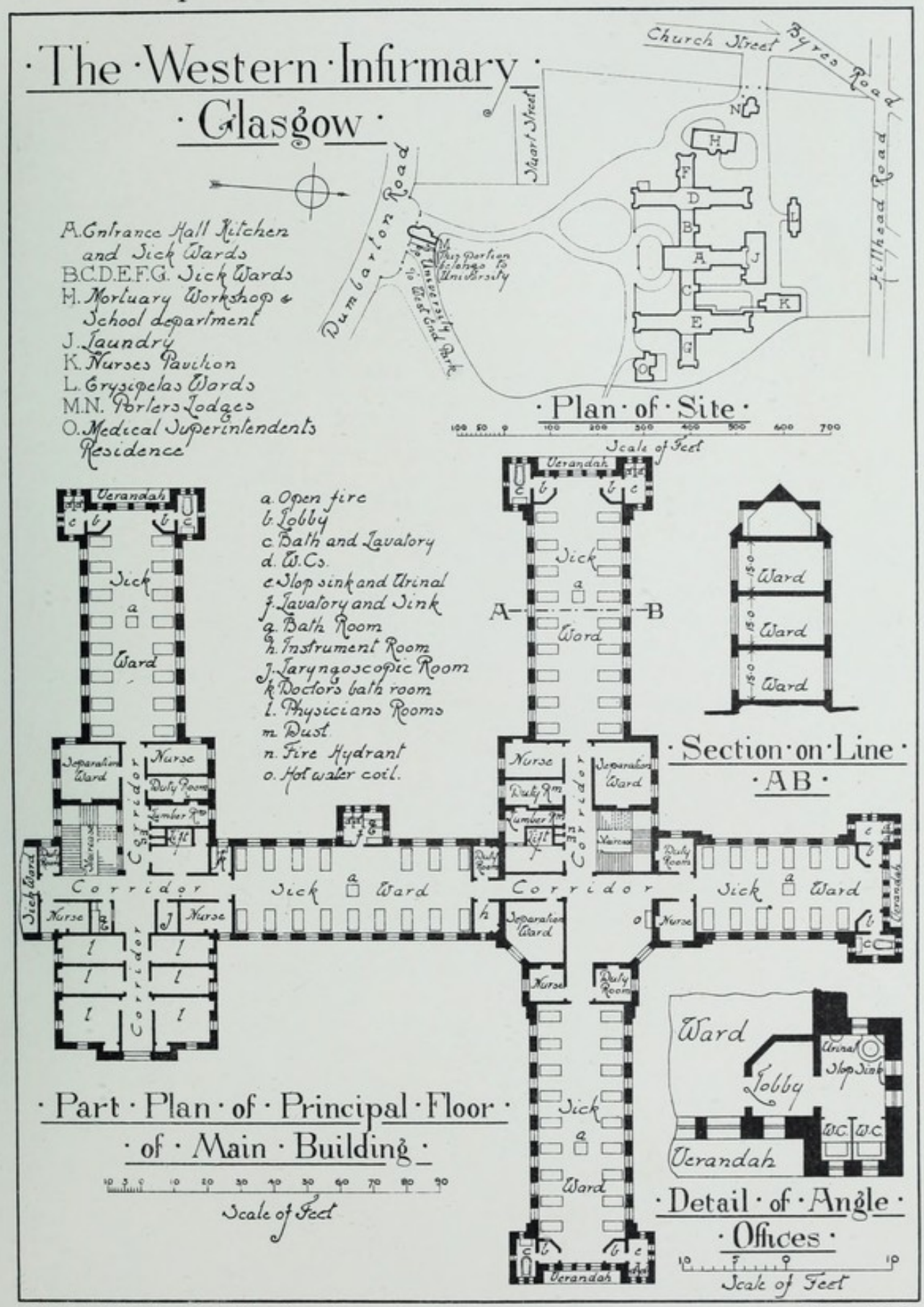


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H. Saxon Snell del.

offices, but the second floor is divided into smaller rooms, intended to be used as private wards for six patients ; they do not, however, appear to be so occupied at present, private patients generally being placed in the separation rooms adjoining the larger wards.

Block C has store rooms on the basement, and on the ground floor a napery and the matron or lady superintendent's living rooms and office. The first and second floors of this block are planned in every respect similar to those of block B, last described.

Block D contains on the basement, store rooms and an out-patients' department consisting of waiting rooms, physicians' and doctors' rooms, bath room, w.c., &c. On each of the ground, first and second floors of this block, there are two wards for 18 beds each, and two separation wards, each for the accommodation of two patients. There are also in this block doctors' and nurses' sitting and bed rooms, and the usual ward offices.

Block E contains on the basement a nurses' dining room and a meter room, the centre portion only being carried down. The ground, first and second floors contain wards and offices somewhat similarly planned to those last described for block D, and containing the same accommodation for patients.

Block F contains on the basement floor the janitor's house, a waiting room for out-patients, and a doctors' consulting room. On the ground floor there is a ward, with the usual attached offices, for the accommodation of eight patients suffering from skin diseases, and also seven bath rooms, fitted with ordinary and spray or needle baths and other appliances. The first floor contains a ward and attached offices for 12 patients also suffering from skin diseases, and there is a circular staircase for access from this floor to the bath rooms on the ground floor last described. The second floor of this block contains attic rooms, but they are only used to store lumber.

Block G contains on the ground, first and second floors respectively a ward for the accommodation of 12 patients, with the usual attached offices. There is no basement here.

Block H is the medical, clinical, and pathological department, and contains a theatre, lecture room, museum, professors' room, mortuary, workshop, and other usual offices.

Block J is the laundry, and in the basement there is a dust house, engineer's shop, and furnace room.

Block K is devoted to the accommodation of those nurses who are being trained in the institution, and is approached from the main building by a covered corridor.

Block L is now in course of construction, and when completed will provide accommodation for 12 patients suffering from erysipelas.

Total Accommodation.—Accommodation is provided ior 388 sick, viz.: twelve wards for 18 beds each, four for 16 each, four for 12 each, one for eight, and fourteen for two each. In addition, there are private wards for the accommodation of 12 patients, and erysipelas wards also for 12 patients.

Water Supply.—The water is supplied by the Town Corporation Waterworks Company, without charge. In the portion of the building first erected there is a slate cistern over each of the blocks of w.c.'s and bath rooms adjoining the main sick wards, and also a cistern for supplying hot water to the heating pipes ; but in the wings lately erected the supply is directly from the mains, and there are only a few small intermediary cisterns, or water waste preventers, to the w.c.'s, &c.

Drainage.—All the drainage is effected by glazed earthenware pipes, carried directly into the town sewers, without disinfection.

Area Covered.—The area covered by buildings is 56,242 feet, being rather more than one-tenth of the site, and 145 superficial feet per bed.

Cost.—The cost of the land was £23,136, or about £60 per bed. The buildings erected to this date, including fittings, laying out the grounds, architect's commission, clerk of works, &c., have cost £97,051, and the erysipelas wards and medical officers' residence are estimated to cost £3,186, so that, when complete, the whole of the buildings will have cost £100,237, or about £258 per bed. The total cost, including the land, will, therefore, be at the rate of about £318 per bed.

Principal Sick Wards.

The two main blocks of sick wards of this building are each planned so as to form the four arms of a cross, the centre or connecting portion of which contains the staircases, nurses' rooms, &c. The end of one arm of each of these blocks connects itself with the central or administrative department, and thus all parts of the main building are, unlike an ordinary pavilion hospital, connected together on every floor. An additional block of sick wards also juts out from the rear of the central building. But for the fact of these sick wards being thus connected together, they are generally planned as ordinary pavilions.

The following details refer more particularly to the wards on the first floor of block E, illustrated at page 44; the other blocks are necessarily in some respects different, but not so in any essential particulars.

Aspect.—The form of the building being that of a double cross, the axes of the wards run in different directions—viz., from north to south and from east to west.

Size of Wards.—Each ward of the double pavilion contains 18 beds, and is 70 feet 6 inches long, 26 feet wide, and 15 feet high. There is a canted recess at one end, eight feet deep. The total superficial floor space is 1,944 feet, or 106 feet per bed, and the cubic contents 29,160 feet, or 1,620 feet per bed.

Bed Space.—The average lineal wall space per bed is 7 feet 10 inches.

Windows.—There are eight windows in each side wall, and the total area of their effective glazed surface is 379 feet, or 21 feet per bed. If, however, the windows situated in the end recesses be taken into consideration, the effective glazed area is 472 feet, or 26 feet per bed. When all the windows are open to their fullest extent, the total area through which air can be admitted by them into the wards is 96 feet, or $5\frac{1}{3}$ feet per bed.

The sashes are generally double glazed, with two thicknesses of 16 oz. or 21 oz. sheet glass. They are generally double hung sash windows, with small casements at the top hung on their lower rails and opening inwards.

The lower ordinary sashes are prevented by a catch from opening to a greater extent than six inches, excepting for the purposes of cleaning, when a special key is used. It is stated, as a reason for this very objectionable method of stopping the main source of ventilating these wards, that a delirious inmate once opened one of the windows and jumped out. Thereupon the objectionable catches were ordered, but it appears to have been overlooked that the windows at the ends of the wards are without these special

fastenings, and the balconies on to which they lead still invite the attention of those having suicidal tendencies.

Warming.—Each ward is warmed with one double open fire-stove, standing centrally between the feet of the beds, and having upright flues running through the ward; they are supplied with fresh air through channels running under the floors, from openings outside the walls. Besides these stoves, there is on the ground floor a hot water circulating heating pipe, running down each side of the ward, and branching off from this pipe, at each of the four end windows, there is a coil of pipes enclosed in a casing, and having a flue for conveying the air heated in this casing to the floor above. On the upper floor the four corresponding windows of each large ward have coils of hot water pipes enclosed in grated boxings beneath them.

Ventilation.—The ventilation of the wards is effected in summer mainly by the windows, which, as before stated, can be opened to the extent of about 5⅓ superficial feet per bed, and in winter by the introduction of fresh air through the central stoves. For outlets there are four openings in each ward, 18 inches square, situated in the upper parts of the walls, and in each corner of the ward. These openings, which are controlled by flaps, are made to communicate, by means of flues, with two large shafts situated in the roof over each block of wards, and these shafts have in each of them a hot water cistern, to assist the extraction of foul air from the wards.

Lighting.—Each ward is lighted with two gas pendants, having four arms with one burner each. No means are provided for carrying off the products of combustion.

Floors.—The flooring of all the wards is of pitch pine boards, four inches wide, grooved and tongued, and polished with bees'-wax, turpentine, and resin, and these boards are carried upon ordinary wood joists and wrought iron girders.

Walls.—The outside walls are of stone, 2 feet 4 inches thick, the interior faces being battened, lathed, plastered, and finished with ordinary papering, and sized and varnished. The walls of the w.c.'s and bath-rooms are tiled with white tiles, 6 inches square.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated at the extreme corners of each pavilion, and they are entered by lobbies from the recess at the end of each ward. No provision is made for heating these offices, and the lobbies are not cross ventilated, but this is an omission only too common in many otherwise well-designed hospital buildings in this, and especially in foreign countries. One of the compartments is divided into a room about 7 feet 6 inches long and 6 feet wide, containing a slop sink and urinal, and adjoining there are two water-closets, each 4 feet long and 3 feet wide. The water-closet apparatus are of the kind known as Bramah's valve closet, and the seats and risers are made of teak. There are three foul air outlets, 10 inches square, in the ceiling, one being directly over each w.c., and one in the centre of the compartment containing the sink and urinal. The slop sink is of glazed stoneware, 1 foot 6 inches diameter, and about 1 foot deep, and the shelf in which it is fixed is covered with copper. The urinal is of earthenware, and fitted with an ordinary water tap. The other compartment is 12 feet long and 6 feet wide, and is fitted up as a bath room and lavatory. The baths are of glazed earthenware or porcelain, manufactured by Messrs. Rufford and Co., of Stourbridge. The lavatories have two white earthenware

basins, sunk in slate slabs, and have hot and cold water laid on to them. The soil pipes, which are enclosed by wooden casings, run down recesses inside the building, and there is a space of about 4 feet 6 inches deep between the floor and ceiling of the bath rooms and w.c.'s, for access to the various pipes.

Separation Wards.—These wards were apparently originally intended as day rooms for the convalescents, but they are now used as separation wards, and some of them are occupied by private patients. They vary somewhat in size, but the average area of each is about 282 feet, or 141 feet per patient, and their average cubic capacity is 4,230 feet, or 2,115 feet per patient.

Day Rooms.—No day rooms are provided, but there is a large open space at the junction of the passages leading to the wards, and this is available as a lounging place for the patients; it does not, however, appear to be made use of for this or indeed any other purpose, probably because, being lighted only by one comparatively small window, it is by no means so cheerful as the ward itself. This space in the opposite wing is partitioned off to form an additional separation ward.

Duty Rooms.—Each large ward has a duty room adjacent to it, of varying size, but the average area of each is 104 feet; they are fitted with ranges, earthenware sinks, and dressers.

Nurses' Rooms.—Adjoining the large wards there are three rooms, having an average area of 100 feet each, and one with an area of 165 feet. These rooms are used indiscriminately as nurses' bed rooms and sitting rooms, and in some cases as a doctors' instrument room or a bath room. There is also on each floor a room that is in some cases used as a lumber or store room, and in others as a bath room. The appropriation of these small rooms varies very much. There are no inspection windows for overlooking the wards.

Lifts.—Adjoining one of the nurses' rooms, and entered from the corridor, there is a room which gives access to the lifts. There appears to be no other special use for this room, but it is made use of as a depository for all kinds of ward utensils. The lifts are each 4 feet 6 inches wide and 7 feet 6 inches long, and rise from the basement floor; they are worked by hydraulic power directly from the water company's mains.

Staircases.—The staircases of each set of four pavilions occupy an area of 481 feet, and are constructed with stone spandril and moulded steps, tailed into the walls, and carried on cast-iron moulded girders. The landings and all the corridors are of oak, polished with bees-wax, turpentine and resin. The steps are six feet long, with a tread of twelve inches and a rise of six inches.

Basement.—There is no basement to the pavilions last erected, and more particularly referred to in the foregoing description, but in the opposite wing the lower floor, owing to the fall of the site, is to a great extent level with the ground, and is occupied by the out-patients' department, dispensary, janitor's house, stores, and other offices; it is ten feet in height.

Total Area of Pavilions.—The total area covered by the principal floor of the four sick wards just described is (including the surrounding walls) 14,169 feet, or about 208 feet per bed.

·Norfolk·&·Norwich·Hospital·



Edw^d Boardman del

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NORFOLK AND NORWICH HOSPITAL,

NORWICH—ENGLAND.

THIS institution is said to have been founded in the year 1771, and the old buildings, greater part of which are now removed, were erected about the same period. In comparison with other hospitals erected prior to 1880, it was a remarkably well-planned structure; but the wants of an increasing population had outrun the capacity of the building, and overcrowding ultimately reached to such an extent that "during the ten years, 1865-74, there had been an increasing tendency to fatal pyæmia among the surgical cases, and during the year 1874 a tendency to fatal erysipelas in the same class had been added, a condition of things that would, if persistent, almost of necessity give rise sooner or later to an unmanageable intensity of traumatic atmosphere."* Under these circumstances, it is not to be wondered at that a determination was come to by the Governors to make an alteration at any cost. As a first step, the advice of Captain Douglas Galton, Architect of the Herbert Hospital (then the best one existent), was asked as to the plan to be adopted for altering and enlarging or rebuilding the structure. Captain Galton made a very careful examination of the premises, and sent in an elaborate Report, containing suggestions few of which have been acted upon.

Mr. Edw. Boardman, F.R.I.B.A., was then requested to prepare plans for adding to and adapting the old hospital; these after great scrutiny by the medical men and other authorities, were approved by the Governors, and on the 20th November 1876 a meeting was held at St. Andrew's Hall, presided over by the Earl of Leicester, and attended by the Prince and Princess of Wales, and most of the nobility and gentry of the county and city, for the purpose of raising funds for carrying it out. At this meeting the Earl of Leicester announced his intention of giving £11,000 (since augmented by his lordship to £15,000) as a sustentation fund conditionally upon the public building an entirely new hospital, instead of altering the old one. No decided step seems, however, to have been taken until the following year, when the late Mr. T. H. Wyatt, Past President of the Royal Institute of British Architects, and Architect to Middlesex Hospital, was requested to associate himself with Mr. Boardman in preparing designs for the new buildings. These gentlemen suggested two different schemes, which were submitted to Dr. F. de Chaumont, Professor of Military Hygiene at the Army Medical Schools, Netley, for his opinion as to the merits of each. Ultimately, in June 1878, it was decided to carry out the work in the manner shown upon the accompanying plans, and on July 17th 1879 the foundation stone was laid by His Royal Highness the Prince of Wales, in the presence of many of the nobility; the Earl of Leicester, K.G., President of the hospital; the Lord Bishop, Vice-President; the Mayor of the city, Mr. H. Bullard;

* "*Report on the Sanitary Condition of Norfolk and Norwich Hospital.*" Mr. Netten Radcliffe. 1875.

the Sheriff, Mr. D. Steward; the Chairman and Vice-Chairman of the Board of Management, Mr. H. W. Edwards and the Rev. Canon Heaviside; the Chairman of the Building Committee, the Rev. Canon Copeman; the Architects, the Medical Staff, and other local celebrities. Mr. Wyatt, who had then been for some time in very bad health, did not live to see the completion of the enterprise, and at his death, in August 1880, the work was and is still being carried out by Mr. Boardman, to whom, and also to Mr. Matthew Wyatt, I am much indebted for the facilities afforded me in gathering together the following details of the structure.

The central administration block and the south-west pavilion having been completed, these portions of the building were formally opened by the Mayor of Norwich, Mr. S. Grimmer, on the 30th June 1881. The key, together with a Report of the work so far as completed, was handed over by the Chairman of the Building Committee to the Chairman of the Board of Management, Mr. Humfrey Mason, and the ceremony was attended by the Sheriff, Dr. Eade; the Dean of Norwich; the Rev. Canon Copeman, Chairman of the Building Committee; the Architect, Mr. Boardman, and other distinguished citizens.

Since then the further execution of the design has been continued, and it is hoped that it will be entirely completed and occupied in the early part of 1883.

The following "Remarks and Suggestions," extracted from Dr. F. de Chaumont's Report, previously referred to, contain much interesting and useful advice as to the leading principles to be observed in the construction of hospitals:—

"I venture to append a few remarks and suggestions for the consideration of the Committee, believing it to be their desire that I should do so.

"I propose to touch upon the following points:—

"I. The construction, ventilating, and warming of the general wards.
"II. Ditto, of the operating block, and of the smaller wards round the theatre.
"III. Ditto, of the isolation wards.
"IV. The ventilation of the out-patient department.
"V. Ditto, of the chapel.
"VI. Ditto, of the nurses' apartments.
"VII. On the laundry and disinfection arrangements.
"VIII. The drainage.
"IX. The periodical evacuation of the wards.
"X. Sanitary supervision.

"1. Construction, ventilating, and warming of the general wards. The wards are to be for 24 beds, each patient to have about 108 square feet of floor-space. This is a fair amount, but not excessive when surgical and medical cases have to be placed together. It would be desirable to leave a vacant bed in the neighbourhood of any serious surgical case, where circumstances admit, in order to increase the floor-space.

"The breadth of the ward ought certainly not to exceed 26 feet, as the difficulties of ventilation, especially perflation, are thereby increased.

"The height of the wards is an important question. It is proposed to make it 14 feet, which, with 108 feet of floor-space, would give 1,512 feet of cubic space. In my opinion, nothing is gained by making the height greater than 12 feet, indeed, in some directions it is a distinct disadvantage, as it increases the difficulties in the way of ventilation and warming. A notion prevails that lofty rooms are advantageous, and they are so under certain limitations. Thus, in tropical climates, or in extremely hot weather in this country, they give a larger mass of air, and so favour coolness; also in large buildings, such as churches, meeting halls, &c., which are to be occupied for only a short time (a couple of hours, say), height is advantageous, as it supplies a store of fresh air where proper ventilation is difficult of accomplishment. But if a space is to be occupied continuously, like a ward of an hospital, that is, if it is to be in occupation beyond a couple of hours, the size of the space becomes a matter of indifference, so far as any value is to

be got out of it for ventilation purposes. The following Table illustrates this. The results are compared as calculated in spaces of 1,200 and 1,400 cubic feet, each having one inmate, and an hourly supply of 4,000 cubic feet of fresh air. A similar calculation is added for a cubic space of 10,000 (ten thousand) cubic feet, occupied by one inmate, and with the same supply of air per hour, namely, 4,000. The impurity is stated in terms of carbonic acid (CO_2) per 1,000 volumes over and above what the incoming fresh air normally contains.*

Hours the Air-space has been occupied.	Size of Air-space = 1,200 cubic feet.	Size of Air-space = 1,400 cubic feet.	Size of Air-space = 10,000 cubic feet.
1 hour	0·144650	0·141580	0·04948
2 hours	0·149810	0·149500	0·08260
3 ,,	0·149990	0·149970	0·10480
4 ,,	0·149999	0·149998	0·11970
5 ,,	—	—	0·12970
6 ,,	—	—	0·13640
10 ,,	—	—	0·14725
15 ,,	—	—	0·14963
20 ,,	—	—	0·14995
24 ,,	—	—	0·14999

"REMARK.—The limit to which all are approaching is 0·150; the differences in the smaller spaces become rapidly inappreciable, so that the numbers have been omitted after the fourth hour.

"This is on the supposition that diffusion of the vitiated air is uniform; if it be not uniform the case is rendered, if possible, worse, for it then argues a stagnation of air and a continually increasing impurity in some part of it; that part is usually the upper part in a lofty room, and this will always be the case unless there be ventilating openings at the top, either in the ceiling or at the top of the walls. Such a space of stagnant air is favourable for the retention of organic particles, which may at any time be sent into the breathing space of the room, to the danger of the occupants. Therefore, although with care it is possible to keep a lofty ward in good condition, it becomes much more difficult, and the difficulty is not counterbalanced by any material advantages. From the foregoing table it may be seen that there is practically no difference in favour of 1,400 over 1,200 cubic feet, for, if we stop, as is usually done, at the third decimal place, the conditions are identical at the end of the second hour. Even in the exaggerated case of 10,000 cubic feet of space per patient, the conditions are practically the same after 10 hours, that is, one night's occupation, and absolutely the same after 15 hours.

"When, therefore, we take into account the increased difficulty of warming, and the greater cost of construction, there seems little or no advantage to be gained by passing a certain limit in height. We must, however, look at the limit from another point of view, namely, the practicability of ventilation. We can hardly hope to change the air much oftener than three times in the hour, and as 4,000 cubic feet is the minimum that ought to be given hourly in hospitals, the third of this, or 1,333 cubic feet, ought to be provided as air-space per head. Now, if the floor-space be 108 square feet, this would argue a height of 12.35 feet, or 12½ feet would give 1,350 cubic feet, which multiplied by 3 would yield 4,050 cubic feet; this slight margin would allow for the space occupied by the furniture and the inmates themselves. I do not, therefore, see any necessity for raising the wards beyond this height, certainly not beyond 13 feet. On this question I may point out that Captain Galton in his Report (page 7, line 31), has also put 13 feet as a limit which need not be passed. I hope I have shown reason for not going beyond this, because the acceptance of this principle will prove, I believe, more convenient in practice, and will save some considerable outlay in the original construction.

"As regards *means* of ventilation, it ought to be remembered that in cold weather in this country, warming part of the air is necessary, if a sufficient supply is to be brought in for sanitary requirements. For this purpose, air brought in directly from without over coils of hot-water pipes is the best for a large ward. Heated air brought through basement stories is always unsatisfactory, and seldom pure. As regards outlet, if a number of Sheringham valves be provided close to the ceiling, these will act very well; or they may be supplemented by extraction shafts at the corners, as suggested in Captain Galton's Report. But in

* The formula from which this table is calculated is $\frac{3}{20}\left(1 - \epsilon^{-\frac{4000h}{c}}\right)$, where ϵ is 2.718, h = the hours of occupation, and c = the size of the air-space.

the upper-storey wards the opportunity may be taken to have central extraction through the ridge of the roof, by three or four openings in the ceiling, communicating with shafts surmounted by extraction cowls. The lighting of the wards by gas may also be adapted, by means of sunlights, to aiding the outgoing current. One thing to be remembered is that the upper storey must have more proportional ventilation opening than the lower—in the ratio of about 5 to 4—so that, if a total of 72 square inches per head be allowed on the ground floor, 90 ought to be allowed on the upper floor. These numbers include outlet and inlet area.

"The advantages of impermeable floors, walls, and ceilings so as to obviate the necessity of constant scrubbing, and to admit of immediate drying when scrubbing is resorted to, are sufficiently obvious.

"II. The operating block ought to be connected by means of a short corridor, at right angles to the main corridor, as shown in the amended plan of B.

"The theatre ought to be ventilated by means of ceiling outlets, with fresh air brought in below, warmed in winter. Perhaps the best plan would be to provide perpendicular tubes (such as those known as Tobin's), which would supply air continuously, whilst the place could be warmed with hot water when required.

"The small wards ought to be arranged so as to admit of a constant supply of not less than 5,000 cubic feet of air per head per hour. A floor-space of 140 square feet, and a height of 12 feet, would give a cubic space of 1,680, and this changed three times in the hour would supply 5,040 cubic feet of fresh air. In surgical cases it is not unfrequently desirable to have even more than this, and this can be accomplished if the air be warmed. These wards, not admitting of cross windows, ought to have perpendicular tubes brought to the inside walls, so as to ensure a supply of air on all sides. Two tubes, each 25 square inches in sectional area, ought to be supplied for each inmate. Besides the chimney, an outlet shaft might be carried up through the roof.

"III. The isolation wards would be treated on similar principles, but a floor-space of not less than 150 square feet should be given, and 120 square inches of outlet and inlet opening.

"In every case it ought to be be laid down as a principle that fresh air is not to be sacrificed to considerations of temperature, except of course in very extreme and exceptional conditions. Most cases do well at comparatively low temperatures; and extra covering, if general means of warming should fail, is much more advisable than the closing up of ventilators.

"For the smaller wards the use of a 'Calorigen' would probably be convenient for combining warmth and ventilation.

"IV. The ventilation of the out-patient rooms is of great importance. I have tested the air in such places during the time of occupation and found the amount of impurity to be excessive, producing a condition of matters offensive and injurious to both doctor and patient. The proposed out-patient room may be ventilated by providing outlets through the roof, and inlets in the form of perpendicular tubes. Of these I should propose about 20, each about 7 inches square, or 8 inches in diameter if circular; the room of course to be warmed sufficiently, either by fires or by hot-water pipes.

"V. It is of importance to secure the warming and *ventilation* of the chapel. This may be done by roof outlets, with fresh air brought in over hot-water pipes, or with perpendicular tubes delivering cold air into the warmed building.

"VI. For the comfort and health of the resident medical officers, pupils, nurses, &c., I would recommend the plan of Tobin for ventilating the sleeping rooms, viz., cutting a hole between the two sashes of the windows, so as to allow a current of air to come in vertically while the window is shut. This plan is well adapted to ordinary rooms.

"VII. I would call attention to the necessity for very great care with regard to the laundry and disinfection chamber. The most complete separation between the foul and clean linen ought to be secured. It seemed to me that this was not satisfactorily accomplished as regards the disinfection chamber when I visited it, and I called the attention of the members of the committee present to the fact.

"VIII. I presume care will be taken to secure a perfect system of drainage, including thorough ventilation of soil-pipes, the emptying of sink-pipes, bath-water pipes and rain-water pipes freely in the open air over gratings, and as complete disconnection as possible between the house and the drains.

"IX. It is most desirable that every ward in the hospital should be periodically evacuated and left empty for some time, at least a month in the year. During that time cleaning could be carried on, as well as the freest perflation of air. As I believe it is contemplated not to fill all the wards at once, this plan may be easily carried out.

"X. Lastly, I beg to call attention to the necessity of responsible sanitary supervision. This is cogently urged by Mr. Netten Radcliffe in his Report, and I am glad to add my testimony in support of its necessity."

It will be noted as singular in the following detailed description of the building that the points most urged upon the Board of Management by both Captain Galton and Dr. F. de Chaumont have been ignored in the actual construction of the building.

Site.—The buildings stand upon nearly the highest ground surrounding the city of Norwich. The main front faces the Newmarket Road, but all other sides are at present bounded by open gardens, excepting on the north side, where there are a number of small cottages. The extent of the site is about 233,194 superficial feet, or 5 acres 1⅔ roods, being about 1,070 superficial feet per bed.

Subsoil.—The subsoil is principally a loamy gravel, intermixed with occasional veins or patches of clay.

General Arrangement.—The plate at page 54 shows, by a block plan, the general arrangement of the buildings upon the site, also a plan of the principal floor of one pavilion, and detailed plans and sections of the ward offices; a perspective view of the exterior of the building is also illustrated.

The principal entrance to the establishment is from the Newmarket Road; there is no porter's lodge. The building is entered through Block A, and this portion of the building contains upon the ground floor a secretary's office, porter's office, visitors' waiting room, board room, library and surgery, and, adjoining the main connecting corridor, a dispensary and matron's store rooms. A large and well-lighted hall is placed in the centre of this block, and is available as a general waiting room for patients and others. On the basement floor, immediately beneath the large waiting hall, there is a kitchen, and surrounding it the scullery, stores, servants' hall, and other usual domestic offices. This kitchen is both lighted and ventilated by a large shaft, about nine feet square, carried upwards from the centre of the ceiling through the large waiting hall above, and terminated with a glazed lantern light. There are two windows, opening on to small areas, at one end of the kitchen, but the principal light and ventilation is obtained through the shaft here described. Leading right and left from this kitchen there are two corridors, communicating with the pavilions on either side, chiefly for the purpose of conveying food to the lifts. This is an objectionable feature in the plan of the building. Leading off these corridors, and on either side of the kitchen, there are two chambers containing apparatus for heating water for the baths, lavatories, &c., and also for warming the wards and other offices. The front portion of this Block A is carried up to form first and second stories, the rooms of which are devoted to the use of the house surgeon, matron, and other officials and pupils.

Block B is one storey only in height, and contains the operating theatre, with three adjoining wards for two patients each and three for one each, also a duty room, nurses' room, bath room, and other usual offices.

Block C is a double pavilion, two stories in height, and contains, on the ground and first floors respectively, two large wards for the accommodation of 24 patients each, and two separation wards for two each. The central portion of this building is carried up to form a third storey, containing two separation wards for two and one for three patients each.

Block D is also a double pavilion, two stories in height, containing two large wards for 24 patients each, two for 17 each, and four separation wards for two each. The

central portion of this building is carried up to form a third storey, similar to that of Block C, but the rooms are used as dormitories for the domestic servants.

Block E contains on the ground floor a nurses' dining hall and a chaplain's room, and on the basement a patients' bath room.

Block F is a chapel.

Blocks H, I, K and M comprise the only remaining portions of the old hospital.

Block H has been adapted on the ground floor to the purposes of an out-patients' department, with surgeons' and physicians' rooms, a dispensary, and a museum. The first floor is divided into nurses' dormitories, with a day room, kitchen, and other offices.

Block I contains on the ground and first floors four isolation wards, with nurses' dormitory, duty room, and other attached offices.

Block K is the mortuary and post-mortem room, L is a carriage shed, and M out-houses, N is the laundry, and O a disinfecting closet.

Total Accommodation.—The total number of patients provided for is, therefore, 218—viz., six wards for 24 patients each, two for 17 each, one for 3, 17 for 2 each, and three for 1 each.

Connecting Corridors.—The central administrative block and the two main pavilions are connected together by corridors x x on plan, 10 feet wide and 10 feet 6 inches high; the roofs form a means of open air communication between the pavilions, and ambulatories for the use of the patients. The corridors throughout the buildings are heated by coils of hot-water pipes. The floors of the ground storey are paved with blocks of pitch pine, 3 inches square and 18 inches long, laid in diagonal patterns upon concrete and bedded in hot tar; a bordering next the walls is formed with Staffordshire coloured tiling.

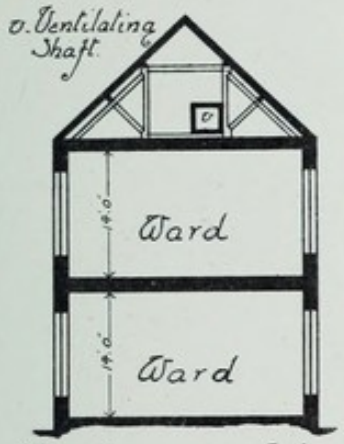
Water Supply.—The water used in this establishment is supplied by a water company; all the outside pipes are of iron, but inside they are of lead.

Drainage.—The drainage of the various buildings is effected by means of three 12-inch earthenware main drains, connected with the city sewers, but intercepted near the boundary of the building by traps having open man-holes for access and ventilation; two of these main drains are connected to the furnace chimney shaft, with a view to the extraction of any foul air. There is in each pavilion a flushing cistern, capable of holding 200 gallons, connected to each end of the main drains, so as to thoroughly scour them out when desirable. Lamp and inspection holes are provided at all suitable parts, and the architects believe that every precaution has been taken to make the system perfect.

Area Covered.—The area covered by buildings is 51,640 feet, or nearly a quarter of the site, and about 237 feet per bed.

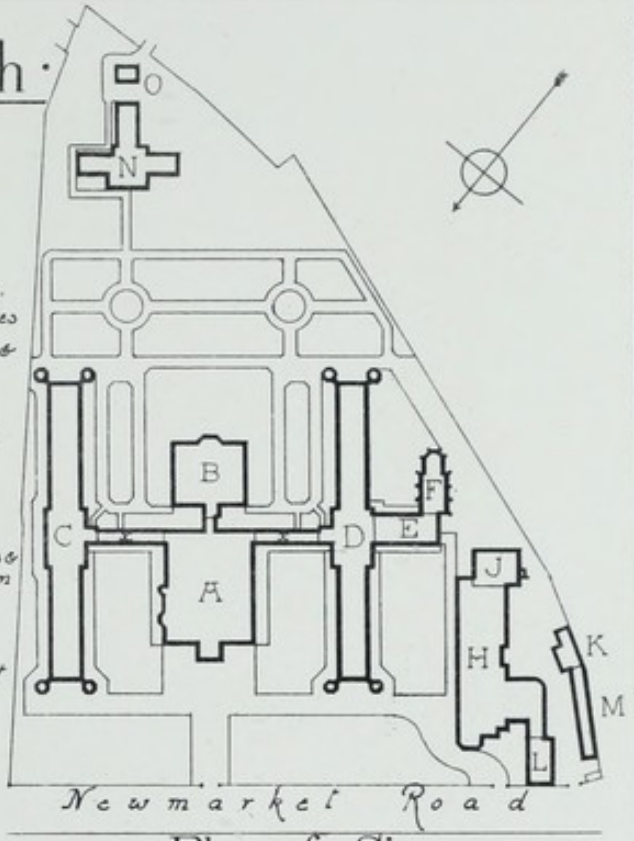
Cost.—The value of the land is estimated at £10,000, or about £46 per bed. The buildings are not yet completed, and the cost of them cannot, therefore, be stated exactly, but the architect estimates that it will not exceed (including the laundry, which was erected some years since) £54,000, or about £248 per bed. It should, however, be borne in mind that part of the administrative and the out-patients' department consists of old buildings. The land and buildings together will therefore cost, according to the architect's estimate, £294 per head.

Norfolk and Norwich Hospital

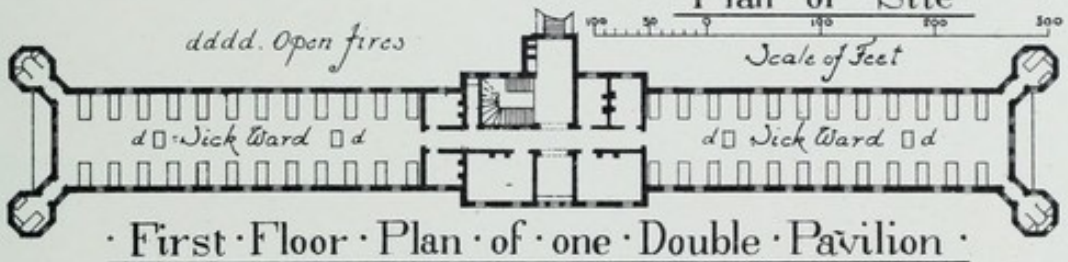


Section on Line AB

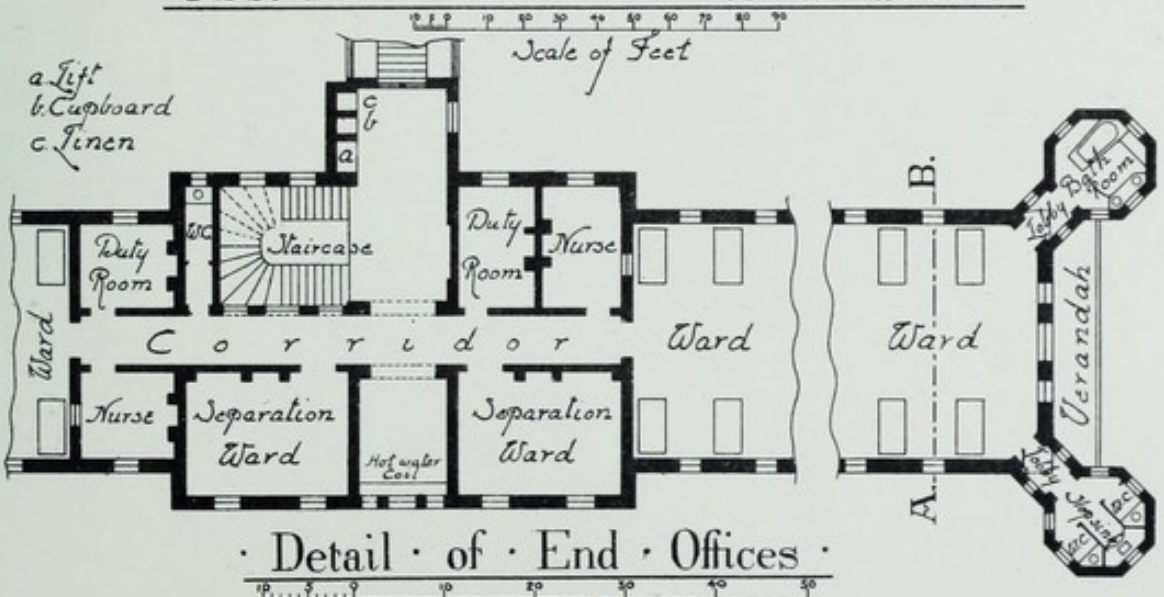
A. Administrative Offices
B. Operating Theatre & Wards
C.D. Sick Wards
E. Nurses Dining Hall
F. Chapel
J. Isolation Wards
H. Out-patients Nurses &
L.M. Sheds Museum
K. Mortuary
N. Laundry
O. Disinfecting Closet
x.x. Connecting Corridors



Plan of Site



First Floor Plan of one Double Pavilion



Detail of End Offices

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del

Principal Sick Wards.

The following description refers more particularly to the wards on the upper floor of Block C, illustrated at page 54 :—

Aspect.—All the pavilions run from north-west to south-east, so that the windows of the wards face north-east and south-west.

Size of Wards.—The large wards are of parallelogram shape; they each contain 24 beds; their extreme length is 100 feet, their width 26 feet, and their height 14 feet. The superficial floor space of each, after allowing for the canted ends, is 2,591 feet, or about 108 feet per bed, and the cubic contents 36,274 feet, or 1,511 feet per bed.

Bed Space.—The average lineal wall space per bed is 7 feet 10 inches, the entrances to the towers at the ends being deducted.

Windows.—There are nine windows in each side wall, and their total effective glazed surface is 305 superficial feet, or 12¾ feet per bed. If, however, the end window be taken into account, the effective glazed surface is 367 superficial feet, or 15¼ feet per bed. When the windows next the beds are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 147 feet, or 6⅛ feet per bed; but if the end windows be added, this area is increased to 204 feet or 8½ feet per bed. The windows next the beds are each divided into two heights by a wooden transom. The upper part consists of a sash hung upon its lower rail, and opening inwards to the extent of about five inches at the top; the lower part is an ordinary deal-cased sash and frame. The two side windows in the end wall of the ward are similarly constructed, but the lower part of the central window is a folding casement opening on to a verandah. All sashes are glazed with 21-ounce sheet glass.

Warming.—Dr. F. de Chaumont advised in his Report that air should be brought into the wards "directly from without, over coils of hot water pipes," and Captain Douglas Galton recommended the use of open "ventilating fire-places." In this case it was deemed advisable to follow the advice of these gentlemen, and, in consequence, it was determined by the authorities to warm the principal wards by means of two double "Thermhydric Hot-water Grates," inasmuch as these apparatus combine in their construction the above desiderata. See page 62.*

Ventilation.—The ventilation of the wards is in principle similar to that of St. Thomas's Hospital, previously described. The water-closets and bath rooms in the angle towers are separately ventilated, by means of coils of hot water pipes placed in chambers beneath the louvred turrets which crown each roof, and an upward current is thus induced through the flues which rise into these chambers from the floors below. The outer air is admitted through gratings, first into casings formed between the brickwork and the panelled window backs, and then into the rooms through "hit or miss" gratings fixed in the wooden capping over these casings.

Lighting.—Each of the wards is lighted at night by two sunlights, having ventilating tubes, which rise upwards through the ceiling, and then travel horizontally to flues in the side walls; they no doubt act, when lighted, as powerful additions to the other contrivances provided for the removal of foul air from the wards.

* Also, *Charitable and Parochial Establishments.* London, 1881.

Floors.—The flooring of the upper wards is constructed with wrought-iron joists and concrete, but that on the ground floor consists of timber joisting laid on two sleeper walls, which run longitudinally down the centre, and so form a passage-way, four feet wide, for the conveyance of the hot and cold water pipes running to the offices in the angle towers at the ends of the buildings. The finished surfaces of the floors are formed of pitch pine tongued and grooved battens, 1¼ inches thick and 5 inches wide, stained, beeswaxed, and oil polished; the ceilings are plastered.

Walls.—The outer walls of the wards are built throughout with brickwork 18 inches thick, finished on the outside with red bricks and Bath stone dressings. The interior faces, to a height of 4 feet 6 inches above the floors, are rendered with parian cement, and the remainder with ordinary plastering, prepared for painting.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated in towers which jut out from the angles of the extreme ends of each pavilion; these towers are separated from the wards by cross-ventilated lobbies, about four feet square. The arrangement of these offices shows a marked improvement upon that of many other hospitals illustrated in this work, and is well worthy of study. They are warmed with coils of hot water pipes, and the temperature can always be kept higher than that of the adjoining wards; consequently, the tendency is rather that air shall be drawn from the ward than that it should flow in an opposite direction; then the arrangement for drawing off any vitiated air, as previously described under the head of "ventilation," is very satisfactory. The tower on the left hand side of each ward forms on each floor a bath room, and is fitted with a "Rufford's" porcelain bath and two enamelled iron lavatory basins fixed in slate shelves; the area of this room is about 84 superficial feet. The tower on the right hand side contains on each floor two somewhat irregularly shaped water-closets, 3 feet 4 inches wide, and an average length of 4 feet, fitted with "Dodd's" patent white earthenware pans and traps and plain deal seats; there is also a compartment in the centre, fitted with "Beard and Dent's" enamelled iron slop sink, 14 inches square, with shelves on each side for the bed-pans. The partitions dividing the various compartments are about seven feet high, and it is worth noting that the lower parts of these stand four inches above the floor, so that the air will more readily circulate around them. All the soil pipes are of lead, and are carried down the inside of the walls of the buildings, and they are open at the top, above the level of the eaves, for the purpose of ventilating them.

Verandah.—The casement windows at the ends of the wards open on to verandahs, 5 feet wide and about 25 feet long, intended for use as lounging places for the patients when the weather is suitable, but, as I have pointed out in another instance, they are in too close proximity to the water-closets to be commended.

Separation Wards.—There are two separation wards on each floor, situated in the centres of the double pavilions. Each one is intended for the accommodation of two patients, and has an area of 243 square feet, and are 14 feet high, so that the occupants of them would each have about 122 superficial and 1,702 cubic feet of air-space.

Duty Rooms.—The nurses' duty rooms have each an average area of 107 feet, and they are fitted with gas cooking ranges and hot closets.

Nurses' Rooms.—In addition to the duty rooms, and adjoining each large ward, there is a nurse's room, having an average area of 107 feet.

Lifts.—Each double pavilion is provided with a food lift, 4 feet long and 2 feet 9 inches wide, which descends to the subway situated in the basement; there is no bed lift for the use of the patients. At the side of each of the food lifts there is a cupboard for the temporary deposit of dust, &c.

Staircases.—The pavilion staircase, in the wing first built, occupies an area of 332 feet, and is constructed of teak, on ordinary timber carriages. The treads are 4 feet 6 inches long and 12 inches wide; the rise is 6 inches The staircase of the pavilion now being erected to the right of the main entrance descends to the basement, but that to the left, first built, does not do so.

Total Area of Pavilions.—The total area covered by each floor of the double pavilion just described, including the surrounding walls, is 8,924 feet, or about 172 feet per bed.

ST. MARYLEBONE INFIRMARY,

NOTTING HILL, LONDON.

THIS Infirmary was erected for the accommodation of the sick poor of the Parish of St. Marylebone. The foundation stone was laid July 7th 1879, by Mr. Edmund Boulnois, M.A., Chairman of the Board of Guardians, and on June 29th 1881, rather less than two years afterwards, it was formally opened by their Royal Highnesses the Prince and Princess of Wales, in the presence of a large and distinguished assembly.

Being the architect of the building, I cannot well say much as to its merits or demerits, beyond stating that the details of it embody to a great extent, and so far as the limited means at my disposal would permit, the result of previous experience in the design and erection of five other large Metropolitan Infirmaries, and that the inducement to give it a place amongst these memoirs arises from the high commendations passed upon it by some of the most eminent authorities upon the subject of hospital construction. It must not, however, be supposed that I consider it to represent the model of a perfect hospital building: the limited extent of the site would alone render this impossible; nevertheless, it is allowed to be "the most perfect building of its kind yet erected."

Workhouse Hospitals contain a large proportion of patients suffering from maladies of a non-acute character, though surgical cases and indeed all classes of diseases (other than those of an infectious character) are admitted; the proportion of these is, however, so small as compared with those in ordinary hospitals, that the average area and cubic space per patient is made much less.

It would not, however, appear that this reduction in the size of the wards makes a proportionately large difference in the first cost, for the extent of the ward offices, and of the administrative departments of the building generally, are necessarily the same in both. The actual cost of erecting this building, for example, was at the rate of £161 per bed; but had the wards contained 1,200 instead of 936 cubic feet per bed, the total cost of the whole would not have been increased by more than £10,000; that is to say, it would have been £175 instead of £161 per bed.

Site.—This building is situated in one of the western suburban districts of London, near to the Ladbroke Grove Road, Notting Hill, in the parish of Kensington. At the present time it is surrounded by open fields, excepting on the eastern side, where it is separated by a road from the end houses in Rackham and Treverton Streets. According to the original plan of laying out the adjoining ground, public roads were to have run down either side of the northern and southern boundary, but since the occupation of the building the road and a piece of land on the southern side have been purchased and added to the site, and it is possible that a similar improvement may be made upon the northern side. It is much to be regretted that this additional ground was not acquired in the first instance, as the planning of the building could have been much improved and especially so by placing the pavilions at a greater distance apart than they are at present.



Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

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The fall of the ground from the south-east to the north-west corners of the site is nearly 15 feet, and, in consequence, the ground floors of the western pavilions are at a lower level than those on the eastern side.

The original extent of the site was 140,225 superficial feet, or 3¼ acres nearly, being about 188 feet per bed; but now that more ground has been purchased, the area per bed is about 264 feet.

Subsoil.—The subsoil is of brick earth, overlying the London Blue Clay, but every part of the site has been well drained.

General Arrangement.—The general disposition of the buildings upon the site, and detailed plans of the principal sick wards, are shown upon the accompanying plate, page 60, and a perspective view of the exterior is also illustrated at page 58.

The principal entrance to the main building is through the centre of the block marked A on the plan of site. This building contains on the left of the central roadway the medical officers' residence, and on the right the residences of the matron and the assistant medical officer. Immediately over this central gateway and entrance there is a chapel for the use of the officers and convalescent patients.

Block B contains on the basement floor the helpers' and men-servants' dining rooms, coal and beer cellars, and on the west side, which is level with the garden, the nurses' dining and recreation rooms and library, and a servants' hall; on the ground floor an entrance and waiting hall, male and female reception wards and bath rooms, dispensary and drug store, committee room, matron's office and stores, steward's office and stores, kitchen, scullery, bakehouse and larders; the first floor is entirely occupied by the nurses' bed-rooms.

Block C contains on the basement a furnace, engine and well room; the engineer's residence is situated at the west end of this block; on the ground floor there is a large store for patients' own clothing, a disinfecting closet, and a store for clean linen when brought from the laundry above. At the east end of this block there is a mortuary and post-mortem room, entered from the outside, and separated from the main building by an open court; on the first floor there is a laundry with drying horses; on the second floor an open drying ground surrounded by arched openings, and the third and top floor a wash-house and laundry.

Blocks D D D D each contain on their ground, first, and second floors, six sick wards, each for 28 beds, with attached offices, as described in detail hereafter, and nine separation wards for the accommodation of two patients each.

Block E is a porter's lodge, which has been erected since the purchase of the additional ground. The porter's lodge originally formed part of the entrance, Block A.

Block F is a nurses' home, and consists of 38 private apartments and a lecture hall.

Total Accommodation.—Provision is thus made for 744 inmates—viz., 36 wards for two beds each, and 24 wards for 28 beds each.

The following detailed account of the space allotted to each of the various offices of this institution may possibly be useful to the designers of workhouse hospitals to be erected in the future:—

Pavilions Generally.

	Area in feet.
24 wards, each for 28 beds, and each	2,016
36 separation wards, each for 2 beds, and each average	200
6 day-rooms	520
4 day-rooms	514
4 ,, ,,	202
24 nurses' duty-rooms, each	203
24 bath rooms	58

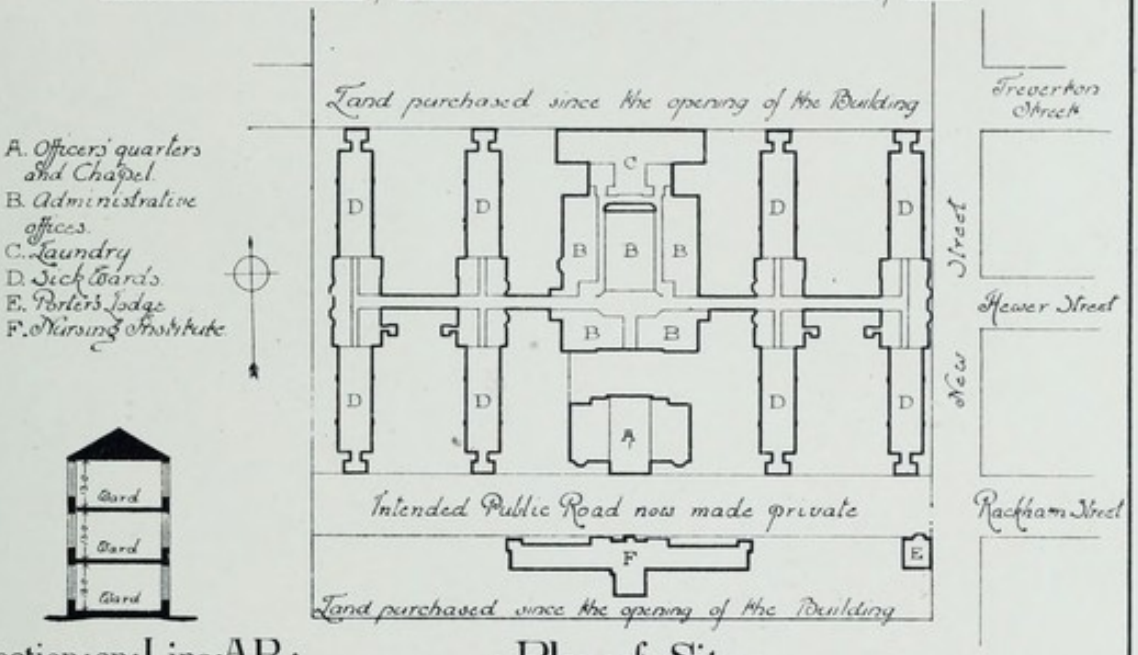
Administrative Offices.

	Area in feet.
Vestibule	250
Entrance hall and waiting-room	1,080
Porters' office	270
Two receiving wards for males and females each	347
One bath-room and w.c. to each, and each	165
Chapel (over entrance gateway) to seat about 230	1,800
Vestry (with w.c., lavatory, &c.)	240
Committee room	775
,, ,, w.c., lavatory, &c.	
Dispensary	617
Matron's office	195
Steward's office	178
Medical officers' consulting room	195
,, ,, drawing-room	395
,, ,, dining-room	348
,, ,, breakfast-room	348
,, ,, study	207
,, ,, kitchen	270
,, ,, scullery	113
,, ,, larder, coal and wine cellars	161
,, ,, bed-room	282
,, ,, ,,	230
,, ,, ,,	196
,, ,, ,,	143
,, ,, ,,	109
,, ,, bath-room	91
,, ,, w.c.'s and china closet, &c.	
Assistant medical officers' sitting-room	250
,, ,, ,, bed-room	213
,, ,, ,, kitchen	95
,, ,, ,, bath-room, w.c. and sink	90
Matron's sitting-room	270
,, bed-room	218
,, ,,	99
,, kitchen	123
,, bath-room, w.c. and sink	90
,, larder, coal store, cupboard, &c.	
Dispenser's sitting-room	152
Additional officers' sitting-room	246
,, ,, bed-room	246
Engineers' living-room	235
,, kitchen	170
,, scullery	55
,, pantry, coals, w.c., &c.	
Engineers' bed-room	232
,, ,,	152
,, ,,	80
,, ,,	54
29 Nurses' rooms, each (average)	100
4 ,, ,,	120
10 ,, ,,	133
2 ,, ,,	150
2 ,, bath-rooms, w.c.'s, and sinks, each	77
General kitchen	1,840
Scullery	330
Bakery	240
Servants' hall	425
Officers' recreation room	621
,, mess ,,	613
,, reading ,,	425
,, cloak room, lavatory, w.c.'s	137
,, scullery	105
Female helpers' dining-room	500
,, sitting-room	500
Male officers' dining-room	300
Store-rooms, larders, &c.	3,663
Inmates' clothing store	544
General coal-cellar, with two lifts for raising coals to ground floor	3,840

Laundry, &c.

Receiving room	492
Wash-house	1,625
Officers' wash-house	492
Drying-room, with horses	475
Covered drying ground	2,055
Ironing and folding room	1,580
Clean linen store and delivery room	432
2 Lifts and shoots for raising and lowering clothes	
Laundresses' living-room	180
,, bed-room	110
Workshop	426
Engineers' shop and boiler-room	1,570
Engine-room	287
Artesian well and pump-room	286
Furnace coal-cellar	470
Disinfecting closet and ante-room to ditto	426
w.c., dust-hole, &c., &c.	
Dead-house	291
Post-mortem room	217
Gardeners' tool shed	35

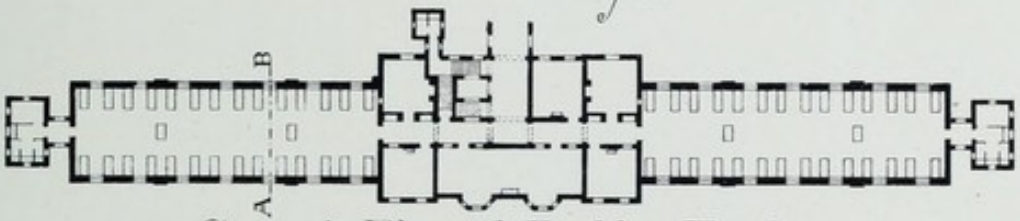
St. Marylebone Infirmary.



Section on Line AB

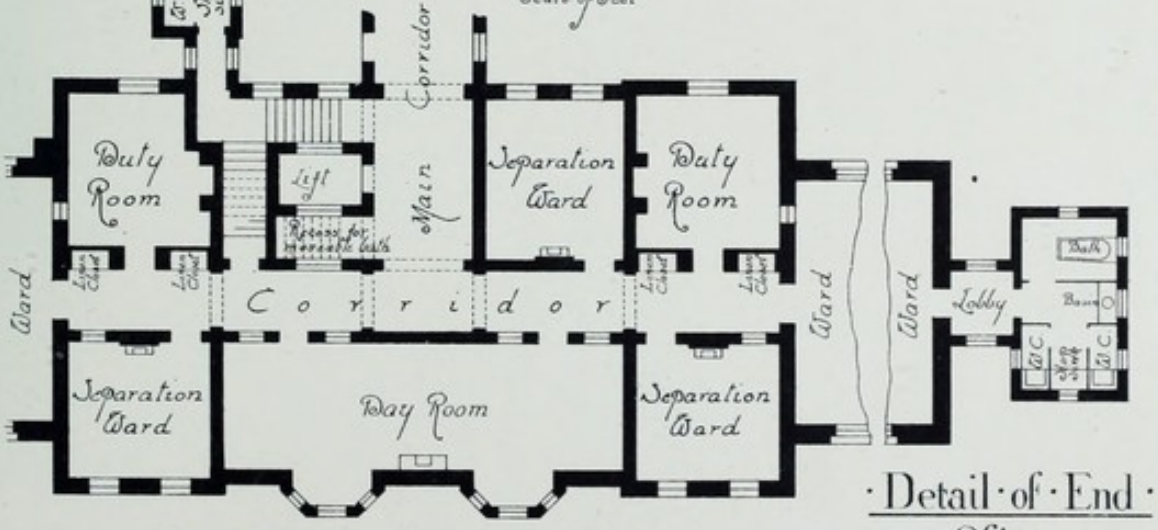
Plan of Site

Scale of Feet



Ground Plan of Double Pavilion

Scale of Feet



Detail of End Offices

Detail of Central Offices

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Connecting Corridors.—The main corridor connecting together the various blocks of buildings is 10 feet wide; it runs through the centre of each double pavilion, and has passages six feet wide leading off from it to the various wards. It is enclosed with ordinary double hung sashes, and it is so roofed as to form an ambulatory for the use of convalescent patients.

Water Supply.—The building is supplied by water from an artesian well, having iron cylinders 6 feet diameter sunk firmly into the upper stratum of London Clay, so as to stop out all surface water, and continued downwards with a brick shaft 5 feet diameter, to a depth of 235 feet below the surface, from thence cast-iron pipes 12 inches diameter are carried down to the level of the chalk, found at a depth of 289 feet below the surface and then a bore hole is sunk to a further depth of 213 feet; the total depth of this well is, therefore, 502 feet. Provision is made that in case of failure from repairs being required to the pumps or other causes, the supply can be supplemented from the remains of the Grand Junction Water Works Company, and these mains are continued to all the principal buildings, and to other parts of the buildings where it has been thought best to place hydrants for the protection of the building in case of fire.

Drainage.—The drainage of the establishment is effected by means of glazed earthenware pipes, 6 and 9 inches diameter, leading respectively from the various soil and rain water pipes to four main drains 9 inches diameter, running midway between the five principal blocks of buildings into a brick culvert situated beneath the road on the southern side of the site, and thence into the parish sewers. The main drain from the laundry to the brick culvert is about 12 inches diameter.

Area Covered.—The area covered by buildings is 60,658 superficial feet, or nearly half of the original site, and 81½ superficial feet per bed.

Cost.—The total cost of land now acquired has been £11,500, or about £15 9*s.* 0*d.* per bed. The buildings and their appurtenances, including engineering works and fixtures of every description, also professional fees and clerk of works' salary, cost £120,037, or about £161 per bed, so that the total cost of both land and buildings was at the rate of £176 9*s.* 0*d.* per bed.

Principal Sick Wards.

The main sick wards of this building are, like those of the Herbert Hospital, planned as pavilions, in pairs, connected together, in each case, by a staircase, duty and day rooms, and other offices. Each double pavilion contains three floors of wards. A detailed lan of one floor is shewn upon the accompanying plate, at page 60.

In accordance with the rules laid down by the Local Government Board for the planning of this class of building, the superficial and cubical contents of the principal sick wards are, as has already been stated, somewhat less than obtain in ordinary hospital buildings; but little difference was shown to result in the total first cost of the two kinds of structures, inasmuch as the attached offices and the administrative departments generally cannot be correspondingly reduced in size, and the latter generally form the larger portion of a hospital building.

Aspect.—The axes of the pavilions run nearly directly north and south, so that the windows of the wards face east and west.

Relative Position of Pavilions.—The height of the pavilions, as measured from the lower floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 39 feet 6 inches, and the least distance between any two pavilions is 75 feet, or about 1·9 times the height.

Size of Wards.—Each ward is of parallelogram shape, contains 28 beds, and is 84 feet long, 24 feet wide, and 13 feet high. The total superficial floor space is, therefore, 2,016 feet, or 72 feet per bed, and the cubic contents 26,208 feet, or 936 feet per bed.

Bed Space.—The average lineal wall space is 6 feet per bed.

Windows.—I much regret to have found it impossible to induce my clients to admit the introduction into this building of the casement windows, usually adopted by me for pavilion wards, and described in another part of this work; * as it is, the windows, of which there are seven in each side wall, are ordinary double-hung sashes, glazed with 21-ounce sheet glass, and the total area of their effective glazed surface is 406 feet, or 14½ feet per bed. When all the windows are opened to their fullest extent, the total area through which air could be admitted by them into the wards would be 225 feet, or about 8 feet per bed. Now, had the windows been of the combined casement form I so strongly recommend, the air area would have been at the rate of about 12⅔ feet per bed; moreover, in the latter case the head of the patient being protected from draught, the casements could be fully opened at all times and independently of the quarter from which the wind was blowing, whereas the present windows can only be opened when the wind is in a favourable direction; otherwise the patients, as they lay in bed, would suffer from the effects of draughts.

Warming.—The system adopted for warming these wards is that of open fireplaces, combined with hot water heating pipes, on a principle invented by myself. This apparatus is known as the "Thermhydric Grate," and its construction, as shewn upon the accompanying plate,† is such that the sides, back, and top of the fire are surrounded by a wrought-iron case containing water, and communicating by means of short tubes with upright coils of pipes so placed on either side that the water when heated by the fire circulates through them. Thus the whole of the products of combustion are utilized for heating purposes, and it will be seen that as the water cannot attain a temperature higher than 212° Fahrenheit, the iron over which the air passes cannot, as is the case with the ordinary air body stoves, be so heated as to burn the air impinging against its surface. As the water in the apparatus becomes warmed it expands and rises into the vase placed upon the top of the apparatus, and the slight vapour that is consequently emitted from this vase serves to moisten the air of the rooms in which the apparatus is placed. It will be seen that when, as shown by the accompanying plate, the apparatus is placed in the centre of an apartment, the smoke has to descend and run in horizontal pipes beneath the floor before entering the brick upright flues. The channel containing these horizontal flues is also made to serve the purposes of a duct for fresh air to pass from the outside round the stove and through the heated coils of pipes into the room. Stoves,

* *See* also, *Charitable and Parochial Establishments*, page 19.

† *Ibid*, page 21, for drawings to a larger scale.

Detail for Central Thermhydric Stoves for S

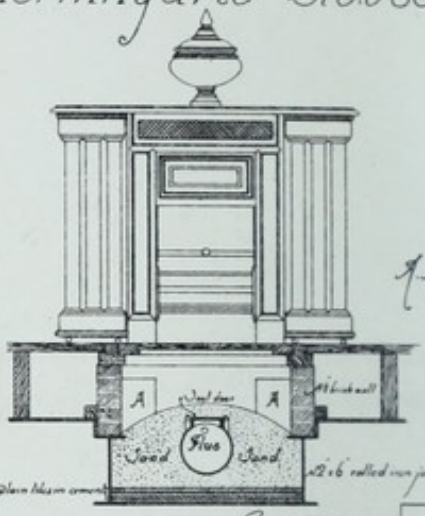
THE THERMHYDRIC
VENTILATING HOT WATER OPEN FIRE GRATE
H. SAXON SNELLS, PATENT.

THIS INVENTION CONSISTS OF AN OPEN FIRE GRATE SURROUNDED ON THREE SIDES AND ON TOP BY A WROUGHT IRON CHAMBER CONTAINING WATER WHICH WHEN WARMED BY THE FIRE CIRCULATES THROUGH UPRIGHT COILS OF PIPES PLACED ON EITHER SIDE. THE HEARTH IS MADE OF IRON AND THE WHOLE SPACE BELOW THE GRATE AND PIPES IS FORMED INTO A CHAMBER FOR THE ADMISSION AND COLLECTION OF AIR FROM THE OUTSIDE. THE OUTER FRESH AIR THUS ADMITTED PASSES UPWARDS AND IMPINGING AGAINST THE SIDES OF THE HOT WATER CHAMBER AND PIPES BECOMES THOROUGHLY HEATED WITHOUT BEING BURNT BEFORE ENTERING THE ROOM.

THE OBVIOUS ADVANTAGE POSSESSED BY THIS GRATE IS THAT UNLIKE ALL OTHER SUCH INVENTIONS THE AIR CANNOT BE BURNT OR HEATED ABOVE THE TEMPERATURE OF BOILING WATER AND THE WATER CONTAINED IN THE VASE BEING SLIGHTLY WARMED IT EVAPORATES AND THUS KEEPS THE AIR OF THE ROOM MOIST.

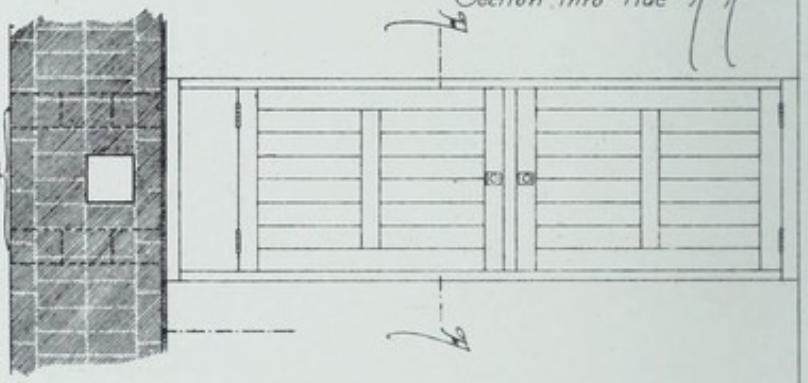
MANUFACTURED BY

MESSRS. POTTER & SONS 298 OXFORD STREET. W.



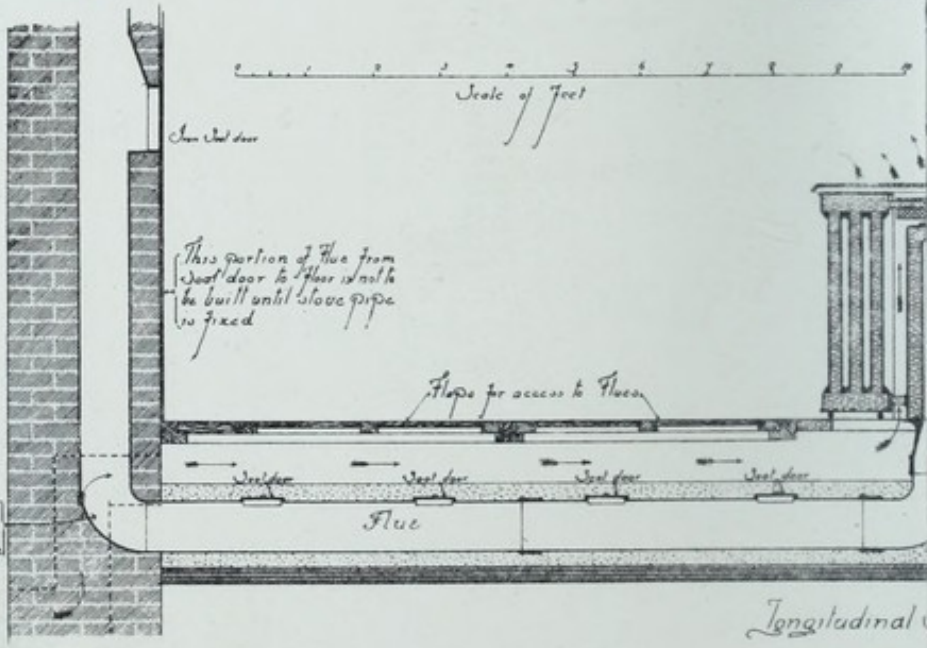
A.A. Fresh

Section thro Flue A A



Dotted lines show Fresh Air inlets

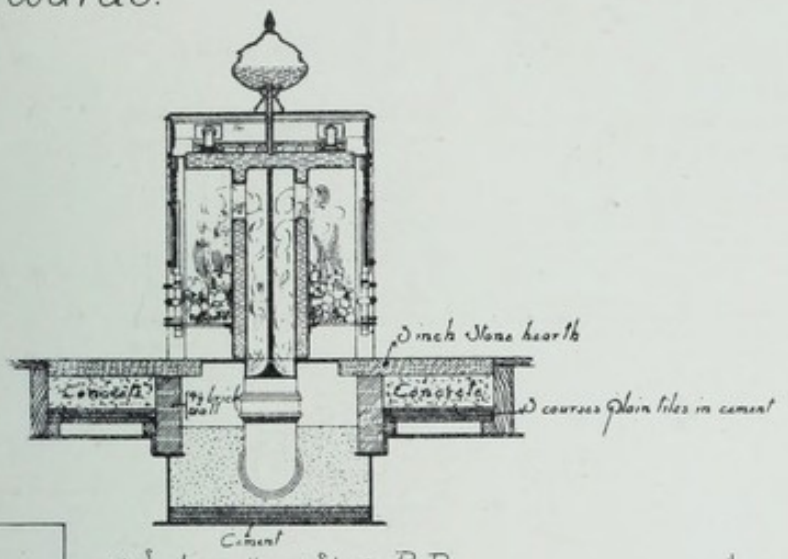
The height of the Chimney Shaft above the floor line should be at least 26 feet and where possible it is better to arrange that all the upright flues may be swept from the ground or basement.



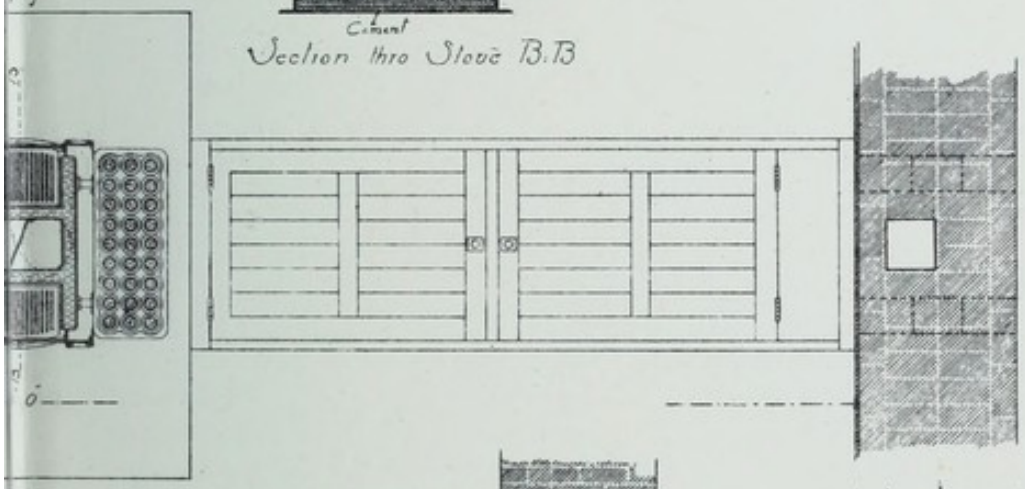
Longitudinal

Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

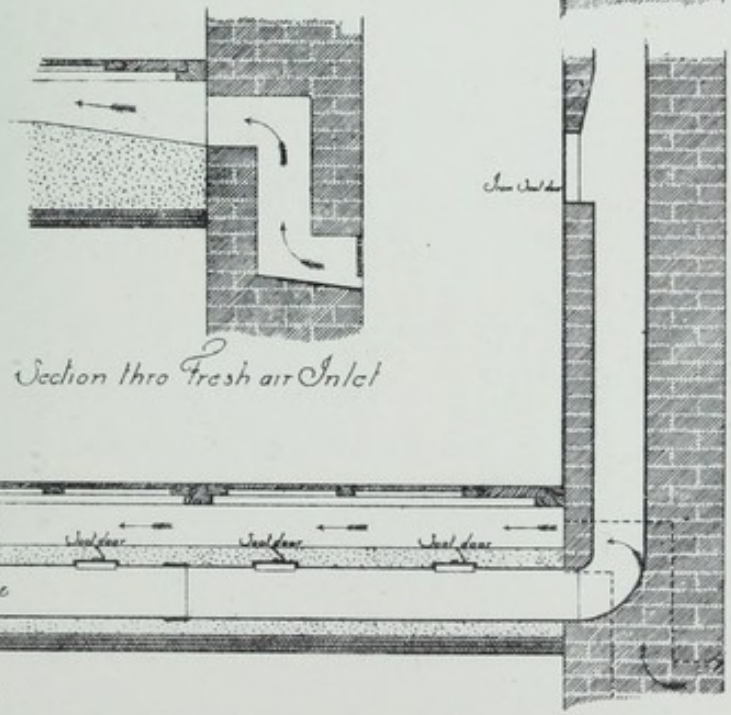
Sick Wards.



Section thro Stove B.B



Plan



Section thro Fresh air Inlet

Section thro Stove & Flue

with descending flues, are generally found to smoke when the flue gets cold through the fires being neglected or from their being let out during the night, but this difficulty is surmounted by incasing the horizontal iron flue pipes (as shewn) in sand, where they pass through the floor. The sand retains the heat of the flue for many hours; and it is only once, therefore, if at all, and then at the beginning of the winter, that the flue will require "piloting."

These Thermhydric Fire-places have been patented, and they are manufactured by Messrs. Potter & Sons, of 44 South Moulton Street, London, W., from whom all information respecting them can be obtained. They may also be seen there in operation, as well as at St. George's, St. Olave's, St. Marylebone, and Holborn Infirmaries; also at the Norfolk and Norwich Hospital, and at many other important public buildings. Those at St. Olave's Union Infirmary, in Lower Deptford Road, Rotherhithe, may be compared with other central stoves of an ordinary description working in the same building and the following letter received from Dr. Shepherd, the Medical Superintendent of that establishment, describes the result of his observations on their action :—

"St. Olave's Union Infirmary,
"Deptford Lower Road.

"DEAR SIR, "March 19th 1880.

"It has occurred to me that you may be pleased to hear a good report of the Patent Thermhydric Warming Apparatus which have been in use in three of the large wards here during the past winter. I must confess that I was inclined to think, from the size of the fireplaces, that the old plan would give better results as far as warmth was concerned, even if at the expense of more fuel, but experience has proved to me that I was thoroughly mistaken. You will remember that of the six male wards, all built in a precisely similar manner, three are provided with simple open fireplaces, and three are furnished with 'Thermhydric' apparatus, the fireplaces being in a precisely similar situation in all six of the wards; this permits of an exact comparison being made, and, as a matter of fact, I have found the wards heated by the 'Thermhydric' apparatus to be from 3° F. or 4° F. to 5° F. warmer than those heated on the old plan, notwithstanding the fact, a most important one I think, that the 'Thermhydric' grates consumed about a third less fuel.

"There are other and by no means unimportant advantages belonging to the 'Thermhydric' grates, but the above facts were, during the severe winter we are just emerging from, most striking and appreciable, and most incontestably in their favour.

"The impression left upon my own unbiassed judgment by the facts I have given is so favourable that I have felt bound in common justice to bring you acquainted with them.

"I remain, DEAR SIR,
"Yours faithfully,
"R. SHEPHERD,
"*Medical Superintendent.*

"To H. SAXON SNELL, Esq."

As a further testimony to the value of these apparatus for the heating of hospital wards, it will be well to state the results of the tests to which one of them was submitted, in competition with other "air heating" stoves, at the Smoke Abatement Exhibition, held November 1881, at South Kensington, and the opinion formed of the apparatus by the Jurors. At page 88 of the Report * they say :—

"Class 1. *Air Heating and Ventilation: Wallsend Coals.*—T. Potter & Sons' Thermhydric Grate stands at the head of the list for efficiency in virtue of the great expansion of radiating and air-warming surface developed in the hot-water tubes to the right and left of the fireplace, whilst *excessive temperature* of heated air is avoided."

* *Official Report of the Smoke Abatement Committee.* London, 1882.

Then, on page 83, there is given the following results of the tests :—

CLASS 1.—OPEN GRATES HAVING ORDINARY BOTTOM GRIDS AND UPWARD DRAUGHT.

No. of Test.	EXHIBITOR AND GRATE.	Average rise of temperature per lb. of coal per hour.	Average radiation per lb. of coal per hour.
	Air Heating—Wallsend Coal.	Deg. F.	Deg. F.
10	T. Potter & Sons, Thermhydric grate	5·16	5·35
19	A. B. Verrier, Comet grate	4·69	2·00
20	Do. do.	3·04	1·56
21	Rosser & Russell, Firebrick lining, fluted ...	3·85	5·71
23	G. Holler & Co., Kohlhofer's hot air stove ...	3·73	2·41
3	The British Sanitary Company, Enclosed grate	3·14	1·64
11	Perceval & Westmacott, Parlour stove ...	2·98	2·98
26	E. H. Shorland (G. L. Shorland's Patent), Manchester grate, firebrick lining	2·16	1·77
6	J. Wright & Co., Hygienic ventilating stove ...	1·55	1·46
	Averages	3·37	2·88
	Anthracite.		
9	J. Wright & Co., Hygienic ventilating stove ...	3·24	1·59

When not standing in the centre of a room, but next the wall, they are constructed in the manner shewn in the accompanying *Figs.* 4 and 5.

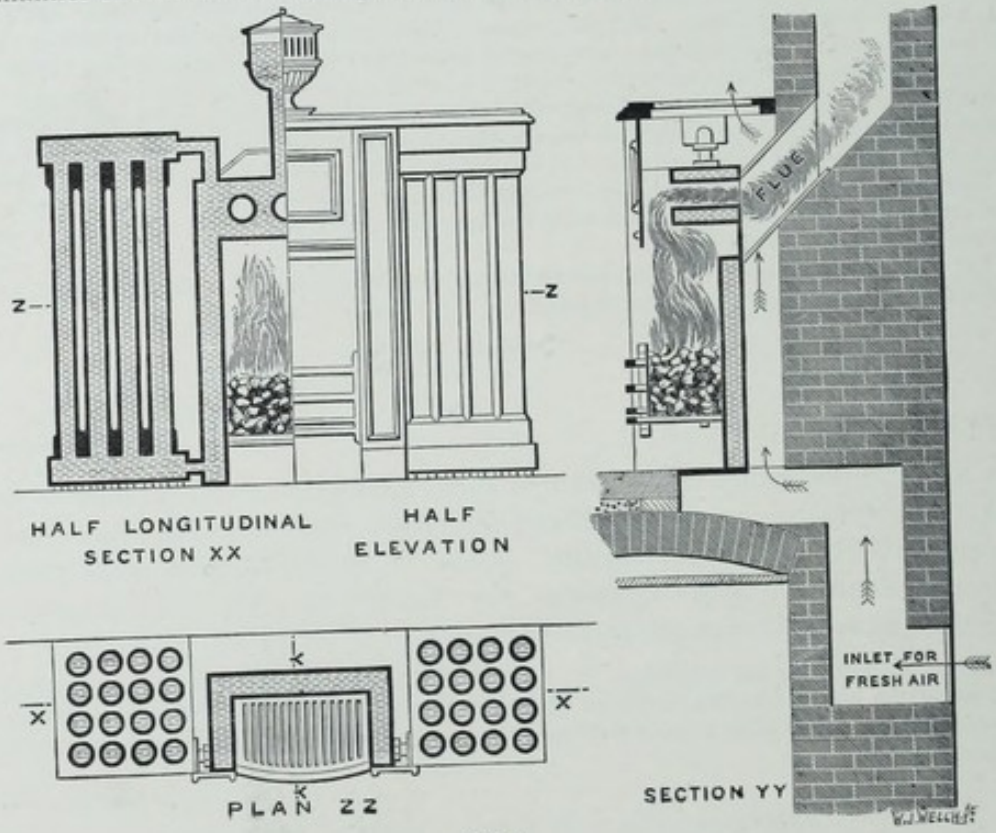


Fig. 4.

They are often enclosed in ornamental cases, one of which is shewn in the accompanying *Fig.* 5.



Fig. 5.

It will be seen by the next paragraph that an unusually large amount of ventilating area is provided for in these wards by inlet and outlet flues, which are kept constantly open during all seasons of the year; and as I was somewhat doubtful whether the Thermhydric stoves would, under the circumstances, be found always sufficient for supplying the requisite amount of heat, provision has been made for the addition of circulating hot water pipes down each side of the rooms. The experience of two winters, however, shows that the stoves are so far all-sufficient for maintaining the wards at a suitable temperature, and it has not, therefore, been found necessary to provide the additional source of heat referred to. A similar result has been experienced in the case of those fixed at the Norfolk and Norwich and other hospitals. In these two buildings two stoves were fixed in each ward, but in the other hospitals above referred to there is only one; consequently hot water pipes round the walls were, in these cases, provided in addition.

Ventilation.—The ventilation of the wards is effected by purely natural means, and is dependent therefore upon the very simple and well-known fact that heated air will always rise to a point higher than that of the colder air surrounding it, and that in its passage it will carry away with it noxious gases, and other deleterious matters which would otherwise, by reason of their greater density, remain stationary or descend to the floor level. Behind the head of each bed, and next the floor and wall, there is a large hollow skirting box, the front of which is formed of perforated zinc; this box is made so as to be easily lifted out of position for the purposes of cleaning, but when in its place it covers an aperture in the floor, from which a ventilating inlet pipe descends in a slanting direction to the outside wall, and through this pipe the external fresh air is admitted, first into the skirting box, and then out of it through the perforated zinc panels (situated under the heads of the beds) into the room. It was intended that hot water pipes

should also pass through these boxes. In the ceiling immediately over, and between each pair of beds there are perforated panels running the whole width of the ward; these panels cover large channels, the full depth (12 inches) of the floor, and these channels communicate at each end, with flues 14 inches by 9 inches, which run upwards in the thickness of the wall like ordinary chimney flues. Now, returning to the skirting box, it will be obvious that a greater part of the air passing into the room through the perforated front immediately under the head of the bed would be drawn upwards, and, passing through the perforated ceiling channel, be conveyed through the upright flue and find an exit at its termination; and it will be observed that the air in thus passing upwards from the skirting box to the ceiling must encircle, as it were, the space surrounding the head of the sick patient, and carry away with it his or her foul emanations. Thus, therefore, each pair of beds is provided with its own separate system of ventilation, whilst the general ventilation of the wards is supplemented by the central stoves previously described, and also by upcast shafts in the side walls. The total area of outlet and inlet flues in each of these wards is 15 feet, and no means are provided by which they can be closed, excepting in the case of four of the outlet shafts in the end walls which have doors that may be opened and shut as occasion may require.

Lighting.—The lighting of the wards is effected at night by three gas pendants. The burners are placed under inverted wrought-iron japanned basins, with white fire proof enamelled inside faces; and from the upper part of these basins galvanised iron pipes, three inches diameter, are carried along the ceiling ventilating channels, and thence into the upright flues described in the last paragraph; thus, it is hoped, a greater part, if not the whole, of the products of combustion is carried into the outer air.

Floors.—The flooring is formed of ordinary timber joists covered with 1½-inch tongued boards in half deal widths; the ceilings are plastered. Ventilation channels, as before described, communicating with upright flues in the outer walls, are formed in the ceiling over each pair of beds by the omission of the plastered ceiling between two joists, and inserting instead panels of perforated zinc, made easily removable for the purpose of cleaning.

Walls.—The two ouside walls are of brick, two feet in thickness and they are all much perforated with ventilating flues. The facings are of ordinary London stock bricks, and stone only is used for the cills of windows and other parts likely to be affected by the weather. The inside faces are finished with Keene's cement and will be painted. All other walls are of similar construction; those at the ends of the wards are 18 inches thick, but are perforated with ventilation flues.

W.C.'s, Baths, &c.—The main ward water-closets, baths, and other sanitary appliances are situated at the extreme ends of each pavilion, and are cut off from the wards by cross ventilated lobbies, 6 feet wide. The buildings containing them are carried up above the ordinary level of the adjoining pavilions, and form towers, the upper parts of which contain hot and cold water cisterns for the supply of the various baths, w.c.'s, &c., beneath them. A fully detailed drawing of the general arrangements of this department of the building, to which considerable attention was given, has been published elsewhere,* and it will be sufficient, therefore, to state that there are on each floor two

* *Charitable and Parochial Establishments*, page 17. London, 1881.

water-closets, each 2 feet 8 inches wide, and 6 feet 3 inches long, fitted with ordinary blue earthenware hopper pans and traps, and with Underhay's regulating water valves. The slop sink, which is placed in a recess next the water-closets, is formed of lead, 1 foot 10 inches long, 1 foot 7 inches wide, and 10½ inches deep. The bath room is 9 feet 3 inches long, 6 feet 3 inches wide, and contains a glazed fire-clay bath, manufactured by Mr. Finch, of Stourbridge, who also supplied the necessary brass fittings. The lavatory consists of one blue earthenware basin, sunk in a slate shelf. There are no urinals.

The soil and waste pipes are formed of cast-iron hot water socketed tubes, caulked with gaskin and red lead; they are carried down on the outside walls, and are so arranged as to render it almost an impossibility that any foul air contained in them can enter the building.

Leading off the staircase landings of each pavilion floor, and separated from them by cross-ventilated lobbies, there are water-closets for the private use of the nurses, and compartments containing slop-sinks for the purposes of the separation wards.

Day Rooms.—Situated on each floor, and midway between the two large sick wards, there is a day-room, 39 feet 6 inches long, 12 feet 6 inches wide, with two bay windows, the total area being 540 feet, or about 9⅜ feet per patient, occupying the adjoining large wards. They are heated by open fire places, standing centrally between the bay windows.

Separation Wards.—There are on each floor three separation wards, each for the accommodation of two patients; they vary slightly in size, but their average area is 200 feet and their cubic contents 2,600 feet. Each patient has, therefore, 100 superficial and 1,300 cubic feet of air space.

Duty Rooms.—Attached to and overlooking each large ward there is a nurses' duty-room, having an average area of 203 feet. They are fitted with ranges, sinks, and racks and shelves for ward crockery, &c. The nurses' sleeping and recreation rooms are, as previously described, situated in another part of the establishment.

Lifts.—Adjoining the main corridor, and forming a centre round which each pavilion staircase winds, there is a lift, 8 feet 3 inches long and 5 feet wide, for conveying coals, food and patients from the lower to the upper stories. These lifts are each worked by an hydraulic ram, which descends into a brick well a depth corresponding to the extreme height through which the cage has to be lifted.

Staircases.—The pavilion staircases, including the lifts, each occupy an area of 390 feet, and they and the corridors adjoining them are all fire-proof, being formed of Yorkshire stone, resting upon brickwork vaulting or iron joists and concrete. The steps are each 4 feet 3 inches long, with a tread of 11 inches and a rise of 6¼ inches.

Basement.—The whole of the ground beneath the various buildings is covered with a layer of cement concrete six inches thick. In each pavilion the only part carried down to form a basement is that immediately below the ground floor duty-room adjoining the staircase, and likewise the tower-building containing the nurses' water-closets; this basement is utilised as a coal store and also as a furnace-room, in which are placed boilers for heating the sanitary offices at the ends of each pavilion and providing hot water for the supply of the various baths, lavatories, sinks, &c.

Total Area of Pavilions.—The total area covered by each floor of these double pavilions, including the surrounding walls, is 8,336 feet, or about 149 feet per bed.

A complete set of the plans and sections of this institution will be found in a work entitled *Charitable and Parochial Establishments*, published by Batsford, London, 1881, and before referred to.

The erection of workhouse infirmaries is subject to the control of the Local Government Board, and it will doubtless be both interesting and useful to learn the principles which guide this body, in their approval or rejection of any designs submitted to them. These principles are those laid down in the Report of a Government Committee, of which the following is a copy* :—

"The Committee appointed by the Right Honourable the President of the Poor Law Board to advise upon the amount of space to be required in metropolitan workhouse infirmaries, and upon other allied matters, have had under their most careful consideration the questions proposed to them, and upon these questions, taken in their order, the Committee beg leave to offer the following observations and replies:

"Question 1. 'What amount of floor and cubical space should be allotted to the bed of each sick inmate in wards occupied both by day and night; it being understood that fever and small-pox patients, idiots, and epileptics are for the future to be provided for in separate and distinct buildings?'

"The essential condition of the needful cubic space is the maintenance, in the air which fills that space, of such degrees of purity and temperature as shall keep it free from danger to the health of those who habitually breathe it; and this condition evidently involves the difficult problem of ventilation. The purity of the air within an inhabited space enclosed on all sides is necessarily vitiated by the emanations proceeding from the bodies of those who inhabit it, and especially by the effects upon it of their respiration. What is the precise limit between safety and danger from vitiation of that kind, science has as yet been unable to determine. Experience, and impressions made upon the senses, are herein more trustworthy guides than authority, which on this question has been strangely at variance with itself.

"It is stated in a Return laid before the Committee from the medical officers of 42 metropolitan and suburban workhouses, that in nine instances only of the 42 could any facts be alleged by them showing that patients in sick wards had suffered at all from overcrowding. In two of these nine instances the *spread of fevers* was the evil specified; in one case, inconvenience; in another, retardation of cures and deterioration of health; and in the remaining five, slowness of convalescence;—were ascribed to that cause.

"In another return of 40 answers to the question, 'Is the recovery from illness retarded by the existing accommodation and arrangements generally, or in any particular wards?' 10 are in the affirmative, 21 in the negative, and nine are either vague, inconsistent, or not to the point.

"One very remarkable fact disclosed by these returns is the infrequency of childbed fever, and the small ratio of mortality produced by it in those houses; where within the last five years nearly 12,000 poor women have been delivered.

"The wards of nearly all the metropolitan workhouses and infirmaries have been visited, some of them more than once, by more or fewer of the members of the Committee, both by day and in the night, without previous notice; and although the visitors found some of those wards free from close or offensive odours, yet most of the wards were not exempt from the peculiar odour which results from overcrowding; the sense of smell being a very delicate test of that sort of impurity. Under a better system of ventilation, strictly enforced, it may reasonably be concluded that a more favourable condition of the air would have been noticeable.

"The result of the information thus collected, of the personal knowledge and experience of the several members of the Committee, of other diligent inquiries, and of careful and repeated consideration of the whole subject, is that, in the opinion of the Committee, there should be allotted to each sick inmate in metropolitan workhouses an air space of not less than 850 cubic feet on an average, and that in those cases where the height of the ward is more than 12 feet, such additional height should not be taken into account in calculating the cubic space of 850 feet; that there should be allowed a clear space of 6 feet across each bed, and that no bed should be placed on the middle of the floor.

* *Report of the Committee appointed to consider the Cubic Space of Metropolitan Workhouses.* London, 1867.

"In thus fixing the space which they consider requisite for the comfort and proper administration of the sick in workhouses, the Committee have not overlooked the fact that it may be impossible (on account of the construction of the present buildings) to give immediately in every case, the space recommended, and they feel that a certain amount of discretion must be left with the administrative, in carrying into effect the recommendations of the Committee. But it is their strong opinion that, even under existing circumstances, there should in no case be allowed a less space than three feet between the beds, and that no bed should, under any circumstances, contain more than one person.

"The amount of floor and cubical space recommended by the Committee is less than that which has been assigned, by men whose opinions command respect, as the requisite amount for hospitals generally.

"The discrepancy is more apparent than real. The difference arises from a difference in the objects contemplated. Hitherto contagious fevers have been rarely admitted, and never long retained, in workhouse infirmaries, and henceforth they are to be entirely excluded. Persons suffering disorders of that kind are to be sent to hospitals appropriated to such cases; or, should that not be practicable, are to be placed in separate wards, provided and arranged beforehand for the purpose.

"Now, between wards in which infectious fevers and other contaminating disorders are admitted, and wards from which they are excluded, the difference is immense; and it is a difference which concerns the welfare and safety, not so much of the sick who are so afflicted, as of the other inmates of the ward.

"Wherever these infectious disorders are present, ample space and a very free circulation and change of the air, are imperatively required for diluting and dissipating, and so rendering innocuous the contagious products and emanations which they engender; and for thus obviating a danger far greater and graver than that belonging to an atmosphere made impure by mere overcrowding—the danger, namely, lest the air should become and remain so charged with the poison of the specific disease, as to excite the same perilous disease in other occupants of the ward.

"The Committee further recommend that cases which give rise to offensive smells, should be placed in wards completely separated from the wards occupied by ordinary cases, and called 'Separation Wards;' and that an air-space of not less than 1,200 cubic feet on the average should be allowed for each of such offensive cases; the selection of these cases being left to the discretion of the medical officer of the workhouse.

"To question 2, which is—'What amount for each bed in those wards which are *partially* occupied by day and by night by the "chronic" and infirm, many of whom are usually able to leave these wards during a portion of the day for change of air in any adjoining yard or day-room?' the Committee answer—

"That each of such wards should have the use of a day-room. This being provided, an average of 500 cubic feet for each bed will suffice.

"As bearing upon this question, the Committee would call attention to the fact that while the bulk of the patients admitted into General Hospitals are of adult and middle life, a very large proportion of the habitual inhabitants of these wards are simply men and women whom age has rendered mentally and bodily infirm; and it is well ascertained that far less air is respired in a given time, and far less vitiation is therefore occasioned, by old persons than by persons in the vigour of life.

"To question 3, which runs thus: 'What space should be allotted to each bed in those wards which are termed "surgical"?' the Committee reply—

"The same as has been recommended in the answer to question No. 1, it being understood that in workhouse infirmaries surgical cases of a serious character are of rare occurrence.

"To questions 4 and 5, namely—'What space should be assigned to each patient in venereal or lock wards?' and 'What for inmates having itch, and other cases of cutaneous disease?' the Committee reply—

"The same as to the other sick.

"Question 6 is—'What for lying-in wards?'

"The general exemption of these wards in the workhouse infirmaries from serious disease, and especially from puerperal fever, and the very small amount of mortality which they present, have already been noticed. It appears, indeed, from a minute analysis of the returns laid before the Committee on this subject, that, in point of fact, a very large air-space, much exceeding 850 cubic feet, has been enjoyed, on an average by each of the parturient women in almost all the workhouses. The comparative freedom of the lying-in wards from disaster may probably have been owing in part to the ampler air-space thus actually shared among the women, though the Committee are conscious that much of the immunity was attributable to other causes. They recommend, therefore, that a rule should be laid down limiting the air-space to be allowed in each ward, for the future, as a minimum for these cases, to 1,200 cubic feet on the average.

"Question 7. 'Do the Committee consider it essential for health that any addition should be made to the minimum space of 300 cubic feet which is now required for each bed in wards occupied by night only by healthy adults or children?'

"The Committee have had before them no evidence to show that the minimum space now required is too little; they recommend, however, that whenever there is sufficient width in these wards to admit of more than one row of beds along their centre, the ward shall always be divided longitudinally by what is called a spinal partition. They also recommend that in future the dormitories be so constructed as to contain two rows only of beds.

"Question 8. 'What course would the Committee recommend for adoption in the event of its being temporarily necessary under present pressure to retain cases of fever or small-pox in a workhouse until admission can be obtained at one of the hospitals specially provided for such cases?'

"The Committee recommend that, under the circumstances specified, such cases should be removed at once into a separate ward; or, if that should not be practicable, that a bed should be taken away on each side of every fever or small-pox patient lying in the ordinary wards.

"Question 9. 'What space would they recommend for each patient in special hospitals for fever and small-pox?'

"The same space as is allotted in the existing fever and small-pox hospitals; or, 2,000 cubic feet.

"Question 10. 'Can they offer any and what general recommendations on the subject of ventilation of existing sick wards; or, as to the best proportions for, arrangements, and ventilation of new wards in any workhouse hospitals hereafter to be built?'

"The question of cubic space is subordinate to the more important question of ventilation; by which the Committee mean the continuous renewal of the air within a given confined and inhabited space, of whatever shape, size, or surroundings, so that it shall be kept pure or nearly pure, and shall vary within a few degrees only of moderate temperature.

"It is plain that the complete and scientific solution of the problem of ventilation, thus understood, would govern and include the scientific answer to the questions of space proposed by the Poor Law Board for consideration by the Committee.

"The requisite space, when settled once for all, will need no further pains; deviations from the prescribed amount can scarcely escape notice. It is not so with ventilation; yet if this be neglected, all regulation of cubic space becomes an idle care. The Committee, therefore, would suggest watchful and constant attention to this subject of *ventilation;* to its easiest, cheapest, and most effectual methods, and to the means of adapting them to the various forms and dimensions of existing rooms. Whatever methods are adopted should be rigidly enforced by some resident official or frequent inspector; they should be made secure against the intermeddling of the pauper inmates and servants of the house; and they should avoid the ingress of strong currents of cold air, or at least the incidence of such currents upon the bodies of the inmates; for to aged persons there is much more, both of peril and of discomfort, from exposure to a low temperature, and especially to cold draughts, than from the closeness which may be consequent upon overcrowding. In the sick wards, and in the rooms of the aged and infirm, the temperature during the night ought not to be allowed to fall much below the day average; and this arrangement should be under the control of the medical officer.

"In respect of both present and future infirmaries, the Committee are desirous of directing the attention of the Poor Law Board to a plan described* by one of the Members of the Committee, as having been devised and found practically successful in solution of the analogous problem—the ventilation of barracks and military hospitals.

"In relation to the general subject submitted to their consideration, the Committee hold it to be most desirable that adequate day-rooms well ventilated and lighted, and proper exercising grounds, should be provided for the paupers who are not confined to their beds.

"Question 11. 'Can the Committee advise the Board as to the best means of securing and keeping up an efficient supply of trained nurses, and as to the proportion of nurses to patients which it is desirable to maintain in workhouse infirmaries?'

"The Committee, not having gone into the subject themselves, refrain from expressing any opinion of their own respecting it. They append, however, a paper relative to this question, which Miss Nightingale has been kind enough to send, in answer to a request from the Committee, conveyed to her through their Chairman.†

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* *See* Extract from Captain Galton's Paper following.

† This Paper is not published here, as it relates rather to the management than the structural details of a hospital.

"Throughout their deliberations and enquiries the Committee have regarded the questions submitted to them as being, not merely speculative, but, on the contrary, eminently practical questions, involving vast and wide principles, moral and economical. They conceive that the balance needs to be held as evenly as may be possible between the well-being of the inmates of the workhouses, and the interests of the ratepayers, by whom those places of refuge are supported. The problem to be solved really is, What is the amount of floor and cubical space which shall not be too little on the one hand, nor more than enough on the other—not too little for the health and due comfort of the pauper inmates, sick or well, not pressing too much upon the means of the poorest ratepayer? This practical aspect of the question the Committee have deemed it their duty to keep steadily in view; always with an inclination, if the balance cannot be strictly adjusted, towards the side of the sick and poor. It is fit that these houses be made safe, decent, and commodious; it is neither necessary nor expedient that they be made inviting.

"In conclusion, the Committee desire to say that while the space which they have recommended is in excess of the minimum space hitherto allowed, the increase has been suggested, both because the latter space is not, in their judgment, compatible with the rapid restoration of the sick to health, and because they think it insufficient for the purposes of ventilation, decency, and administration—matters of importance to all inhabitants of a workhouse, whether to those who are actually ill, or to those who may be regarded as inhabitants for life."

The following is the extract from Captain Douglas Galton's Report on Ventilation above referred to:

"The problem for ventilating workhouses is much the same as that laid down for barracks, which was stated by the Barrack and Hospital Improvement Commission Report of 1861, p. 71, as follows:—

"In a building consisting of a number of rooms generally entered from common passages or staircases, sometimes directly from the outer air, and each having an open fireplace, which it is essential in every instance to retain, how to supply, at all seasons and temperatures, and by day and night, each room by itself and independent of every other room, with a sufficiency of air to keep the room healthy, and at the same time to prevent the temperature from falling below what is required for the comfort of the men. To do this with the least possible interference with the structure of the rooms, on a plan not easily deranged and at a minimum of cost?

"The principles laid down by that Commission appear to be those best calculated for workhouses, viz.:—

"I. To keep each room independent of every other room in respect of ventilation.

"II. To depend for the ventilation upon the fire-places and upon the difference of temperature between the external air and the air within the rooms.

"These principles can be carried into effect as follows:—

"1. Outlets for heated and impure air should be provided by means of shafts carried up from the ceiling to above the roof, affording a sectional area of 1 inch to every 50 cubic feet of space in the room for the upper floors; of 1 inch to every 55 cubic feet in rooms on the floors next below, and of 1 inch to every 60 feet for rooms on lower floors.

"These shafts should be placed if possible on the same side as the fire-places, but in the corners of the room furthest removed from the grates.

"Each gas jet burning in the bed rooms at night should be covered with a bottomless lantern, connected by a tube with the foul air extraction shaft, thus carrying off the products of combustion and also tending to put the air in motion upwards in the shaft.

"2. Inlets for fresh air. Means for the admission of air of the ordinary temperature should be provided direct from the outer air, independent of the windows and doors; for this purpose, Sherringham's ventilators should be placed between the windows near the ceiling, which should afford a combined area of at least 1 square inch for every 100 cubic feet of space in the room, and openings of equal size should be placed close to the floor under the beds, but these latter should be capable of being easily and securely closed.

"For the admission of fresh warmed air, the ventilating grate which has been adopted in barracks should be used.*

* These grates were invented by Captain Galton, and they may be seen in use in many barracks and large public buildings. The Thermhydric Ventilating Grates, recommended by the author, and illustrated at page 62, had not been introduced at the time Captain Galton wrote this Memorandum.

"It is essential that the ventilating apparatus should be periodically thoroughly cleaned, and that some person in the workhouse should be charged with the superintendence of the arrangements, and be responsible that they are maintained in an efficient condition.

"In all newly constructed infirmaries the wards should be on the pavilion principle, with windows on opposite sides, the beds being arranged along the walls between the windows. The pavilions should not have more than two floors of wards, *i.e.*, the ground floor and the first floor, and the adjacent pavilions should be placed laterally apart, at a distance equal to at least twice the height from the level of the floor in the wards on the ground floor of the building to the eaves of the roof.

"The width of the wards should not be less than 24 feet. The other dimensions would follow from the cubic space laid down in the recommendations of the Committee.

"The number of windows should be at least equal to half the number of beds, and they should extend from 2 feet 6 inches or 3 feet from the floor to within one foot of the ceiling. As light is second only to air in importance in sick wards, the proportion of window space to cubic contents should be as nearly as possible 1 square foot to 50 cubic feet, which is the proportion adopted in hospitals of the best construction.

"It would economise space to place the fire-places in the middle of the wards, with a chimney carried in a trough under the floor to a flue in the wall, and arranged to warm the fresh air which is admitted from the external air by means of a trough on the plan adopted in the wards of the Herbert Hospital, and explained in detail in a report presented to Parliament in the session of 1865.*

"Every ward should have attached to it or should have easy access to—

"1. A nurse's room.

"2. A ward scullery, with a grate and oven, racks for crockery, a sink for washing up, and table.

"3. Water-closets and a sink for emptying bed pans, placed in a chamber cut off from the ward by a lobby. These chambers and lobbies should have separate through ventilation by means of windows, and an independent supply of fresh warmed air in winter, so as to prevent the smell from the water-closets and sinks from being drawn into the wards in cold weather; they should be closed by means of swing doors. Urinals should be placed in these chambers for the use of those patients who can leave their beds.

"4. Bath and ablution rooms, with hot and cold water laid on, should be attached to each ward, but cut off from the ward, in the same manner as the water-closets, by a ventilated lobby, and separately warmed and ventilated."

The Local Government Board act generally upon the recommendations contained in the above report, but they have issued "regulations" for the construction of *country* infirmaries (from which the following is an extract) that allow a much smaller cubic space in the sick wards. Excepting, however, in respect of this question of space, these regulations are equally applicable to metropolitan as to provincial infirmaries.

"Sick Wards.

"1. The sick wards should, as far as practicable, permit of the sub-division of the patients of each sex into the following classes:—

(*a.*) Ordinary sick:
  1. Medical.
  2. Surgical.

(*b.*) Lying-in women, with separate labour room adjoining the lying-in ward when necessary.

(*c.*) Dirty and offensive cases.

(*d.*) Itch cases.

(*e.*) Venereal cases.

(*f.*) Children.

(*g.*) Infectious fevers (*vide* Isolation Wards).

"2. The infirmary should also contain suitable apartments for the nurses, and such kitchen offices as the size of the building and its position relatively to the general kitchen may render necessary.

"3. In any case where the number of sick is sufficient to justify a special establishment, it is desirable to arrange the infirmary so as to be under separate management from that of the workhouse wherever it is deemed necessary or advisable.

"4. No single infirmary should, as a rule, be arranged for more than from 500 to 600 patients; any such separate infirmary should possess suitable apartments for a resident medical officer, also offices,

* A similar arrangement is shown at page 62.

surgery, and the rooms for the other necessary resident officers, such as matrons, nurses, &c., &c., in such proportions as may from time to time be determined.

"5. The itch and venereal wards should be so arranged that the patients occupying them may not come in contact with the other patients. These wards, moreover, should be respectively provided with distinct water-closet and lavatory accommodation.

"6. The following minimum amount of space per bed is necessary in sleeping wards:—

	Wall Space, irrespective of that occupied by doors and fire-places.	Floor Space.	Cubic Space.
	Feet.	Feet.	Feet.
Wards for ordinary sick	6	60	600
Itch and venereal cases	6	60	600
Wards for lying-in, &c.	8	80	960
Offensive cases	8	80	960
Children	5 if the wards are 20 feet in width.		
	6 " " 18 "		

"7. Sick wards to hold one row of beds only should not be constructed, but in the case of already existing rooms when appropriated to the sick they should have a width of at least 12 feet, the gangway and fire-place being, if possible, on the side opposite the beds.

"8. Day wards for the sick should afford accommodation at the rate of 20 feet superficial of floor space per patient for not less than one-half of those who occupy the day and night wards.

"9. Day wards should ordinarily be upon the ground floor, and should have ready communication with the airing yards, but in large infirmaries some day room accommodation should also be provided on the upper floors for those who are unable to get up and down stairs.

"10. Sick wards should be 20 feet in width if the fire-places are at the side or in the end walls; and 24 feet in width if they are in the centre. They should be from 10 to 12 feet in height.

"11. In the case of small infirmaries a room or suite of rooms may be connected with a similar suite in the same line by the central part of the building in which would be placed the apartments of the nurses and other officers.

"12. The walls of all sick wards should be plastered internally with some hard and non-absorbent plaster, or should be painted to a height of 6 feet with some material which can be thoroughly washed and purified without vacating the ward.

"13. Yards for the sick should be enclosed with dwarf walls and palisades where consistent with due classification. They should be furnished with seats and covered places of refuge in wet weather.

"14. In the cases in which hot water is not laid on or very near to sick wards the grates should be provided with self-feeding boilers of adequate size.

"Isolation Wards.

"15. The isolation wards for fever, small-pox, or other infectious cases, if at the workhouse, may sometimes be constructed of a temporary character. They should be so placed as, with ordinary precautions, to preclude the possibility of the spread of infection from them to the other parts of the establishment. It is further desirable that where practicable the building should contain distinct accommodation for the safe treatment of at least two different kinds of infection.

"*Note.*—In regard to the provision for isolating cases of infectious disease at workhouses, it should be considered whether arrangements can be made for the reception of paupers suffering from any such disease into some local public hospital for the purpose, or into the hospital provided by the Sanitary Authority under the provision of the 131st section of the Public Health Act 1875, the provision at the workhouse being in that case limited to such accommodation as may be necessary to the treatment of any cases that may arise there or may be accidentally brought there.

"16. The space per bed in wards for infectious cases should be at least as great as that required for offensive cases, and the ventilation as complete in summer and winter as can be possibly attained.

"17. Adequate means of disinfecting linen, clothes, bedding, &c., should be provided at a convenient distance from the isolation wards, and a detached wash-house for washing infected linen, &c., should also be provided.

"GENERAL.

"18. Suitable store rooms for linen and clothing of the several classes of inmates and for dry and other goods should be provided in convenient situations. These should be properly lighted and ventilated.

"19. A suitable dead-house should be provided. It should be a detached one-storey building with ample ventilation at the roof as well as at the sides.

"20. Special means of ventilation, apart from the usual means of doors, windows, and fire-places, should be provided, and so arranged that each ward may be brought into constant communication with the outer air. No plan is recommended for universal adoption. One of the simplest methods is the use of air bricks 9 × 3 or 9 × 6 inches covered on the inside with finely perforated metal in moveable frames (the perforations being about $\frac{1}{10}$ of an inch in diameter) inserted about 8 feet or 10 feet apart in the upper and lower parts of the external walls (that is, at the floor level and immediately under the wall plate), by which means only a small body of air would be admitted in one place, and it would be so diffused as to prevent strong draughts. No permanent means of closing the upper set of ventilators should be provided, but the lower set may be fitted with hit-and-miss gratings made to lock so that they may be regulated by the proper authorities. The outer opening should be placed a little above or below or to one side of the inner one, the two being connected by a flue or shaft. Ventilating fire-places, providing when in use a constant supply of warmed fresh air, are found to be very useful. It is very desirable that where hot-water pipes are used they should run round the wards, and be so arranged that a portion of the fresh air admitted into the room may pass over them and so be warmed.

"21. Arrangements should be made for the distribution of hot and cold water where necessary in the quantities needed for all purposes. Care should be taken to place the cisterns so as to be easy of access for inspection and periodical cleansing; and the pipes where the water in them will not be likely to be affected by frost.

"22. Where no other system of warming is adopted, fire-places should be provided in all inhabited rooms. As a general rule wards 30 feet or less in length require one fire, 30 to 60 feet in length two fires, and so on: the fire-places in the dormitories being arranged so as to interfere as little as possible with the bed space, and those in the day rooms being placed so that the inmates may sit round them without being exposed to draughts from the doors.

"23. External windows should be filled in with double hung wooden sashes, and should extend to within 1 foot of the ceiling, and to 3 feet or 3 feet 6 inches from the floor of the ward. They should ordinarily be placed about 8 feet or 10 feet apart from centre to centre. Windows are not to be glazed with ground or opaque glass except for special reasons to be approved by the Local Government Board.

"24. Water-closets, earth-closets, and slop sink closets in connection with buildings should be placed in projections from the building with an intervening lobby between them and the adjoining rooms. External windows arranged so as to ensure thorough cross-ventilation should be provided in this intervening lobby as well as in the closets themselves.

"25. Drains from buildings should be constructed of glazed stoneware pipes not less than 4 inches in diameter laid in direct lines, and with uniform gradients between the points where they change direction, with water-tight joints, and man-holes or lamp-holes for inspection at the points of junction or change of direction. The soil pipes of water-closets and slop sinks should be of lead, and not less than 4 inches in diameter, and should be fixed outside the building and carried up without diminution of diameter in such a manner as to allow a safe outlet for drain air.

"26. No drains should pass under any building, but all drains should terminate outside the buildings, and the waste pipes from sinks, lavatories, and baths, the overflow pipes from cisterns and tanks, &c., should be taken through the external wall into the open air and discharged visibly on to a surface channel leading to a trapped gully grating at least 18 inches distant. Special care must be taken to ensure the proper ventilation of the drains, and also to preclude the entry thereto of sewer air. For this purpose a suitable trap must be provided in the drains as near to their outfall or junction with the public sewer as possible and a suitable and sufficient opening for ventilation should be provided in the drains immediately above this trap, a second opening being also provided at the highest point in the drains. Other intermediate openings for ventilation may also be provided, but if suitable inspection holes are formed, as suggested in par. 25, they may ordinarily be made to answer the purpose. Means of flushing the drains by the discharge of a body of water at the head of the drains should also be provided.

"27. Glazed stoneware or enamelled iron stop and waste water shoots should be provided in suitable positions on the bedroom floor of all large workhouse buildings.

"28. The sewage of the workhouse premises, whether or not it contain matters from water-closets, should be conveyed whenever possible into the public sewer. If this cannot be done it should be carried

into impervious tanks placed at such a distance from inhabited buildings as to preclude any nuisance. The tanks must be properly ventilated, and have arrangements for the delivery of their contents at frequent regular periods to properly prepared ground. So far as water-closets are not in use, the excremental matters may be disposed of on the dry earth system, or, in case of closets outside buildings, may be received into a pail under the closet-seat, and be afterwards applied to properly situated land.

"*Note.*—It must be understood that the application of sewage to land and the collection and disposal of excremental matters on the dry earth system require that certain appliances for them should be provided and maintained, and that certain service requisite for keeping them free from nuisance shall be regularly supplied; and no plan for thus dealing with sewage or excrement is admissible except on condition that the necessary appliances and service must be provided. The earth used must be garden mould, containing organic matter, and be properly dried and sifted. All excrementary matters applied to the land must be so disposed of before putrefaction has commenced.

"29. In addition to the ordinary means of water supply to the workhouse, the rain water from the buildings should be collected in covered tanks conveniently placed for the purposes of the wash-houses. It may be desirable to provide means of filtering the rain water.

"30. The airing yards for all the classes of inmates should have the best practicable aspect. If the yards are partially or wholly paved with stone or brick, or asphalted or gas tarred, it will frequently be found preferable to a covering of gravel. All yards should be formed so that the water may readily pass off into the drains. Airing yards should be drained to channels and gratings at the sides, so as to leave the centre space free for use.

"31. The external walls of all buildings of two or more storeys in height, and of one-storey sick wards and school rooms, should, if of brickwork, be not less than 14 inches thick, and if of stone, not less than 18 inches thick.

"32. A proper damp course should be provided in the walls of all new buildings, slightly above the level of the ground adjoining the walls, and below the floor-timbers. In some cases it may be desirable to construct the external walls hollow.

"33. The staircases should be constructed as 'return staircases' 7 feet in width, and have stone stairs 3½ feet wide. The stairs should be supported on iron strings, or be properly tailed into the walls, and the landings supported on iron girders. All the steps should be 'flyers,' none exceeding 7 inches rise, and those to the wards of sick and children not exceeding 6½ inches rise. Steps of the former rise should have 10 inches tread, and of the latter rise 11 inches tread.

"34. The floors of inhabited rooms should be boarded, and the boards tongued and grooved; the floors of water-closets, bath-rooms, and lavatories may be similarly floored, or may be paved with tiles or some other form of washable and impervious floor, in which case wooden gratings to stand upon are indispensable.

"35. All sleeping rooms should be ceiled at the level of the wall plate.

"36. The timber used in the construction of workhouse buildings should be Baltic fir and English oak, properly seasoned.

"37. Means of escape in case of fire should be most carefully considered."

A document, of which the following is an extract, has recently been issued by the Local Government Board. It enumerates the points to be attended to as regards fittings and medical appliances in workhouses.

"*The fittings should be such as are usually provided in the Wards of General Hospitals, and amongst them the following :—*

"28. The bedsteads should be of iron, of modern make, and kept in good order. The length should be 6 feet 2 inches, and the width 2 feet 9 inches, except for the bedridden, the lying-in cases, and women with children, for whom the width should be 3 to 4 feet.

"29. A palliasse of straw or other material, or a layer of cocoa fibre matting, to be placed beneath the bed.

"30. The beds, whether of feathers, carded flock, wool, cut straw or chaff, to be properly made, kept in good order, and sufficiently full. Sometimes, hair beds are found to be better, especially when placed on suitable mattresses.

"N.B.—The beds for all wet and dirty cases should be in three equal divisions, so that when fouled or otherwise rendering a change necessary, the centre one may be removed and another put in its place without difficulty.

"31. Two sheets, two or three blankets, and a white counterpane or cheerful-looking rug.

"32. One half the number of bedsteads to have a raising rack.

"33. Separate bed rests; also ropes with wooden handles suspended from the ceiling or otherwise arranged over some of the beds, to assist bedridden cases.

"34. Spittoons.

"35. A stoneware urinal to each bed and special strong glass urinary bottles for the use of bedridden men. Glass is preferable to stoneware as it permits the contents to be always visible.

"36. Medicine glasses and feeding bottles.

"37. Stoneware or metallic feet and chest warmers.

"38. Air or water beds.

"39. Mackintosh sheeting to be used to all lying-in beds.

"40. The same with funnels for dirty cases.

"41. Square and round mackintosh cushions with depression in the centre to prevent bed sores.

"42. Mackintosh urinals to be worn by men who pass their urine involuntarily.

"43. A locker with open shelves for the use of two inmates.

"44. A suitable place, with lock and key, for the safe keeping of medicines.

"45. Arm and other chairs for two-thirds of the number of sick; also one or two arm chairs on noiseless wheels, and a few special chairs for epileptic cases.

"46. Short benches with backs and (for special cases) cushions.

"47. Rocking chairs for the lying-in wards.

"48. Little arm chairs and rocking chairs for children's sick wards.

"49. Tables.

"50. Moveable bed-tables for use by patients in bed.

"51. Moveable bath on noiseless wheels, with suitable means of charging it with hot and cold water and of emptying it.

"52. Stoneware wash-hand basins for those who are washed in bed.

"53. Fixed stoneware lavatory basins for others, or washstands with fittings.

"54. A sufficient number of round towels on rollers, and one small towel to each person who is usually washed in bed.

"55. A proper supply both of combs and hair-brushes, to be kept clean and in good order, in each ward.

"56. Sealed night-stools.

"57. Two or three screens (on wheels) large enough to completely surround a bed when a patient is being bathed in the ward, or is very ill or dying.

"58. Gas, where practicable, to remain alight during the night.

"59. Bells to the nurses' room.

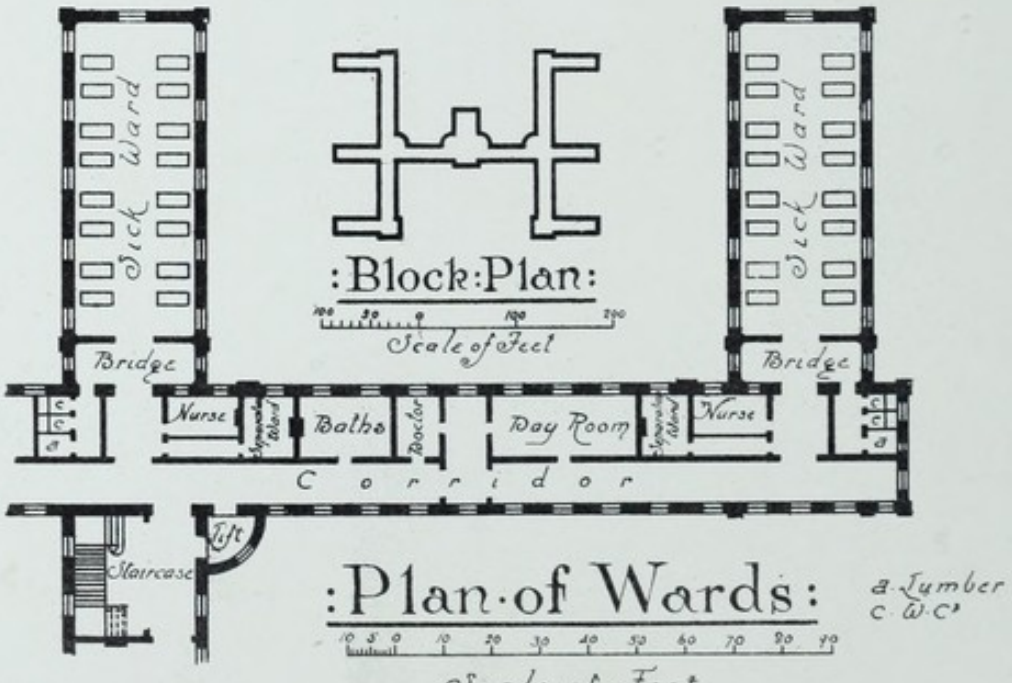
"60. Jackets with long sleeves, for lunatics.

"61. It may be desirable that an inventory of the furniture, fittings and medical appliances supplied, should be fixed in some conspicuous place in each ward."

:Mons:Civil:Hospital:
·Belgium·



:Birds·Eye·View:



:Block:Plan:

Scale of Feet

:Plan·of Wards:

a Lumber
c W.C.

Scale of Feet

Photo Lithographed & Printed by Jethro Akerman, 6, Queen Square W.C.

H. Saxon Snell del.

CIVIL HOSPITAL, MONS,

BELGIUM.

THERE are very few hospitals at present erected in Belgium the plans of which can be considered to represent the more advanced views of hospital construction; yet there can be no question on reading through the Reports of the Conseil Supérieur d'Hygiène Publique at Brussels, to whose approval all plans are submitted, that its members are quite at one with all other nations in advocating the principles now almost universally laid down for the construction of hospital wards. The Hospital of St. Jean, at Brussels, accommodates 550 beds, and is on the pavilion principle; but these pavilions are much too close together, and in other important respects the architect has quite ignored the conditions necessary to be observed in the design of a good hospital building.

The hospital at Mons is one of the best types at present existing in Belgium. The designs for this building, prepared by the architect Mons. Hubert, gave rise to considerable controversy, in consequence of the opposition raised by Mons. Defontaine, Surgeon of Hospitals, who strongly condemned the scheme and proposed a counter project. A plan of one of the pavilions, as proposed by Mons. Defontaine, is shown at *Fig.* 6, and is taken from the printed reports. U is a bath-room, V a lavatory, T a lift, and S S the water-closets; the other details are, however, not clear.

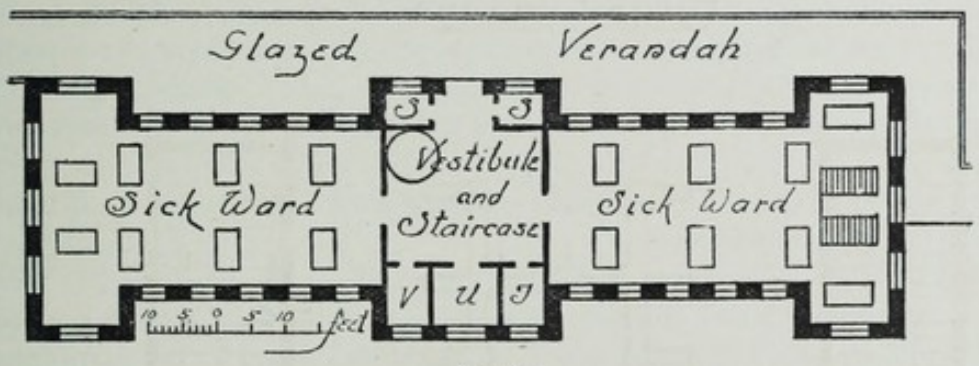


Fig. 6.

If this plan be compared with that of Mons. Hubert, it cannot but excite surprise that a proposal for carrying it out should have been so seriously entertained as it appears to have been. The ultimate overthrow of the scheme was, however, finally due to the decision of the Council of Hygiène, to whom the question was referred.

I do not propose to give any very detailed description of this building, as I have been unable to obtain access to reliable documents relating to it; and I was not at all satisfied that the information given to me on the occasion of my visit, as to matters of detail, was quite accurate. Mons. Hubert, the architect, who, unfortunately, was unable to accompany me over the building, has, however, sent me much interesting printed matter, detailing the progress of his controversy with Mons. Defontaine, before referred to.

The building is situated on the outskirts of the town of Mons, the country around being very open, and the adjoining land occupied as market gardens. The extent of the site is stated to be 2½ acres. The general disposition of the buildings upon the site will be seen by the accompanying block-plan and bird's-eye view. The general administrative offices, with the operating and consulting rooms, form a front façade to the structure, the central feature being the roof of the chapel, which is situated on the upper floor. Branching off from either end of this building are the corridors, which give access to six pavilions that jut out at right angles from each of them; the front pavilion to the right of the accompanying view is occupied by a religious sisterhood, the members of which act as nurses to the sick; the corresponding wing on the left is devoted principally to the accommodation of private paying patients; the rear blocks are the sick wards proper, for males and females respectively; the lower floors being devoted to the surgical and the upper floors to medical cases. The distant central building is intended to be erected for the reception of patients suffering from infectious diseases; the distant building on the left is the wash-house, laundry, and disinfection house.

The total accommodation at present provided in the building is stated to be 146, viz., eight wards for 16 beds each, and 18 for one each. The average number of patients in actual occupation is from 80 to 90.

The cost was originally estimated to be £4,520, or £153 per bed; but although the building is still in a very unfinished condition, this outlay has already been very considerably exceeded.

The only peculiarity observable in the structure of the main sick wards is their entire isolation from the connecting corridors, the w.c.'s, nurses' rooms, and other usual offices, by means of low covered bridges, having large glazed doors at either end of them; these doors, excepting in very cold weather, are kept open, and the cross ventilation thus set up effectually prevents the communication of the ward atmosphere to other parts of the building.

The position of the w.c.'s and other sanitary offices, is, as is usual in Continental hospitals, unfortunately chosen.

The ventilation of the wards is effected principally by the windows, but there is, in addition, between each pair of beds, and at the level of the floor, a large opening about 14 inches square, closed by double doors, which can be opened for the admission of fresh air from the outside. The arrangement for warming is, however, found to be a failure and will be altered. It consists simply of a closed circular pedestal central stove, and the flue pipe from it is carried along the entire half-length of the ward in a slanting direction and from 8 to 10 feet above the floor, into a flue situated in the end wall.

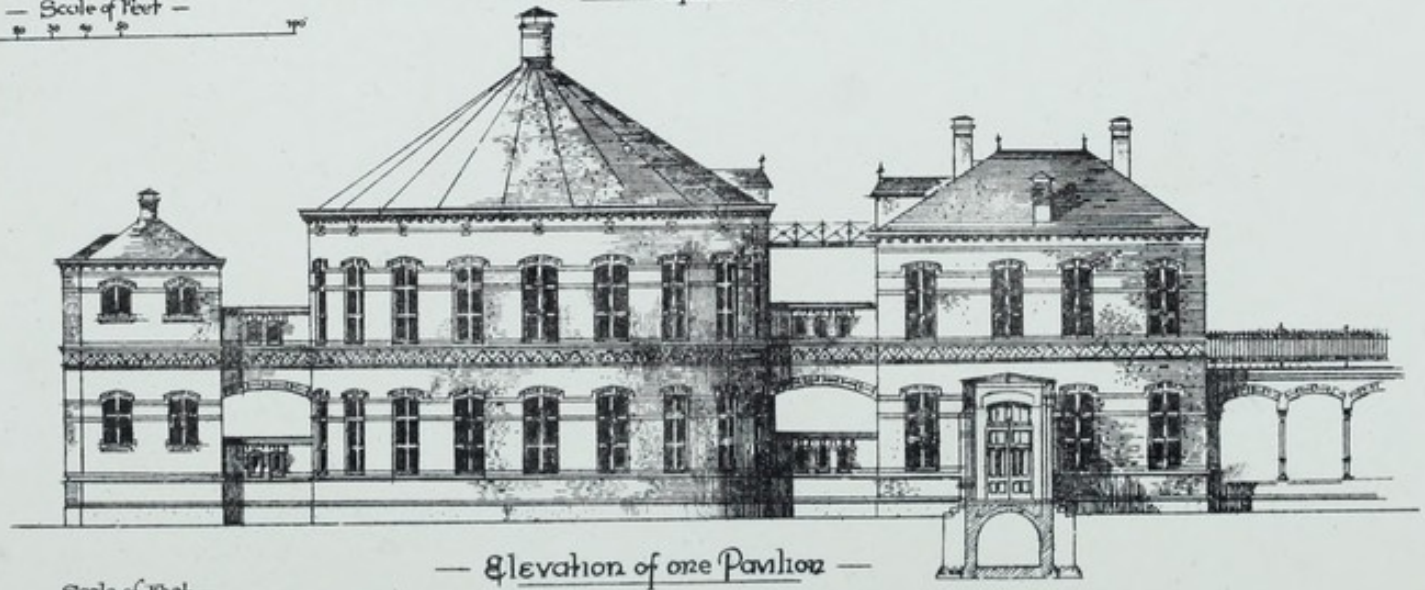
A further account of this building is given by Dr. Mouat, in the first section of this Work.

Antwerp. Civil Hospital



— Elevation of Principal Front —

— Scale of Feet —



— Elevation of one Pavilion —

— Scale of Feet —

Photo Lithographed & Printed by James Akerman, 6 Queen Square, WC.

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ANTWERP CIVIL HOSPITAL,

BELGIUM.

CONSIDERABLE interest attaches to this building, in consequence of its being the first hospital erected having circular sick wards. A proposal to erect hospital buildings of this form was first made in England, by Professor John Marshall, F.R S., of the University College and Hospital, London, in a paper read by him at a meeting of the Social Science Congress, in the year 1878, and shortly afterwards this paper was published as a pamphlet, together with some interesting and valuable criticisms by Mr. P. Gordon Smith, F.R.I.B.A., Architect to the Local Government Board.

In the year 1881, I published a work,* containing a design prepared by me for the erection of a Workhouse Infirmary for 700 inmates with circular wards, on Professor Marshall's system, but up to this time it does not appear to have been generally known that the foundation stone of the hospital at Antwerp, about to be described, had actually been laid in the same year that Professor Marshall, in total ignorance of this fact, had first propounded his scheme to an English audience.

I am indebted to Dr. E. Janssens, one of the members of the Conseil Supérieur d'Hygiène Publique, at Brussels, and to Mons. Baeckelmans, the designer of the building, for their courtesy in affording me the opportunity of perusing reports of the proceedings of the authorities charged with the erection of this building. I am also particularly indebted for much valuable information to Mr. A. J. Bacon (of the well-known engineering firm, Bacon and Co., Antwerp), and also to the very intelligent clerk of works, both of whom accompanied Dr. Mouat and myself over the building on the occasion of our visit. From the documents referred to, I gather that, on the 19th May 1873, a meeting of delegates was convened for the purpose of considering the appointment of an architect for the construction of the new building; there were present—

"Mons. Oudart, Inspector of the 'Establissement de Bienfaisance et d'Alienes,' delegated by the Government; Dr. Haylen, Member of the Permanent Deputation of the 'Conseil Provincial,' delegated by the Province: Mons. Leféber, Sheriff and 'Bex Conseiller Communal' at Antwerp, delegated by the City of Antwerp; Mons. Bayaert, architect, and Mons. Athanase de Meester, delegated by the Hospitals Commission; the latter gentleman was subsequently elected secretary to the jury; Mons. Eugene Meens, Vice President of the Hospitals Commission, by whom he was delegated; Mons. Olivier Van Stratum, President of the Hospitals Commission, accompanied by Messrs. Wontners and Grossens."

At their next meeting, on the following 26th of May, it was unanimously decided to recommend to the approval of the Communal Administration of Antwerp the design with circular wards, prepared by Mons. Baeckelmans; and, in submitting this design, together with two others having wards of a parallelogram shape, a strong hope was expressed that the former would be allowed to be executed, as "it more surely satisfied than any others, the conditions of æration and facility of service so long looked for in hospitals,

* *Charitable and Parochial Establishments.* London, 1881.

and, moreover, the design, inspired by a new idea, seemed to realise a notable progress on all that had been produced to that day."

The administration, before coming to a conclusion upon the question submitted to it, forwarded the designs to the managers, and medical officers of the hospital of St. Elizabeth, for their consideration. The reports of these bodies contained suggestions for improving the arrangements of some of the minor offices, but otherwise they were in perfect accord with the decision of the Committee as to the form the plan should take. Great diversity of opinion appears, however, to have been expressed by the various authorities consulted as to whether the plan of circular wards was or was not more expensive than that of parallelogram form, and as to whether in carrying out the works the system of contracting for the whole in one sum was more to be preferred than that by divided contracts and schedules of prices.

Ultimately, however, the plans were agreed to unanimously by the Administration, and forwarded for approval to the "Ministre de l'Intérieur" at Brussels, together with an exhaustive report upon the whole matter.

The Minister of the Interior referred this report, together with the plans, to the "Conseil Supérieur d'Hygèine Publique," and this body instituted a Commission, consisting of Mons. J. F. Vleminckx, Dr. E. Janssens, and Dr. Victor Vleminckx, to consider and report upon the matter. The following extracts from the report of this Commission deal principally with the question of the advantages to be derived from the erection of circular wards; and, as will be seen, the opinion arrived at was directly opposed to that unanimously entertained by the authorities at Antwerp:—

"The circular form to which great advantages are attributed, appears to have for its origin the counsel given to you at divers times to 'round the angles of the wards.' The author of the designs under discussion said to himself: 'Since no angles are desired, let us make a circle, and we shall completely satisfy the hygienists.' No doubt, it is very important to prevent the stagnation of organic dust in the angles of the wards, but the complete circle which is proposed has also its inconveniences.

"In the first place, it is evident that in a round room the beds next the walls are a less distance apart than they would be in a rectangular ward having the same superficies, and that the beds at the feet being very close together, the nurses and doctors will be inconvenienced. Then again, although it has by some been thought otherwise, we have no doubt that this radiating position will be found distressing to the sick, since any patient can the more easily see a larger number of his companions in misfortune.

"Now comes the question, Would superintendence be more easy? We do not think so.

"The nurses placed in the centre of the circle in a sort of cabin would certainly not be able to so easily keep their eyes upon the patients confided to their care as if they were at the extremity of an oblong ward. And when so placed in the middle of the emanations of the sick patients, will they not be under much more unfavourable conditions, especially during an epidemic, than if they were out of the ward and in a separate room overlooking it and provided with special ventilation?

"Finally, with respect to the principal argument advanced in favour of the circular system of wards, that a maximum capacity with a minimum surface is to be obtained, thus securing the acquisition without extra cost of an enormous cube of air, one of the most sure guarantees for salubrity.

"We at once admit that the volume of air will indeed be considerable, for, according to the calculations of the author of the plan, each sick person would have 2,120 cubic feet. But, is this great cube of air the best solution of the problem of ventilation?

"With good ventilation much less would suffice, and is it not rational to admit that a smaller quantity of air would be more easily renewed in a given time? In the matter of ventilation, the important fact must not be forgotten that it is not only necessary to supply pure air incessantly, but we must arrange for the evacuation in the smallest possible time of *all* the vitiated or altered air, and this without causing troublesome draughts. The present methods of ventilation have not yet arrived at such a degree of perfection as

to give us full and entire confidence in them, and our mistrust would, therefore, warn us not to run the risk of constructing wards of too large a size, and so exposing ourselves to one or the other of the inconveniences referred to.

"In our opinion, then, gentlemen, there is nothing which authorises an *à priori* declaration that circular wards, as proposed by the designer, are better than oblong pavilions with rounded corners.

"We now come to that part of the project which has given us cause for serious criticism. It concerns the general arrangement of the plan."

It is here necessary to remark, that by the plan first prepared and now under discussion, the connecting corridors were to be continued up to the first floor, and were intended to be closed in by low buildings on the sides next the interior courts, and in such wise that these courts would be entirely shut in. The report goes on to say :—

"The central blocks of buildings, grouped in the form of a parallelogram, are destined for the general administrative offices of the hospital, and contain four closed courts.

"It is almost unnecessary to remind you, gentlemen, that you have at all times shown yourselves decided adversaries to the construction of *interior courts* (bâtiment concentré); during the whole of the 27 years that the council has had existence, it has made ceaseless efforts to oppose the construction of every kind of interior court. Now, in the Antwerp project, the four courts of the central building would be closed in on four sides by buildings carried up to the first storey. These courts, surrounded as they are by pavilions for the sick, would necessarily become receptacles for miasmas, and the entire building would form by its mass an obstacle to the free circulation of air round the pavilions.

"We are quite aware that it will be objected that the pavilions alone are destined for the occupation of the sick, and that the central building is simply to be devoted to administrative purposes; but surely we must protect the healthy as well as the sick. And we must not forget after what we have just said, that those in health occupying the closed centre of this vast edifice, would not be placed under proper conditions of salubrity. In addition, we may observe that in and around the buildings referred to, it is proposed to place isolation wards and the ambulatories for the convalescent patients.

"No closed courts, neither for the healthy nor the sick, are principles upon which your Commission are unanimous, and cannot admit discussion."

The report deals with a large number of questions of much interest; and amongst other things, it makes objection to the proposed position of the mortuary, which is considered to be too close to the entrance; and it suggests that the number of beds in each circular ward, if erected, should be reduced from 24 to 20, also that the extent of the site should be increased, in order that the various blocks of buildings might be distributed at a greater distance apart from each other.

Acting upon this report, the Ministre de l'Intérieur sent back the plans to the Communal authorities of Antwerp, with a request that the recommendations in it should be acted upon. After much angry discussion, it was agreed to carry out all the suggestions with the exception of the proposed alteration of the form of the wards and the removal of the site of the mortuary, but Mons. Baeckelmans positively declined under the circumstances to act as architect of the building, and so it was ultimately arranged that two of his pupils, Messieurs Belmeyer and Van Kiel, should be deputed to make the necessary alterations in the design, and superintend the carrying out of the work. The revised plans ultimately received the sanction of the "Ministre de l'Intérieur;" not, however, without a grumble from the Commission before referred to, which would have had substituted parallelogram for circular-shaped wards.

The foundation stone of the building was laid December 1878, and at the time of my visit in May 1882 the carcasing and plastering of the walls was all completed, but the

authorities informed me that another three years would certainly elapse before the building would be ready for occupation.

Great commendation is due to the acting architects, Messieurs Belmeyer and Van Kiel, for the loyal manner in which they have preserved, as far as it has been possible to do so, the main features of the original design of their master, Mons. Baeckelmans; to a superficial observer no alteration whatever is apparent.

Site.—The site upon which the buildings stand has the shape of an irregular pentagon, and it is bounded on all sides by open roads, the northern, or main entrance, front faces the Rue des Images, and the eastern front faces the Rue de Lazaret, but all the other roads were new and unnamed at the time of my visit. The extent of the site is about 427,833 superficial feet, or 9 acres $3\frac{3}{10}$ roods, being about 1,126 superficial feet per bed.

General Arrangements.—The general arrangement of the buildings, together with plans and details of the principal sick wards, is shewn upon the accompanying plates.

The principal entrance to the establishment is through the centre of the front block A. The basement of this building is used only as cellarage, whilst the ground and first floors contain the director's residence and offices, reception rooms for the sick, and apartments for the resident surgeons and the porter.

Block B is a building one storey only in height above the basement or cellar floor, and it contains on the ground story an operation room with two adjoining wards, each for the accommodation of one patient.

Block C is the mortuary and post-mortem house.

The six blocks marked D contain the principal sick wards and their offices d d are connected with them by low enclosed passage ways or bridges. All these blocks are two storeys in height above their basements, and on each of the floors there is a large ward for the accommodation of 20 beds, and three isolation wards for one bed each; but, on the ground floors, where each of the blocks O adjoin, there are only two of these smaller wards. These pavilions will be more particularly described hereafter.

The blocks marked F f are similar to those last described, but the parts f f nearest to the main corridor are larger than the corresponding blocks d d, and instead of ordinary separation wards, they contain, on each floor, rooms for the reception of six private patients.

Block J is a building one storey only in height, and will be fitted up as a bathing establishment, not only for the use of the inmates, but for the outside public.

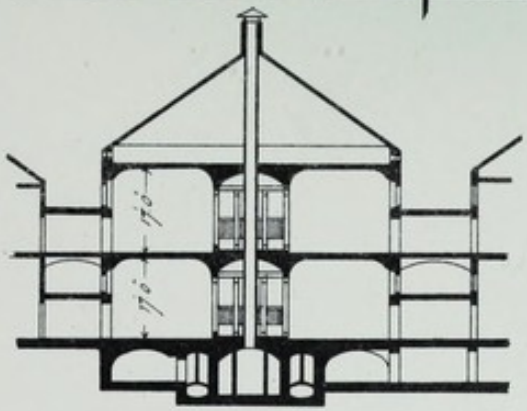
Block K is the laundry and wash-house. The linen from all the other hospitals under the charge of the Communal authorities of the town will be washed here.

Block L is two storeys in height above the basement, and contains apartments and a dining room for the nurses, and on the first floor linen stores.

Block M is generally one storey only in height above the basement floor, but the centre portion is carried up another storey. On the ground floor there is a dispensary and drug stores, and also the kitchen, scullery, stores, and other offices; apartments are provided for the use of various officers of the establishment on the upper floor.

Block N is a chapel.

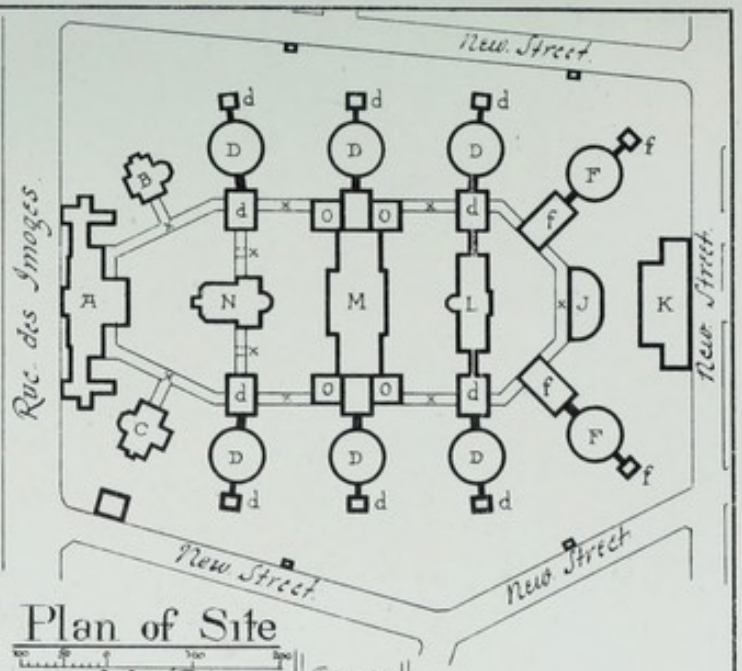
· Civil · Hospital · Antwerp ·



· Section thro Ward ·

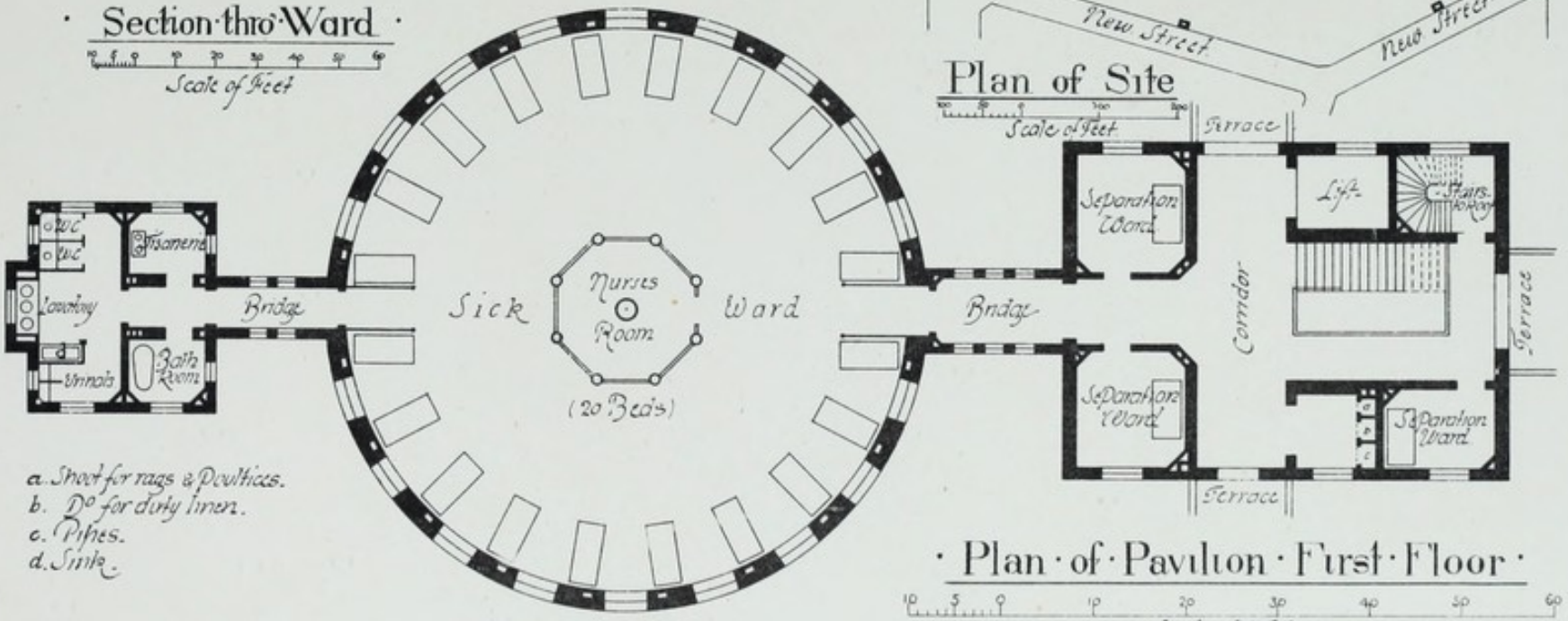
Scale of Feet

A. Entrance-Offices and Residences.
B. Operation Room.
C. Mortuary.
D f. Sick Wards
d f. Ward Offices.
J. Baths
K. Laundry
L. Nurses.
M. Kitchen & Dormitories.
N. Chapel.
O. Patients Dining Rooms
xx Covered Ways



Plan of Site

Scale of Feet



a. Shoot for rags & Poultices.
b. Do for dirty linen.
c. Pipes.
d. Sink.

· Plan · of · Pavilion · First · Floor ·

10 5 0 10 20 30 40 50 60

Scale of feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Blocks marked O are one storey only in height, and are intended to be used as dining rooms for convalescent patients.

Total Accommodation.—Accommodation is thus provided for 380 sick inmates, viz.: 34 separation wards, and two wards next the operation room, with one bed in each; 24 wards each for one paying or private patient; and 16 wards each having accommodation for 20 ordinary patients.

Connecting Corridors.—Covered arcades, marked x on block plan, about 10 feet wide inside, encircle the whole of the buildings and connect them together upon the ground floor, excepting only the laundry (Block K), which stands entirely detached. The two lengths of arcade connecting the front administrative building with the pavilions in the rear are covered with ordinary span roofs, but all the rest have flat roofs and so form, on the first floor, galleries of communication between the several departments, and also ambulatories for the use of the patients in suitable weather.

All these corridors are carried down to the basement level and form subways for conveying away the dust and dirty linen to their respective destinations. The lifts also descend to this basement for the purpose of removing the dead bodies to the mortuary, with which it communicates.

Water Supply.—The water to be used in this hospital will be supplied by the town authorities, and the service will be constant. Iron piping is employed throughout.

Drainage.—Two separate systems of drainage are provided for. The whole of the fœcal matter from the various water-closets is conveyed into two large brick cess-pits, each 285 feet long and 13 feet wide, built underground, and respectively placed parallel with and near to the eastern and western boundaries of the ground. Access to them is obtained from the adjoining roads, so as to facilitate the removal of the contents by carts. All surface and ordinary dirty water is conveyed away into the town drains by a distinct system of pipes.

Area Covered.—The area covered by buildings is 114,611 feet, being rather more than $\frac{1}{15}$ths of the site, and 302 superficial feet per bed.

At the time the First Edition of this Work was published the building was not completed, and it was therefore only possible to form an estimate of what would be the cost of the work. Now, however, I am able to state from information kindly furnished to me by Dr. E. Janssens, one of the Commissioners of the Conseil Supérieur d'Hygèine Publique, that the total sum expended upon the establishment has been £128,360, viz.: £112,360 for the building works (exclusive of furniture), and £16,000 for the land. This is at the rate of £322 per bed for the buildings and £42 per bed for the land, or £364 per bed for both land and buildings.

Principal Sick Wards.

The main sick wards are circular on plan, and stand detached from the other parts of the building, excepting that cross-ventilated lobbies afford a means of communication with the w.c.'s, bath-rooms, and the other usually attached offices; but it is important to notice that these lobbies, like those at Mons Civil Hospital last described, are not nearly so

high as the adjoining wards, and that the upper forms a bridge over the lower one with the result that currents of air can pass between the two; this is a great improvement upon the ordinary mode of constructing lobbies of communication, and should be adopted in all new hospital buildings.

Relative Position of Pavilions.—The height of the pavilions, as measured from the lower floor of the sick wards to the outer edge of the iron roof gutter, is 40 feet, and the least distance between any pavilion is 74 feet, or about 1⅘ths of the height.

Size of Wards.—The dimensions of the wards are not materially altered from what was shown to be intended by Mons. Baeckelman's original drawings, but the number of beds have been reduced from 24 to 20, as it was thought by the governing authorities that they would otherwise be too close together. As now planned, the diameter of each ward is 61 feet 6 inches, and the average height 17 feet. The total superficial floor space will therefore be 2,970 feet, or about 149 feet per bed, and the cubic contents 50,490 feet, or about 2,525 feet per bed. It will, however, be observed that this includes a space in the centre which is divided off by a low partition only for use as a nurse's room, "cabinet de la soeur," but although a bed is indicated on the original plans I could not ascertain whether this is really intended to be used as a sleeping apartment for the nurse; no doubt, however, this point will have reconsideration.

Bed Space.—The average lineal wall space per bed (deducting the width of the entrance lobbies) will be 9 feet, but as the beds will necessarily converge towards the centre of the ward, the distance between the feet of them will be reduced to about 7 feet.

Windows.—Eighteen windows are ranged round the outer walls, and it is intended that one bed should be placed between each of them. These windows are designed somewhat similarly to those of the three infirmaries erected by me some years since for the St. George's, the Holborn, and the St. Olave's Unions, and they more nearly approach than any I have seen elsewhere the form that I have in another part of this work recommended for general adoption in hospital wards. They each consist, for three-fourths of their height, of a pair of folding casement sashes; but the upper part, which is separated from the lower by a transom, is a sash hung on centres. It will thus be seen that the whole of the window is capable of being opened to its fullest extent. The objection generally urged against casement windows similar to those used in this hospital is the difficulty of keeping them wind and weather tight, but I find no such difficulty arise where the meeting rails are made to shut against a central mullion, and when proper grooved and tongued joints are formed at all junctions of the sash with the frame; a proper weather bar on the sill and lower rail is also essential, and for this I have always found Archibald Smith's patent contrivance to answer well. The total area of effective glazed surface in the 18 windows now being described is 567 feet, or 28⅓ feet per bed, and when all the windows are opened to their fullest extent the total area through which air can be admitted into the room is 812 feet, or about 40·6 feet per bed.

Warming.—At the time of my visit to this building, a contract had just been entered into for the execution of the ventilating and warming appliances for the sum of £11,680, and it had been determined that the method of heating the wards should be by means of air passed over coils of hot-water pipes contained in a chamber situated in the basement

under the central portion of each tier of wards, and that the air so heated should be propelled into the wards at the upper parts of the central columns by means of the machinery situated in the laundry building.

Ventilation.—The ventilation of the wards is intended to be effected mainly by the windows during weather which will permit of their being opened, but, during night and in the winter time, fresh air will be propelled into the wards by means of fans and other machinery situated in the laundry building, and this air will, when required, be warmed in the manner described in the last paragraph. For the removal of foul air from the wards, there is provided at the lower part of the outer wall, between each window and beneath the heads of each pair of beds, an outlet from which a flue 10 inches long and 8 inches wide descends to the level of the basement, and then, travelling horizontally, it enters a central chamber that is heated by coils of hot-water pipes; from the upper part of this chamber there is carried a large iron shaft which passes vertically through the centre of each ward and finds an outlet at the apex of the conical roof of the building. It will thus be seen that the current of air in this upright shaft is intended to carry with it the foul air drawn into the chamber through the flues, radiating from it to the openings in the wall beneath the heads of the beds in the manner described.

All the ward offices and the separation wards are ventilated by distinct flues formed in the brickwork by cutting off the angles of the various rooms, and these flues are connected by horizontal ducts with the central ventilating shafts.

Floors.—The flooring of the wards is to be formed of deal boarding five inches wide, tongued with iron, and to provide for shrinkage it is not to be permanently fixed for the first 12 months. It will be laid on timber joists resting on the brick vaulting of the ground floor and on the iron joists and concrete of the first floor. The ceilings are to be plastered.

Walls.—The outside walls of the wards are built of brickwork two feet in thickness. The outer surfaces of the walls generally are finished with red brick and stone dressing, and the interior faces with a plastering formed of two parts of lime and one of plaster of Paris.

W.C.'s, Baths, &c.—The water-closets, baths, and other like offices are situated in buildings connected with the main wards by enclosing cross-ventilated corridors about 12 feet in length and 4 feet 3 inches wide; they are only 8 feet 6 inches in height inside, and the upper one in consequence forms a bridge over the lower one, thereby allowing currents of air to pass freely between the two. These connecting corridors are continued on into the centre of the detached building, and then passages branch right and left from them and give access to the various compartments now to be described.

To the left of the entrance corridor there is a bath-room, 8 feet 3 inches long 6 feet 6 inches wide, and opposite to this there is a duty-room, or "tisanerie," described hereafter.

Leading off the cross passage and opposite to the entrance corridor there is a lavatory 7 feet 6 inches long and 6 feet 6 inches wide, intended to be fitted with three basins and with a slop sink.

Two urinals will be placed in a compartment 6 feet long and 4 feet 3 inches wide

leading off one end of the cross passage, whilst at the other end there are two water-closets, each 4 feet 3 inches long and 3 feet wide.

Arrangements appear to be made for warming the bath-room and "tisanerie," but not the other offices in this detached building; special ventilating flues leading into up-cast shafts are provided for all the compartments.

The description of w.c. apparatus, baths, and other fittings had not been decided upon at the time of my visit, but if these are perfect the whole arrangement of these departments of the building will be worth the study of future hospital designers.

Separation Wards.—The "chambres d'isolement" are situated in the detached buildings which give access from the connecting corridors to the large circular wards. These two buildings are separated by other low enclosed corridors 6 feet 6 inches wide and 15 feet in length, but otherwise similar to those described as connecting the wards with the sanitary offices on the opposite side.

There are three separation wards on each floor, each for the accommodation of one patient. Their dimensions vary, but their average superficial contents and cubic capacity, are respectively 133 and 2,050 feet.

Duty Room.—The "tisanerie," situated opposite to the bath room, corresponds to what, in England, we term a duty room. It is like the bath room on the opposite side of the passage, 8 feet 3 inches long and 6 feet 6 inches wide.

Lifts.—Adjoining the staircases and main corridors of each pavilion there is a lift space 10 feet long and 8 feet wide, but I was unable to ascertain upon what principle it was proposed that the apparatus should be worked.

Staircases.—The principal staircase of each pavilion occupies an area of about 485 feet, it is constructed of stone, and the treads are 6 feet long 12 inches wide and 6 inches high. On the first floor, adjoining the lift space, there is a smaller staircase leading to an attic storey, the use of which is not defined.

Adjoining the principal staircase there is a room having three divisions opening out of it into shafts descending to the basement level; one of these shafts is used for conveying away dirty linen, another for dirty rags, disused poultices, &c., and the third is a conduit for pipes.

Basement.—The basements of the pavilions are about eight feet in height, and the central portions beneath the circular wards contain the arrangements for ventilation and heating previously referred to. All other parts are unappropriated, and I could not ascertain whether it was intended to enclose any portion of them by windows.

Total Area of Pavilions.—The total area covered by each floor of the pavilions, including the covered ways connecting its three divisions and the walls surrounding them, is 5,810 feet, or 290 feet per bed.

A proposal has lately been made by Dr. J. Burdon Sanderson for the erection of annular sick wards for the reception of small-pox patients. These wards would have a central chamber 20 feet diameter, inside which an aspirator would be placed for the purpose of removing the foul air from the adjoining ward. It is proposed that this air should be made to pass through a furnace, or otherwise be subjected to a sufficiently high temperature to ensure the destruction of all organic matter contained in it. The

beds would be placed with their heads against the inner chamber and would be divided from each other by partitions; thus the patients would face the windows in the outside walls, placed at a distance of 18 feet from them. No step has, however, been taken at present to test the efficiency of this system, though it would seem to be an excellent plan for preventing the spread of contagion in the district surrounding a small-pox hospital; but more of this hereafter.

[*Since the First Edition of this Work was published the Author has given further consideration to the question of the desirability of erecting Circular Hospital Wards, and his conclusions are stated in a Paper read at a meeting of The Sanitary Institute of Great Britain at Leicester*, 1885, *and published in the Society's Transactions. It is also now printed in the Appendix at the end of this Work.*]

HEIDELBERG UNIVERSITY HOSPITAL,

GERMANY.

No country in the world has, up to the present time, made such progress towards a practical elucidation of the recognised principles of hospital construction as Germany. There, the development of the system of erecting sick wards as single-storied isolated pavilions, has for some years been fully carried out, and numerous examples of this mode of building are now, therefore, to be found in all parts of that country. France is slowly following the good example thus set to it in the hospitals erecting on Mons. Tollet's system referred to hereafter. England has not to the present time awakened to the obvious desirability of altering the present method of constructing its hospitals three, four, and five storeys in height, and although the fact has long been generally recognised that the various blocks of sick wards should be kept well apart from one another, yet (excepting in one or two isolated instances) this separation is rendered incomplete through the intercommunication of the blocks by means of enclosed corridors. Complete separation has, however, been carried out in some of the hospitals for contagious diseases erected in different parts of England, and it is to be hoped that the system may shortly become more general.

It remains to be seen, however, whether the pavilion system of construction is suited to very cold climates, such, for example, as exists in the northern parts of Germany and Russia ; and although I am disposed to think that the corridor system may ultimately be found more suitable in such situations as these, there can be no question as to which is best in our climate. Great difficulty is experienced in keeping the one-storied wards of the Berlin hospitals properly warmed, and, in those lately erected, special means have been taken for constructing the roofs to prevent the passage of heat through them ; this is more particularly referred to in the description given of the Tempelhof Military Hospital.

The erection of the Heidelberg University Hospital is due to the persistent efforts of Professor Otto Weber, who, so early as 1865, repeatedly "and in very emphatic language," drew public attention to the wretched condition of the old structure. He did not, however, live to see his idea for a new building realised ; but, subsequently to his death, a design was prepared, and the carrying out of it entrusted to a Commission of eminent scientists.*

The final designs for the erection of the buildings were completed in the month of September 1868 ; exactly twelve months afterwards the first sod was turned, and in October 1876 every part was pronounced to be ready for occupation. The Friedrichshain

* The Commission consisted of Professor Dr. Knauff, Herr Geh Rath Bluntschli, Herr Geh Rath Friedreich, Hofrath Simon, Bauinspector Waag, and Oberingenieur Esser. Before the works were completed Hofrath Simon died, and Bauinspector Herr Waag having retired, their places were supplied by Professor Lossen and Bauinspector Schaffer. The interior and general arrangements of the Ophthalmic Department and the Pathological Institute were entrusted to the care of Herr Hofrath Becker and Professor J. Arnold.

Hospital Construction and Management.

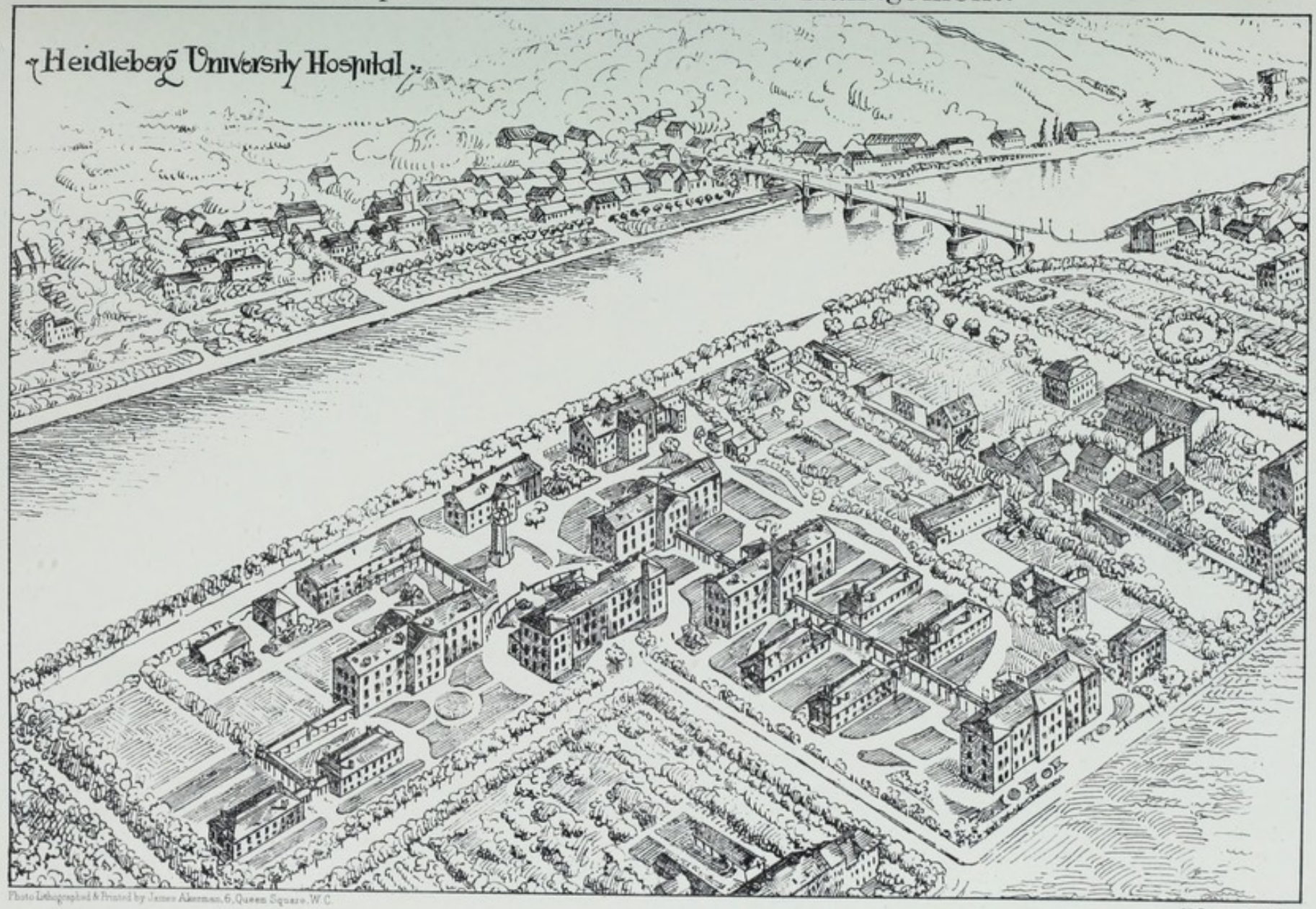


Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Hospital at Berlin was commenced at the latter end of the year 1868, and was completed in October 1874. Practically, therefore, the conception and carrying out of the two buildings may be said to have occurred during the same period, and the reader will consequently find it interesting to note the results arrived at by two different corporate bodies of the same nationality, each acting under the guidance of some of the most eminent medical and other scientific savants of the day.

In both cases it seems to have been determined upon as undeniably requisite that the hut, or one-storied pavilion, system, should be adopted for some at least of the buildings; but there was an evident and somewhat natural hesitation as to the adoption of this principle throughout, seeing that such an innovation had not before been attempted in a permanently erected hospital.

In the result, therefore, we see in both the Berlin and the Heidelberg buildings a combination of the three systems, viz., the corridor, the one-storied, and the two or more storied pavilions. At Berlin the whole of the surgical cases are provided for in one-storied pavilions, the general medical cases in pavilions two storeys in height, whilst the contagious cases are located in a building three storeys in height, planned partly on the pavilion and partly on the corridor principle. At Heidelberg eighty of the surgical and twenty-eight of the medical cases are treated in one-storied buildings, and the remaining patients of these classes, including those suffering from contagious diseases, occupy pavilions three and four storeys in height; whilst patients suffering from eye diseases are provided for in a separate building planned on the corridor principle. As a question of economical management, and indeed of first cost, it is undoubtedly a defect in the arrangement of the wards of the Heidelberg Hospital that so small a number of inmates are placed under the control of each nurse. The best authorities state that a head nurse can, with proper assistance, efficiently supervise from 28 to 32 patients, and these numbers have been taken as the unit for the construction of the Friedrichshain and many other modern hospital wards; whereas here we find that half, and in some cases less than half, this number of patients are given to the care of one head nurse, and it cannot but result either that the expenses of management are thereby increased inordinately, or that patients must suffer from inefficient nursing. In this and in many other matters of detail, there is a marked absence of that careful deliberation and forethought which characterised the proceedings of the Friedrichshain Commission; but, as a whole, the erection of the building is a long step in advance of others.

It will be observed that provision is made for the reception of a large number of private paying patients (nearly 15 per cent. of the total number of patients), and it will be interesting to compare the following translation* of the printed regulations for admission, with similar rules in force at St. Thomas's Hospital, given at page 24 :—

RULES FOR ADMISSION INTO THE HEIDELBERG ACADEMICAL HOSPITAL.

"I.

"Patients of three classes are received :—

"(1) Private room with one bed.

"(2) Room with two beds for two patients.

"(3) General ward.

* *Eleventh Annual Report of the Local Government Board.* London, 1882.

"II.

"The payments for maintenance according to the dietary table or the physician's order, for lodging, with service, fire and lights, bed and table linen, and the occasional use of the ordinary douche and sitz baths, are as follow:—

"1st class.—In winter (16 October—15 April)	8 marks a day.
"In summer	7 " "
"2nd class.—In winter	5½ " "
"In summer	5 " "

"Additional charges are made for—special nursing (2 marks for day and night, and 1 mark for night; medicated and steam baths (2 marks); the use of drugs, bandages and instruments; specially desired foods and beverages (wine, beer, &c.); finally, medical treatment, the fee for which is regulated by the chief director of the hospital.

"In the third class, the charge for entire maintenance is two marks a day, but an addition to this fee may be demanded according to the circumstances of the patient.

"III.

"For patients under two years of age the fees for maintenance are one-half the above in all three classes if admitted with a person in charge, if not so accompanied they pay the full amount.

"IV.

"Persons in charge pay the full fees of the class in which they are received.

"Patients of the 1st class may be accompanied by a person in the 2nd or 3rd class.

"Such persons must, in that case, share the rooms of the patients, except those in the third class on attendance on patients in the 1st class. These are quartered in the general wards.

"V.

"Before admission, or immediately thereafter, an undertaking for the future discharge of the demands of the establishment and of the physician's fee to be given to the governing body of the hospital."

The description of this building, written by Dr. F. Knauff,* has afforded me much valuable information as to many of the details of its construction, and my especial thanks are due to the following gentlemen, who, upon the occasion of our visit, personally conducted Dr. F. J. Mouat, Mr. Percival Gordon Smith, and myself, through the wards, and explained the details of the arrangements of their various departments, viz., Dr. von den Steinen in charge of the medical division, Dr. Arthur Thost in charge of the surgical division, and Dr. Julio R. da Gama Pinto in charge of the ophthalmic division.

Mr. Gordon Smith's observations upon the details of this building have been recorded in a valuable and interesting report made by him to the Local Government Board.† After giving a general description of the building, he sums up as follows:—

"There are many other points of the greatest interest and well deserving of attention by anyone concerned in the erection of a new general hospital and medical school. Thus, the special arrangements in the eye wards for darkening the wards without affecting their ventilation, and for facilitating the treatment of the various diseases of the eye are most complete; the various departments for galvanic and electric treatment, for the use of the laryngoscope and other modern appliances and instruments, the arrangement in connection with the hospital as a school of medicine and surgery, the pathological and dissecting departments, microscopic department, museum, experimental physiological department, &c., appear to be equally complete. The furniture also is, in many respects, deserving of attention. The ward beds are of iron, with wire spring mattresses, upon which are laid canvas mattresses, filled with horse-hair, and made in three parts, so that the middle portion, which is most frequently soiled, may easily be removed and replaced, without serious inconvenience to the patient; and each bed has at its head an upright post, on which is placed a blackboard with the patient's name, disease and treatment, written in white chalk, in such a way that it can be easily read by anyone. A narrow shelf is also provided below the blackboard, and likewise a simple

* *Das Neue Academische Krankenhaus in Heidelberg.* München, 1879.

† *Eleventh Annual Report of the Local Government Board.* London, 1882.

arrangements for suspending an ice-bag for cooling the patient's head. The bedside table is entirely open, so that everything can be seen, and the chamber utensil to each bed is a clear glass vessel, the contents of which are kept in their entirety until they have been seen by the medical officer in charge."

The following notes, by Dr. Mouat, attached to Mr. Gordon Smith's report above referred to, will also be read with interest:—

"In what I regard as clinical hospitals or institutions devoted to the teaching of medicine, as well as scientific research, based on the treatment of the sick, the Heidelberg Hospital is in advance of any of the endowed or other hospitals attached to medical schools in the United Kingdom.

"It not only contains an exceptionally perfect ophthalmic clinic, but in its mechanical and other contrivances for treating diseases of the nervous system, air passages, skin and organs within the reach of such remedial means, it is in advance of any hospital I have yet seen in any country.

"The use of baths as therapeutical as well as cleansing agencies is carried to a much greater extent on the Continent than among us; and the direct removal of impure air from diseased lungs, and its replacement by condensed, or rarefied, air, as may be required, is, so far as I am aware, altogether unknown as a practical application in Great Britain, where lung disease is so prevalent and fatal.

"Of the superiority of the method of heating and ventilation by the machinery described by Mr. Smith I am not so convinced, except as respects the condition of the climate of Heidelberg. I do not consider it necessary, however, to resort to such costly contrivances in our milder, damper, and more equable climate in which the uniform temperature required can, I think, be secured by simpler means.

"In their dealing with latrines and lavatories, and their disposal of excretory matters, the arrangements at Heidelberg contain nothing that can be usefully adopted by us, and much to avoid."

Site.—The buildings are situated on the outskirts of the town of Heidelberg, close to the southern bank of the Neckar, and about 400 feet distant in a westerly direction from the new bridge crossing this river. The height of the ground above "medium" high water mark is said to be about 27 feet.

The extent of the site is 409,032 superficial feet, being about 9 acres 1 rood and 22 perches, or 1,071 feet per bed.

Subsoil.—The upper surface of the ground is stated to consist of a clayey and strong vegetable soil, the next stratum is that upon which the foundations of the buildings are placed, and is a firm clay several feet in depth; below this, gravel is found; and the level of the underground water occurs about 52 feet below the surface. This level is in no way affected by the water of the river, which is shut off by the intervening impenetratable stratum of clay.

General Arrangement.—The accompanying plans, page 92, indicate the general arrangement of the various blocks of buildings, and also the details of the principal medical and surgical wards.

The establishment is entered through the central block A, situated at the junction of Voss Strasse and Hospital Strasse. This entrance building contains on the ground floor the manager's offices, the medical and the surgical officers' consulting rooms, and the apothecaries' apartments; also the patients' and visitors' waiting rooms, the laboratories and surgery, and three rooms for the conduct of therapeutic, laryngoscopic, and microscopic investigations. On the first floor there are apartments for the assistant medical and surgical officers, and for the manager and steward; also the waiting, consulting, and other rooms of the "Poliklinik" department. The second floor is divided into 14 rooms, each of which is devoted to the use of one first-class private patient only; and there are also on this floor two nurses' rooms, two bath-rooms, w.c.'s, &c.

Block B contains the culinary department of the establishment, including store rooms, the engine house and boiler room, and apartments for the engineer and porters. It also contains a vapour bath room with shampooing bench, an ante-room with spray and shower baths, and in addition bath rooms for the use of the officers of the establishment. A water tower with chimney shaft rises from the centre of the building.

Block C is a building three storeys in height, containing the wash house and laundry, with linen stores, work room, apartments for the matron and housekeeper, and sleeping rooms for various officers of the establishment. It can hardly be considered a desirable arrangement to place the living rooms of the officers in a building principally devoted to the washing of linen more or less infected.

Block D is a building containing apparatus for the disinfection and disposal of sewage.

Block E is an ice house.

Block F a coal store.

Blocks N N are medical pavilions four storeys in height above the basement floor, and each one contains on the ground floor bedrooms and dining rooms for the nurses of the medical division, and on the first and second floors four sick wards, each for eleven beds, with attached offices, four separation wards for one bed each, and three rooms each for two private second-class patients; there is also on each floor a nurse's bed room and a duty room. The third or garret floor is available for officers' apartments, and as "private second-class wards for lightly-affected patients."

Block I is a third medical pavilion for the exclusive treatment of patients suffering from syphilis, itch, and other skin diseases. On the ground floor there are four wards with accommodation for four beds each, and a separation ward to contain one bed only. There are three bath rooms on this floor. On the first and second floors there are four wards for eight beds each, as also three private or separation wards (these are, when required, used also for prisoners) each for one bed only, and bath rooms.

Blocks J J are medical pavilions one storey only (exclusive of basement) in height. The basement of each contains heating chambers, and coal and patients' clothes stores. On the ground floor there is a ward for fourteen beds. The bath room, water-closets, and duty room are situated on either side of the entrance. At the opposite end of the ward there is an enclosed verandah or glazed room. These buildings will be more particularly described hereafter.

Block K is a surgical pavilion four storeys in height above the basement storey, containing bed rooms for the nurses of the surgical division and other offices, a library for the use of patients, and a "consulting room for the Hospital Committee." On the first and second storeys there are two wards containing each nine beds, two separation wards for one bed each, and four wards each for two private patients of the second-class, or for those who may have undergone severe operations. The operation theatre is placed upon the first floor, and over it, on the second floor, there are apartments for the use of the head nurse. The attics forming the third storey of this building are available for officers' apartments, and as separation and children's wards.

Blocks L L L L are surgical pavilions one storey only in height (exclusive of basement). The basement of each contains heating chambers, and coal and patients' clothes

Heidelberg University Hospital

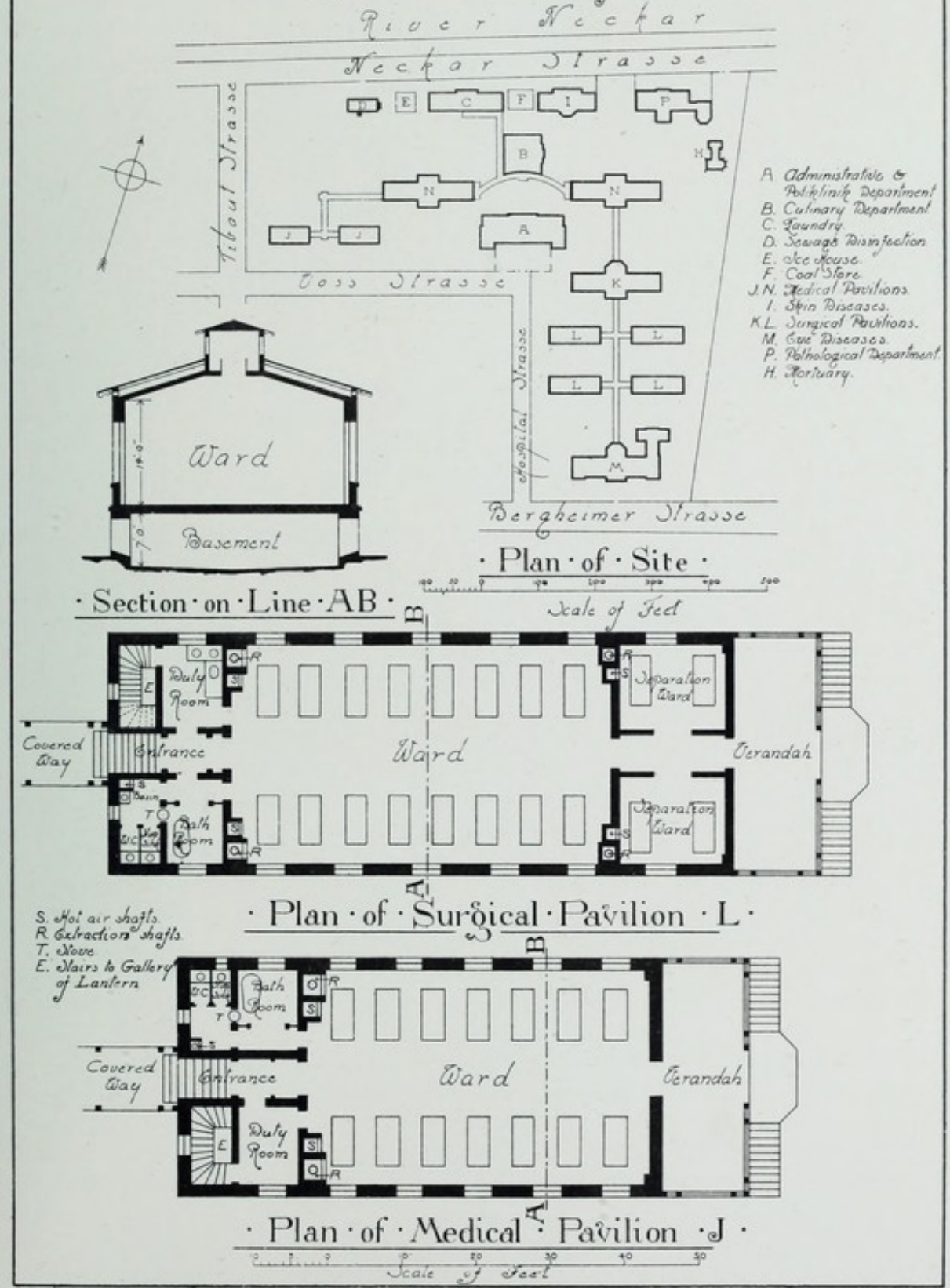


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H. Saxon Snell del.

stores. On the ground floor there is a ward for sixteen beds, and two separation wards for two beds each. The bath room, water-closets, and duty room are situated on either side of the entrance. Beyond the separation wards there is an enclosed verandah or glazed room. This building will be more particularly described hereafter.

Block M is the ophthalmic pavilion, a building four storeys in height above the basement, planned upon the corridor system, and containing complete accommodation for patients and officers, similar to that described for the medical and surgical departments. There is accommodation in this building for fifty ordinary patients and twenty-two patients in separate rooms.

Block P is the Pathological Institution, and contains upon the basement floor apartments fitted with kennels, hutches, stalls, and tanks for the preservation of animals, reptiles, &c. On the ground and first floor there are again various rooms devoted to the purposes of chemical, microscopic, and other like investigations, and on the third floor a large apartment called the "Assembly Room," and containing cases for the preservation of the various instruments used in this department, also a room of similar size more especially devoted to microscopic purposes. On the same floor is an auditorium or lecture theatre, and apartments for the resident assistants. In a kind of annexe to this building, and communicating with it by a corridor on the basement floor, there is a two-storied structure, containing on each floor a dissecting room.

Block H stands at a short distance from the Pathological Institution last described, and contains a mortuary, chapel, waiting hall, and dead-house.

Total Accommodation.—It will, then, be seen that the accommodation provided for the various classes of sick is as follows:—

First class private patients in administrative building, in wards with 1 bed each	14
Second class private patients in medical pavilions, in 6 wards with 2 beds in each	12
Ditto, in surgical pavilions, in 4 wards...	8
Ordinary patients in medical pavilions, in 2 wards of 14 beds each, 8 of 11 each, and 8 of 1 each	124
Ordinary patients in surgical pavilions, in 4 wards of 16 beds each, 2 of 9 each, 8 of 2 each, and 2 of 1 each	100
Ordinary patients in contagious pavilions, in 4 wards of 8 beds, 4 of 4 each, and 4 of 1 each	52
Ordinary patients in ophthalmic department	50
Private patients do. do.	22
Total	382

Connecting Corridors.—The various blocks of buildings are connected together by covered ways seven feet wide in the clear, and open at the sides, and consisting of slated span roofs, supported at intervals upon wooden posts. It is arranged that telephonic communication may be established between the sick wards and administrative offices.

Water Supply.—The town of Heidelberg is supplied with water from a spring (formerly part of the "Wolfsbrunen") stated to be of almost faultless purity, but the authorities could not spare the larger quantity required for all the purposes of this institution, and so it became necessary to sink a well, the water of which is pumped into a large iron tank situated in the upper part of the tower, which rises from the centre of the kitchen

building. This water, however, being very hard, is unsuitable for drinking, or for use in the laundry, and the town water is, therefore, laid on in separate mains, and employed for these purposes.

Drainage.—The drainage of the establishment is quite unconnected with the town system of sewage. It is first carried through main pipes to the disinfecting house (block D on plan), and here the liquid portion is passed through settling tanks containing a mixture of one part coal tar, one and a-half parts chloride of magnesium, and ten parts of chloride of lime, then it is pumped up and sent through pipes into the river Neckar running upon the opposite side of the adjoining road. I could gain no information as to how the solid matter is disposed of.

Areas Covered.—The published accounts of the building state that the total area of the ground, 409,032 feet, has been divided as follows:—79,395 square feet is devoted to buildings, 9,623 feet to covered ways, 149,320 feet to lawns and gardens, 136,260 feet to gravel paths, and 34,434 feet to macadamized roads. The area of the buildings, including covered ways, is, therefore, at the rate of about 233 feet per bed.

Cost.—The sum paid for the land was £5,720, or nearly £15 per bed. The total cost of the buildings, including fittings, laying out grounds and boundary walls, amounted to £86,282, or about £226 per bed. The various items of expenditure are as follows:—

Levelling site, boundary walls, roads	£2,785
Block A, administrative, &c.	6,885
,, B, kitchen, engineers' department, &c.	4,920
,, C, laundry, &c.	3,855
,, D, disinfecting house	1,350
,, E, ice house	450
,, F, coal store	375
,, N, medical pavilion	6,735
,, O, do. do.	5,770
,, I, do. do.	3,385
,, J J, do. do. ... (together)	2,590
Carried forward	£39,100
Brought forward	£39,100
Block K, surgical pavilion	6,130
,, L L L L, surgical pavilions (together)	7,090
,, M, ophthalmic department	9,975
,, P, pathological institute	4,375
,, H, mortuary, chapel, &c.	695
Workshop	322
Connecting covered ways	1,640
Gas and water pipes	6,850
Drainage	3,105
Superintendence of building and other general expenses	7,000
Total	£86,282

The total cost of the land and buildings together was about £241 per bed.

Surgical One-storied Pavilions.

The most important feature in this establishment, as also in that at Friedrichshain, is the introduction of pavilions one storey only in height above the basement. The authorities to whom the task of erecting the buildings was delegated, seem to have been in some doubt as to the advisability of introducing what was at that time (1868) a comparative novelty. It was known that huts and tents had been extensively used during the time of war and epidemics, and on all sides it had been admitted that fewer cases of hospital diseases occurred in them than in the many-storied buildings of more permanent establishments, and, moreover, cures had been effected more rapidly; but, on the other hand, it was feared that the expenses of management, heating, and ventilation would be increased inordinately, and so it came about that six only of these one-storied pavilions were erected here, two being for the reception of a certain proportion

of the medical patients and four for a proportion of the surgical patients. At Friedrichshain similar one-storied huts were erected for the whole of the patients of the surgical division, but those of the medical department were provided for in pavilions two storeys in height.

The wards marked L L L L on the block plan are one storey only in height above the basement floor, and they are connected with the other portions of the buildings by the open covered ways before described. The ward floors are several feet above the ground line, and are approached from the covered ways by flights of steps.

Aspect.—The question of the aspect of the windows of the wards was only settled after very great deliberation by the authorities charged with the erection of this building, and Dr. Knauff gives in his work a very exhaustive account of the considerations which ultimately led to the determination of placing the axes of the various pavilions as nearly east and west as the shape of the ground would permit. Actually, their direction is about E.S.E. and W.N.W. It is remarkable that the Friedrichshain building authorities, as the result of their deliberations on this question, arrived at an exactly opposite conclusion, and placed the axes of their pavilions directly north and south.

Relative Positions of Pavilions.—The height of these pavilions, as measured from the ward floors to the overhanging eaves of the roofs, is 15 feet, and the distance between the eaves of two pavilions is 51 feet, or about 3⅓rd times the height.

Size of Wards.—Each ward is of parallelogram shape, and is designed to accommodate 16 patients. The length is 51 feet, the width 29 feet 6 inches, and the average height 16 feet, exclusive of the ventilating roof lantern 7 feet wide and 6 feet high, which runs the whole length of the ward. The total superficial floor space in each large ward is, therefore, 1,504 feet, or about 94 feet per bed, and the cubic contents 26,206 feet, or 1,638 feet per bed.

Bed Space.—The average lineal wall space per bed is about 6 feet 5 inches.

Windows.—There are five windows in each side wall, and the effective glazed surface in each ward is 200 feet, or 12½ feet per bed; but, in addition, the ventilating openings in the lantern have an effective glazed area of 68 feet, so that, if this be taken into consideration, the total is about 16¾ feet per bed.

When all the windows, including those in the lantern, are open to their fullest extent, the total area through which air can be admitted into the wards by them is 335 feet, or 21 feet per bed. The sashes in the lower portions of the windows of the side walls are hung as casements, and the sashes of the upper portion turn on centres; those in the lantern are all hung on the lower rails, and open inwards to their full extent.

Warming.—The warming of the wards is effected by means of two calorifers placed beneath them in the basements, and the iron smoke pipes from these apparatus pass upwards through the ventilating shafts (*see* R on plan) of the wards, and so assist in promoting the extraction of foul air.

Ventilation.—Space will not allow a full description to be given of the contrivances adopted for the ventilation of this and the other buildings of the establishment. Generally, however, the principle, so far as regards the artificial ventilation of the buildings now under consideration, is that the heating apparatus performs the second function

of withdrawing air from, and inducing the income of fresh air to the various rooms; the amount of air so extracted or admitted is supposed to be regulated by means of numerous thermometers, valves, dampers, anemometers, and other paraphernalia; and it is to be hoped the attendants, not only understand the use of these contrivances, but properly apply them. Besides the air admitted by the windows which, as before stated, open to the extent of about 21½ superficial feet per bed, the space between the ceiling and the roof of the wards affords an additional channel of communication between the outer and inner air.

The most noticeable feature of the arrangements for natural ventilation in these buildings is that of the lantern lights. These run the whole length of the sick wards, and have windows on either side of them, but instead of adopting the usual plan of opening the sashes from the floors of the wards by means of continuous rods and levers, galleries run down either side so that the windows may be opened or shut by hand, and special staircases E are provided for access to these galleries. It may be questioned whether the advantages to be obtained by this more certain method of closing the sashes is commensurate with the outlay in forming so expensive a mode of access to them.

Floors.—As to the construction of the floors, the architect of the building describes it as consisting of pine boards 4¾ inches wide, the joints of which are closed by strips of sheet zinc, and he states that the wood has been protected from damp and rapid decay by repeated immersions into hot linseed oil and afterwards by varnishing; he regrets that the originally projected oak floor was not from financial reasons carried out. These flooring boards are nailed upon timber joists which rest upon the brick vaulting of the basement. The bath rooms, w.c., lavatory, and verandah are paved with asphalte.

Walls.—The walls are of brickwork, covered on the outside with a reddish coloured stucco, they are floated on the inside with plaster of Paris, and partly distempered and painted.

W.C.'s, Bath, &c.—As is usually the case with Continental establishments of this kind, the arrangements of the water-closets, bath rooms, and other like offices are most unsatisfactory; they are situated in this building to the right of the entrance lobby, and they are accessible to the ward by a passage way leading directly from one end of it. No attempt is made to prevent the foul air from the w.c.'s, &c., finding its way along this passage into the ward, but a special ventilating shaft is provided, and the compartments are warmed by a closed stove which stands centrally between the division wall separating the w.c.'s and bath room. The water-closet and slop sink compartments are situated on the right of the entrance, and are separated from the ward by a passage way, they are each about 5 feet long and 2 feet 7 inches wide; the two apparatus are combined in the form of a latrine of wrought iron, and it is stated that disinfectants are in constant use with the water, and so they need be. The lavatory, situated in the lobby which leads to the water-closet and slop sink, is 6 feet long and 5 feet 6 inches wide; it is fitted with "tip-up" earthenware basins fixed in moveable stands over square metal receivers communicating by waste pipes to the drain, and each basin is supplied with hot and cold water.

The bath room is about eight feet square, and the bath is made of zinc without casing. The sanitary fittings generally are in some respects an improvement upon those of many other Continental hospitals, but this is not saying much in their favour ; they certainly would not be tolerated in any similar building in England. It may, though, be worthy of remark here, and perhaps of imitation elsewhere, that the chamber utensils used in the wards are all made of clear glass.

Separation Wards.—A passage way five feet wide, entered from the end of the main ward, leads to an enclosed verandah hereafter described, and situated on either side of this passage there are two separation wards each 14 feet long, 11 feet 6 inches wide, and intended for the accommodation of two patients each, thus giving 81 superficial and (being like the larger ward, an average height of about 16 feet) 1,288 cubic feet per patient. It will be seen that this is a considerably less space than that given to each of the patients in the larger ward, viz., 94 superficial and 1,638 cubic feet, but this is an error that should be corrected by the removal of one bed from each of these small rooms, for the smaller the room the greater should be its superficial and cubical contents per inmate. Both rooms are provided with separate fresh air inlet and foul air extraction shafts, and they are warmed, as are the larger wards, by calorifers situated in the basement beneath.

Day Room.—The passage-way leading from the end of the large ward and giving access to the separation wards last described terminates in a so-called " verandah." It really is a room, 31 feet 6 inches long and 11 feet wide, glazed on three sides, the fourth side being the brick walls of the separation wards. It is stated to have been intended for the reception of four patients, but there can be no doubt that these rooms would be too hot in summer, and otherwise totally unfitted in winter, for occupation by patients in their beds. As a matter of fact, they were found at the time of my visit (September 1881) to be quite out of use, and I was informed that beds had not been placed in them since the building had been opened. No doubt they might be, and possibly are, used by the patients occasionally, and in suitable seasons, as day rooms. If the glazed sides were removed they would, like the verandahs at the Friedrichshain Hospital in Berlin, be a valuable adjunct to the sick wards by their availability for the purpose of airing the beds and bedsteads, which could be wheeled on to them, either with or without the patients, whenever the weather would so permit ; and, at all suitable times, they would be convenient as lounging places for those patients whom it might be desirable to retain within the precincts of the pavilion while enjoying the benefits of the external air.

Duty Rooms.—The duty room (" Warmekuche "), situated on the right of the entrance lobby, is 11 feet long by 8 feet wide, and is fitted with apparatus for warming food, &c. A staircase leading out of this room affords access to the gallery running round the ventilating lantern of the sick ward, and at the level of the half landing there is another room, but it is not apparent to what use this apartment is devoted.

Basement.—The basement storey of this building averages about seven feet in height, and is partly occupied by store and furnace rooms ; the portion beneath the large ward is kept, " excepting during sharp frosts," in free connection with the open air by means of large window openings.

Area of Pavilions.—The total area covered by each of these buildings, including the offices, but exclusive of the "verandah," is 2,730 feet, or 136 feet per bed. If the "verandah" be added, the area is 3,100 feet, or 155 feet per bed.

Medical One-storied Pavilions.

The planning of these buildings is similar to that of the pavilions last described, excepting that the principal wards are smaller, and that the separation wards are omitted altogether.

Size of Wards.—Each building is designed to contain 14 beds in one ward, 46 feet long, 29 feet 6 inches wide, and an average height of 16 feet. The total superficial floor space is therefore 1,357 feet, or about 97 feet per bed, and the cubic contents, including the ventilating roof lantern, 23,644 feet, or 1,689 feet per bed. There is, therefore, a somewhat greater space allotted to the medical than to the surgical patients; a reversal of the general rule.

Bed Space.—The average lineal wall space per bed is 6 feet 7 inches.

Windows.—There are five windows in each side wall, and the area of their combined effective glazed surface is 200 feet, or about 14¼ feet per bed, but, adding the openings in the roof lantern, the total is about 19¼ feet per bed. The windows, when all opened to their fullest extent, give a total ventilating area of 24 feet per bed.

Generally.—The warming, ventilating and other sanitary arrangements, and the construction generally, is similar to that of the surgical one-storied pavilions last described, excepting, as before stated, that there are no separation wards.

Area of Pavilions.—The total area covered by each building, including its offices, but exclusive of the verandah, is 2,132 feet, or 152 feet per bed; if, however, the "verandah" be added, the area is 2,505 feet or 180 feet per bed.

Medical Four-storied Pavilion.

The disposition of the rooms on the principal floor of the medical pavilions, N N, is shewn upon the accompanying woodcut, *Fig.* 7. The two principal sick wards each

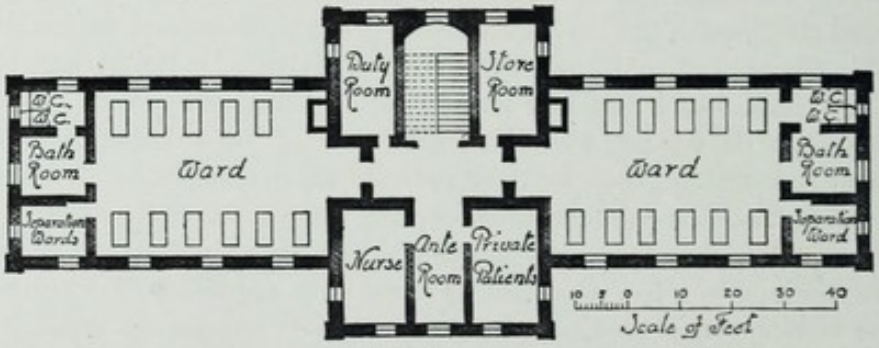


Fig. 7.

contain 11 beds, and are 43 feet long, 31 feet 6 inches wide, and 15 feet high, and, in addition, there is a large recess or lobby, 10 feet long, 6 feet wide, and 11 feet 6 inches high. The total superficial space per patient is, therefore, 1,414 feet, or about 129 feet per bed, and the cubic contents 21,000 feet, or 1,909 feet per bed. The average lineal wall space per bed is about 7 feet 2 inches. The nurses' room is 21 feet long, 12 feet wide.

The duty room and a store room ("abstellraum"), each 21 feet long 11 feet wide; the bath rooms, 12 feet 6 inches long 11 feet wide; the separation wards, 12 feet 6 inches long 10 feet wide: and the water-closets and slop sinks, including their lobbies, 12 feet 6 inches long 6 feet 6 inches wide. Beyond the interposition of the bath rooms there are no precautions taken for preventing foul air from the w.c.'s entering the wards. Adjoining the ante-room there is a ward for two private second-class patients, 12 feet 6 inches long 6 feet 6 inches wide.

Surgical Four-storied Pavilions.

The plan of the first floor of the surgical pavilion K is shewn upon the woodcut below, *Fig.* 8. The large ward is intended for the reception of nine patients, and is 41 feet long,

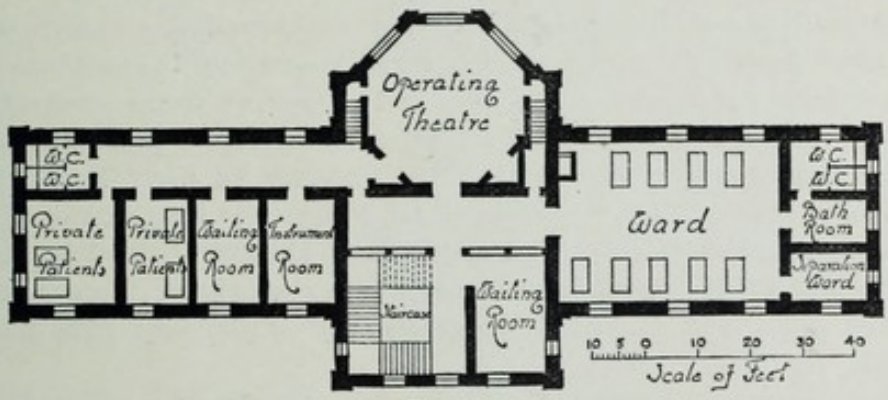


Fig. 8.

30 feet wide, and 15 feet high, so that its total superficial space is 1,230 feet, or 137 feet per bed, and the cubical contents 18,450 feet, or 2,050 feet per bed. The average lineal wall space per bed is about 8 feet 2 inches. Adjoining this ward is a separation ward, 14 feet 6 inches long 9 feet 6 inches wide; a bath room and lavatory, 14 feet 6 inches long 8 feet wide; and a water-closet and slop sink, including the lobby, 14 feet 6 inches long 8 feet 6 inches wide. As in the case of all the other pavilions, no proper precaution is taken for preventing foul air from the w.c.'s entering the adjoining wards; the authorities consider the interposition of the bath rooms all-sufficient. On the same floor, but in the opposite wing, there are two wards each of which is intended for the accommodation of two second-class private patients, and these rooms are respectively 20 and 17 feet long and 12 feet wide. Leading off the adjoining corridor there is a w.c. and slop sink, with a lobby as on the opposite side. The centre of the building is occupied by the staircase, a general waiting room, and an operating room or theatre, as also a patients' waiting room and a room for instruments.

BERLIN CIVIL HOSPITAL,

FRIEDRICHSHAIN, BERLIN, GERMANY.

FEW, if any, buildings hitherto erected are so well worthy the study of those interested in hospital construction as the one now to be described. The first design for it was prepared by the architects, Messrs. Gropius and Schmieden, in the autumn of 1866, and the scheme having ultimately been approved, a Committee consisting of the following members was delegated in the year 1867 to superintend the carrying out of the works: Herr Stadtrath Noeldechen as president, Herren Stadtverordneter Stadtbaurath Meyer, Professor Dr. Virchow, Dr. Newman, Halske and Voight, and the architects.

Before definitely settling the principles to be observed in the construction of the buildings, the written opinions of the following eminent medical authorities were invited as to the general details of the scheme: Dr. Esmarch, of Kiel; Professor Baum, of Gottingen; and Professor von Langenbeck, Dr. Wilms, and Dr. Quincke, of Berlin; as also the Government officials, Dr. Esse and Director Herfordt, both of Berlin.

Consequent upon the opinions advanced by these gentlemen, some alterations were made in the plans, and ultimately, about the end of the year 1868, the work was commenced.

Its progress was marked by the same careful deliberation manifested in the preliminary arrangements: no important step was taken involving any deviation from past principles without a most careful consideration of the resulting consequences, and, wherever it was thought desirable to do so, no expense was spared to test by experiment any doubtful points.

The authorities immediately charged with the construction of the building were, however, much impeded in their work by delays consequent upon the employment of so many advisers and directors, and it was principally owing to this cause, as also that two test pavilions were first erected, that its erection occupied so long a time as six years. It was not completed until September 1874. There can be no doubt that this system of divided control must always lead, as it did in this case, to a great loss of both time and money; but, however this may be, the result of the undertaking has been the production of a building that may well be said to mark an important era in the science of hospital construction. The introduction of one-storied pavilions, although limited to the surgical division only, is especially commendable as being the possible forerunner of a total abandonment of the principle of erecting hospitals, two, three, or more storeys in height. It will be seen, however, hereafter, that the French have already commenced the erection of hospitals, the sick wards of which are all of them but one storey in height, and there can be little doubt that the universal adoption of this principle is but a question of time.

The architectural features of the building are much to be commended, and the principal entrance front, shewn upon the accompanying illustration, has been designed with great skill. The materials principally employed for the exterior facings were red



Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

brick and stone, but in some of the more ornamental portions terra-cotta and mosaic work have been introduced. The buildings in the rear are less ornamental than those of the entrance front.

It has been already stated that the erection of this building was practically contemporaneous with that of the Heidelberg University Hospital, and attention has been called to the varying, and sometimes opposite, conclusions arrived at by the respective controlling and advising authorities (in both cases some of the most eminent scientific men of the day) as to many important questions of hygeine and construction.

The building was visited November 1882, under the kind escort of Herr Schmieden, the architect, to whom my thanks are due for his courtesy in this respect, and that he aided me in gaining much additional information on the subject generally of hospital construction in Germany. To Professor Dr. Virchow I am also much indebted for facilities in obtaining access to this and other hospitals in Berlin, as also for a personal exposition of the views entertained by himself and other eminent authorities in Germany upon the subject of hospital construction. I should not omit to also express my thanks to the intelligent engineer of the establishment, who was most assiduous in pointing out the details of the heating and ventilating appliances, and the machinery generally.

Site.—The establishment is situated on portion of the Friedrichshain, a park outside the Landsberger Gate. It adjoins the high road leading to Alt Landsberger, and lying as it does, an average of 62 feet above the water-mark post of the mill-dam, it offers an uninterrupted view over the city and the grounds of the adjoining park.

Being nearly surrounded by a park, the extent of the site may, from an hygienic point of view, be considered almost unlimited, but the space actually included within the boundary of the hospital is 1,027,962 superficial feet, being about $23\frac{1}{2}$ acres, or 1,713 feet per bed.

Subsoil.—The buildings stand upon a substratum of very firm clay 38 feet deep, having here and there small veins of sand and pebbles; below this clay there was found, during the construction of the wells, soft sand mixed with small pieces of coal, and at a depth of 98 feet this sand became larger grained and contained water.

General Arrangement.—The general arrangement of the buildings upon the site is shewn upon the plate at page 102, together with detailed plans and sections of the principal pavilions, a perspective view of the principal entrance front is also illustrated at page 100.

The main entrance of the establishment is through the administrative block situated in the centre of the western boundary facing the Park. A tradesmen's entrance adjoins the Landsberger Chausee on the south side, and a smaller gateway in the centre of the north eastern boundary gives access to the dead-house, and is chiefly used for funerals.

The block of buildings marked A upon the plan contains the principal administrative offices. The central portion is one storey only in height above the basement, but the wings at either end are each two storeys higher. The basement provides accommodation for the stokers and other subordinate officers, also wash-houses and coal cellars in connection with the apartments of the superior officers on the floor above, likewise furnace rooms, store rooms, cellarage, &c. On the ground floor, the entrance gateway occupies the centre of the building. The doctors' consulting and waiting rooms, the board room, and the manager's and clerks' offices are all entered off an elongated hall and vestibule

to the left of, and opening on, to the arched entrance. On the right a similar hall and vestibule gives access to the dispensary, and to the apartments of the dispenser, his assistant, the chaplain, and other officers. Here also is a reading room and library for the use of the medical officers.

Both the upper floors of the southern wing are devoted to the use of the principal medical officer, the first floor of the northern wing is occupied by the apartments of the managing director, and the second floor by those of the assistant medical officer.

Block B is a building three storeys in height above the basement, and consists of a kitchen, wash-house and engine-house. In most institutions of this kind it has been usual to arrange at least the first two of these departments as separate buildings, and it appears to have been intended in the first instance to do so here, but it is worthy of notice that the present plan was ultimately adopted upon the advice of Dr. Esse, the then managing director of the Charité, a hospital in the same town, providing accommodation for 1,500 patients. The working parts of the wash-house and kitchen are so much dependant upon the steam supplied from the boiler rooms, that it must always be desirable, on econonical grounds, for the three buildings to be as near to one another as possible. Objection is, however, generally felt to placing a department containing soiled and offensive linen in close proximity to one used for cooking inmates' food. It is, however, shewn in this plan that it is quite possible to arrange a combination of the three buildings in suchwise that no objection could really exist on this score. At the Marylebone Infirmary, previously described, the three departments are all contained in one building, but in that case the wash-house and laundry occupy the upper floors of one wing.

Besides a wash-house, laundry, kitchens, boiler and engine-house, and extensive store rooms and cellarage, this building contains a servants' hall, and on the upper floors apartments for the accommodation of a large number of the domestics engaged about the establishment, but this is an arrangement that is certainly undesirable. The whole of the topmost story of the building is utilized as a drying loft, and as a store room for mattrasses, &c.

Block C is an ice house, having a storage capacity of 187 cubic yards.

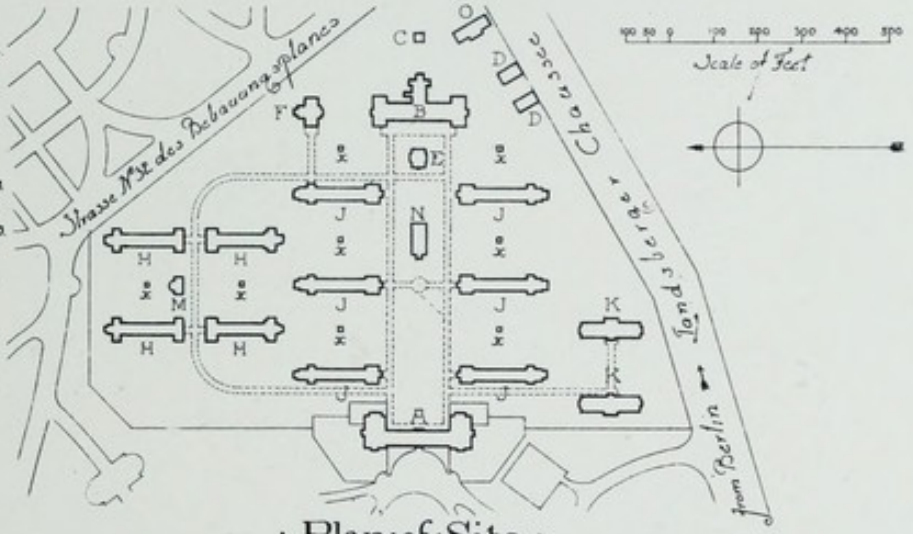
Blocks D D are buildings each three storeys in height above the basement, and, together, they provide accommodation for four married officers, one of whom on the lower floor acts as porter to the tradesmen's entrance gate adjoining.

Block E consists of a very completely designed Roman and vapour bath; the frigidarium having accommodation for six patients in separate dressing rooms formed by dwarf wooden partitions and curtains.

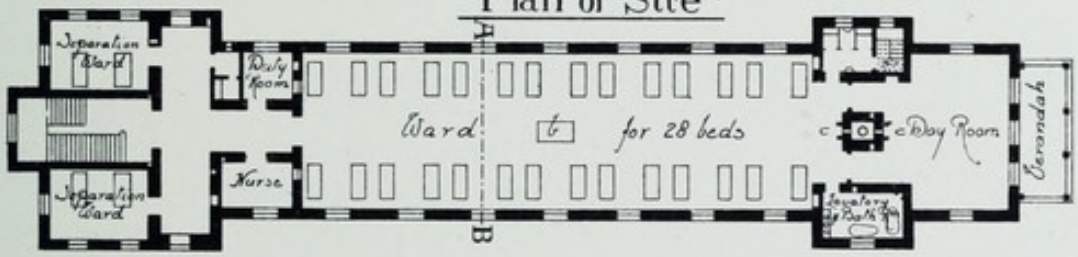
Block F is the mortuary and chapel; the bodies are placed in the basement, and there is a lift for conveying them when required to the floor above. The chapel is situated upon the ground floor, and also the dissecting room and apartments for the attendant. A large room in the upper floor is devoted to the storage of instruments, chemicals, &c. One of the apartments in this building was intended to be specially fitted up with all the necessary appliances for restoring animation in a patient under the influence of a trance; it has not, however, been used for this purpose, but has been appropriated as a chaplain's room.

· Berlin · General · Town · Hospital ·

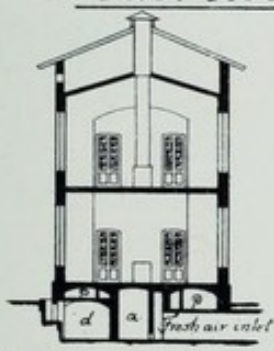
A. Administrative Offices.
B. Kitchen Washhouse & Engine house.
C. Ice house.
D. Married Officers Quarters & Porter.
E. Roman & Vapour Baths.
F. Mortuary & Chapel.
HHHH. Surgical Wards.
J.J.J.J.J.J. Sick do.
K.K. Infectious do.
M. Operating Room.
N. Chapel.
O. Nursing Institute.
x. Fresh air inlets.
a. Heating pipes.
p. Air ducts.
b. Hot water coils.
c. Open fires.
d. Passage way.



· Plan · of · Site ·



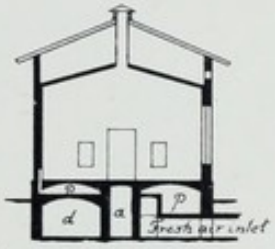
· First · Floor · Plan · of · Two-storied · Pavilion ·



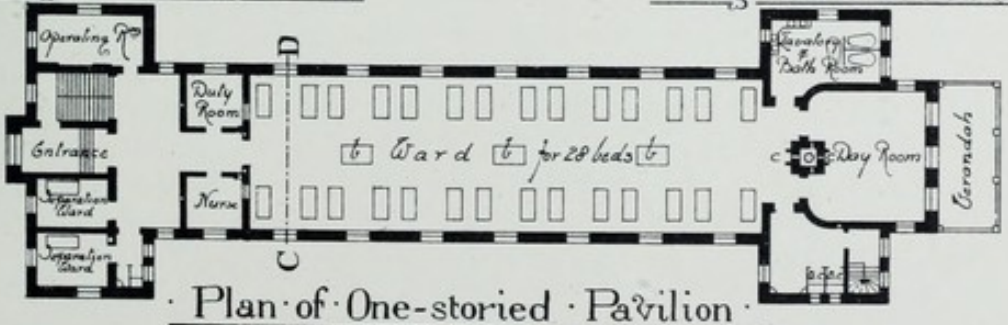
· Section · on · Line · AB ·
· through · Two-storied · Pavilion ·



· End · Elevation · of ·
· One-storied · Pavilion ·



· Section · on · Line · C D ·
· through · One-storied · Pavilion ·



· Plan · of · One-storied · Pavilion ·

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Blocks H H H H are pavilions one storey in height for the reception of surgical patients. The disposition of the smaller rooms is not the same in all of these buildings, some have more and some less accommodation for surgical patients; each pavilion, however, has one large ward for twenty-eight beds, and an average of four beds additional in separation wards, so that the total average number of patients that can be accommodated in each pavilion is 32.

Blocks J J J J J J are pavilions two storeys in height for the accommodation of medical patients. Each building has two wards for twenty-eight beds each, and four separation wards for two beds each, so that a total provision is made in each block for 64 inmates.

Blocks K K, two storeys in height above the basement floor, are provided for the isolation of infectious, contagious, and other forms of disease. Each of these buildings is capable of accommodating 44 patients in four wards for eight beds each, four for two each, and four for one each.

Block M shews the position of the operating room, the erection of which was delayed through want of funds. When visited in November 1882 it had nearly been completed, but not from the designs of the original architect; and this is much to be regretted, for the details generally are much wanting in that completeness which characterises those of the establishment generally.

Block N marks the site of a chapel, which, for similar reasons, is not at present erected.

Block O, like the operating room, was not erected at the same time as the original building owing to the want of funds, but it is now completed. It consists of a nurses' institute, and is a two-storied building, having on the ground floor a lecture hall and dining room, and a ward containing cubicles for ten nurses, with attached bath room, w.c. and waiting room; and on the first floor there are two wards with cubicles for ten nurses each, and apartments for the lady superintendent.

Total Accommodation.—Accommodation is thus provided for 600 beds, viz.: 16 wards for 28 beds each, 8 for 8 each, 32 for 2 each, and 24 for 1 each.

Connecting Corridors.—The original project for connecting the various blocks of buildings by covered ways was, after much consideration, ultimately abandoned; and the mode of communication, as now executed, is by the open uncovered roadways indicated upon the block plan by dotted lines. These roadways are about 11 feet wide, and they are raised 12 inches above the average level of the adjoining ground; narrow granite slabs are laid down on either side, and the intervening space filled in with sandstone landings laid to a quick fall upon brick foundations and bedded in cement. Gutters run down each side for the more speedy collection and removal of the rain water. The whole of the pavilions are connected with the front administrative offices by electric bells, and a code of signals has been arranged for communication between the porter and the medical men and other officials. It may, perhaps, be mentioned here that the external walls of all the buildings containing sick patients are bordered at the ground level with tile pavements three feet in width.

Water Supply.—At the time the buildings were first erected, the water company's mains had not reached this outlying quarter of the town, and it was necessary, therefore, to sink wells and erect pumps for the supply of water to the establishment.

It was estimated by the authorities that the amount of water required would be at the rate of about 68 gallons per day for each patient or other inhabitant of the institution, and it was assumed that 20,528 gallons would be necessary for the daily watering of the grounds. Taking the number of inmates, including officers, at 700, the total daily consumption would, therefore, be 68,128 gallons, or 68 gallóns per inmate for use in the buildings, and 29 gallons per inmate for the grounds.

The cisterns, sixteen in number, distributed throughout the buildings have a total storage capacity of 33,484 gallons, or about two-thirds the estimated daily consumption. Looking to the possibility of an occasional breakdown of the pumping machinery, this provision would appear to be far too small.

Drainage.—The whole of the drainage of the establishment is carried away by glazed earthenware pipes into the city canal near the "Landsberger Platz," but before leaving the building it is passed through two cast-iron tanks kept periodically supplied with carbolic acid, situated beneath the basement floor of the entrance administrative buildings.

Area Covered.—The area covered by buildings is about 123,020 superficial feet, or about $\frac{3}{17}$ths of the whole site, and 205 superficial feet per bed.

Cost.—As the land upon which this institution has been placed formed part of the municipality, its value has not been stated and cannot well be ascertained. As to the cost of the building, we are reminded by the architects that the works were carried on for a period of six years, from the latter end of 1868 to October 1874, when the building was opened, and they state that during this time the prices of building materials rose eighty per cent., consequently, as no general contract had been taken for the work, the actual cost was on the average at least fifty-four per cent. more than it would have been had it all been carried out in the year 1869. As it was, the total sum paid, exclusive of furniture, was 4,217,261 marks, or £210,863. This is at the rate of £351 per bed.

Surgical Pavilions.

The pavilions devoted to the surgical department of the establishment, so far as regards the main sick ward of each, are one storey only in height. A plan and a transverse section through one of the wards is shewn upon the plate at page 102. The rooms at either end of these pavilions are not carried so high as the large central ward, and an additional storey is, therefore, obtained at these parts.

Aspect.—The axes of the buildings throughout run north and south, and the windows of the wards, therefore, face east and west. It is stated that this direction was chosen in order to obtain the beneficial effects of the sun's rays upon both the principal fronts of the sick wards. It is curious to note that the authorities charged with the erection of the Heidelberg Hospital, after a very exhaustive enquiry, arrived at the conclusion that a greater amount of benefit was to be extracted from the sun's light and warmth when the axes of the pavilions laid east and west, or in an exactly opposite direction to that of these buildings.

Relative Position of Pavilions.—The height of the buildings, as measured from the floors of the wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 24 feet, and the distance between the buildings is 173 feet, or about $7\frac{1}{8}$ times in height.

Size of Wards.—The large ward is of parallelogram shape, and contains twenty-eight beds. It is 97 feet long, 29 feet 9 inches wide, and 19 feet 6 inches average height; in addition, there is a recess at one end, 18 feet 4 inches long, 7 feet wide, and average 14 feet 6 inches high; so that the total superficial floor space is 3,014 feet, or about 108 feet per bed, and the cubic contents 58,133 feet, or 2,076 feet per bed.

Bed Space.—The lineal wall space given to each bed is 6 feet 11 inches.

Windows.—There are seven windows in each side wall, and the total area of their effective glazed surface is 654 feet, or about 23½ feet per bed. When all the windows are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 682 feet, or about 24½ feet per bed. All the sashes are double, and are glazed with thin sheet glass. The lower parts of them are constructed as folding casements opening inwards; the upper parts as fanlights opening inwards on bottom rail.

Warming.—An unusual amount of attention was given to consideration of the system to be adopted for warming the sick wards generally. The relative advantages of hot-air and hot-water heating were thoroughly and ably investigated by the builder, Herr Waltzien, and the engineer, Herr Henneberg, and the facts elicited by this enquiry were embodied in an able and exhaustive report.* As the result of the investigation, it was determined that all the buildings, excepting the infectious block, should be heated by hot-water circulation, it being considered that the advantages of this system, as compared with those of air-heating by calorifers, were very considerable. For the purposes of the experiments, two of the surgical pavilions were respectively fitted up with one of each kind of apparatus, and, as these were not afterwards removed, it comes about that the south-east surgical pavilion is exceptionally heated by calorifers. All the others are heated by a low pressure hot-water circulation system, similar in principle to that adopted in this country.

The following is a *resumé* of the considerations upon which this decision was arrived at. The advantages of heating by hot-water circulation were found to be—

1. That the difficulty in retaining equable temperatures in the various rooms was not so much dependent upon proper attention to the heating apparatus as in the case of the hot-air system.

2. The maximum ventilation could be increased to three and a-half times the prescribed limit.

3. The whole of the heating apparatus could be placed in one room, therefore the management was easier.

The disadvantages of water heating were—

1. The greater first cost of the apparatus, it being one and one-third that of the hot-air apparatus.

2. The apparatus consumed one and a-half times more coal than in the other system.

The advantages of the hot-air system were—

1. Less expenditure in the first cost of the apparatus, it being three-fourths that of the hot-water apparatus.

* *Das Städtische Allgemeine Krankenhaus in Friedrichshain zu Berlin.* Berlin, 1876.

2. The consumption of coal was two-thirds that used by the hot-water system.

3. The rooms were more quickly heated.

4. The maximum ventilation could be increased to two and a-half times the prescribed limit.

The disadvantages of the hot-air system were—

1. The quicker cooling of the rooms, and a corresponding decrease of the ventilating power.

2. Greater difficulty in managing the heating apparatus, through their larger number and wider distribution.

3. The unavoidable noise heard in the wards when the apparatus (necessarily situated below their floors) were being stoked.

The furnace room of each pavilion is situated in the basement below the day room, and twelve heating pipes pass from the boiler backwards and forwards through a channel "a" (*see* section) situated beneath the floor of the ward and running down the whole length of it. Two of these pipes are carried on further, and heat a large coil placed in a chamber below the floor of the lobby forming the entrance to the large ward. The air from this chamber so heated is carried by flues into the smaller rooms situated at this end of the building. A second row of pipes is carried from and to the boiler, feeding on its way various coils of pipes situated in the large ward and in the smaller rooms and passages of the building generally. Three of these coils of pipes are enclosed in handsome pedestals, which stand in the centre of the large ward b b b (*see* plan) immediately over outlets from the horizontal central heated channel previously described as running beneath the flooring. In addition to the above method of heating, an open fireplace is provided at the end of the ward "C" on plan.

It is stated that the total average consumption of coal is 7½ cwt. per day, and that of this quantity 3 cwt. must be considered as expended for ventilation.

All the heating and ventilating works were executed under contract, and it may be interesting to note here the conditions laid down by the authorities as to the temperature of the various rooms, conditions which the contractors are stated to have more than fulfilled:

"1. In all rooms designed for the reception of sick patients it is necessary to keep up, day and night, an equable temperature of 15° Reaumur (66° Fahr.), but it must, at the same time, be possible to increase this temperature in all or in any separate room to 18° R. (73° F.), or, so far as the temperature of the outer air will permit, to decrease it below 15° R. (66° F.)

"2. In rooms set apart for medical men, for nurses and other attendants, the temperature during the daytime must not be permitted to sink below 15° R. (66° F.), and during the night not below 10° R. (55° F.)

"3. On the staircases and in the corridors the temperature must not be permitted to sink below 10° R. (55° F.) during either night or day.

"4. The heating of the whole building must, on principle, be central.

"5. The heated air to be conducted into the rooms must not exceed 44° R. (131° F.), and must enter in such a manner that no one can be inconvenienced by it.

"6. The air brought into the building must contain an appropriate proportion of moisture.

"7. Care must be taken that the patients in the wards and day rooms may, at any time, be able to warm themselves either at a stove or a fireplace."

Ventilation.—The points marked *x x x* on the block-plan indicate the position of the inlets for fresh air to be carried by artificial means into the various medical and surgical pavilions. At these points there are louvered shafts standing a short distance above the ground, and from them horizontal channels run underground and enter the basements of the pavilions at the points indicated upon the sections. The air entering by these channels is again carried along smaller ducts into the chambers containing the heating pipes, and, becoming warmed, it is emitted through flues into the smaller apartments of the building at a height of about five feet above the floor lines, and into the larger wards through the hot-water pedestal coils previously described.

The fresh warmed air, on entering any ward, passes upwards to the ceiling, and, being supposed to have performed its function of diluting the foul atmosphere of the apartment, and having become cooler, it passes downwards and is drawn off through gratings situated near the floor in the outer walls at the back of each pair of beds into channels *p p* (*see* section) which communicate with the extraction and chimney shaft situated between the end of the ward and the day room. The flue pipe from the furnaces situated in the basement is constructed of cast-iron, and as it becomes heated it rarifies the air in the brick shaft enclosing it, and so induces an upward current and causes the suction of vitiated air from the ward in the manner last described. It is stated that the withdrawal of air from the ward by this means was found to be so great as to necessitate its control by means of large throttle valves placed across the channels where they opened into the brick chimney shaft; anemometers are also placed in these openings having indicators in the ward so contrived that the velocity of the current may be observed by the ward attendants, and be increased or diminished as the occasion may require. The summit of the chimney and ventilation shaft is provided with an octagonal wrought-iron wind-guard, or cowl, which, it is stated, was shewn by repeated experiments to materially assist the upward movement of air in the shaft, more especially during windy weather.

During summer weather, and when the bath-heating furnaces alone are working, the cast-iron chimneys are kept at the required heat by means of supplementary stoves, the fires of which will last, without attention, for six or eight hours.

The open fireplaces at the end of each ward, and in the adjoining day room, afford additional and important means of ventilation.

In addition to the natural ventilation afforded by opening the side windows there is provided a channel, two feet wide, running the whole length of the ward and joining the apices of the ceiling and the outer roof. This channel is covered with a kind of lantern having flaps capable of being opened or closed when required, and the lower part next the ceiling is also provided with flaps. The opening and closing of both are effected by means of a gallery reached by stairs and running down either side of the roof channel.

As in the case of the heating works, the authorities charged with superintending the erection of the buildings drew up conditions (of which the following is a translation) under which the ventilating arrangements were to be made to work, and it is stated that these conditions have been fully complied with :

" 1. At all hours of day and night, and at all seasons of the year, it shall be possible to convey into the wards fresh air of appropriate temperature at the rate of from 2,265 to 2,574 cubic feet per bed per hour.

" 2. It must be possible to admit fresh cold external air into the wards at pleasure without inconveniencing the patients.

" 3. The admission or extraction of air must not exceed a velocity of 19 inches per second at points where the current can be felt by inmates.

" 4. Gas-lights should assist the ventilation, and the products of combustion must not enter the rooms.

" 5. In case it should be required, the amount of ventilation mentioned in No. 2 should be capable of being doubled.

" 6. The air must not be emitted in places where it can be deleterious to the patients.

" 7. Care must be taken that the air in the extraction shafts cannot be conducted from one room into another, and also that no backward current can take place. In this matter the influence of wind upon the outlet and inlet openings must have special consideration.

" 8. All extraction and inlet shafts must be provided with proper registers for regulating the ventilation, or satisfactory reasons must be shewn for the omission.

" 9. Owing to the open position of the hospital, the air may be conducted into the building from any height, but it must not be allowed to come in contact with the earth and so make it damp.

" 10. The fresh-air inlet openings are to be at such a distance from the mouths of the extraction shafts that no communication of air can take place between them that would affect the proper ventilation of the wards.

" 11, 12, 13. Water-closets and all other rooms, corridors, stairs, &c., are to be properly ventilated in accordance with the respective uses made of them, and in such manner as to avoid draughts.

" 14. Fireplaces for assisting ventilation are to be as few in number as possible.

" 15. The cost of ventilation must be capable of the most exact calculation.

" 16. Recording apparatus must be provided for ascertaining at all times whether the conditions laid down in clauses 1, 3 and 5 are attained."

Lighting.—The lighting of the wards by night is effected by four double-arm pendant gas burners, with white glass globes and green shades to each.

Flooring.—The flooring of the ground storey is supported upon the brick arched vaulting of the basement, and the finished surface of the sick wards and all other rooms, excepting the day and attendants' rooms, is formed with 6-inch " Mettlach " tile paving. All other rooms are covered with close fitting pine flooring. The selection of a tile flooring for the wards was a question much deliberated upon by the authorities, and, with the cautiousness which invariably characterized their proceedings, the two pavilions first erected were respectively floored with oak boards and with tiles, and, in the result,

it having been decided that the latter covering was best, this material was adopted for the wards of the buildings afterwards erected, excepting in the case of the upper floors which are boarded. It was considered that the position of the heating pipes and ventilation ducts below the flooring would tend to nullify any objection that might otherwise have been raised to coldness of the floor constructed of so "dense" a material as tiles.

Walls.—The walls of the wards are about 22 inches thick and are constructed of bricks finished on the outside with red facings. The inside is covered with plastering and painted in oil colors.

W.C.'s and Urinals.—The principal w.c.'s, urinals, and slop sink, are situated in a building jutting out on the right-hand from the end of the large ward. The room in which they are placed is about 14 feet square, one corner being rounded off by the wall of the adjoining day room. The w.c.'s are separated by low partitions 7 feet high, but the urinals and slop sinks are not divided off. There is no cross-ventilated lobby to separate this room from the ward, nor is any other structural precaution taken to prevent foul air arising from the w.c.'s and urinals being blown directly into the wards when the windows are opened; on the contrary, open gratings are inserted in the lower panels of the door communicating with the ward, for it is contended that the action of the ventilating appliances is such that the air is constantly being drawn out of the ward and through the compartment containing the urinals into the ventilation extraction shaft.* It is difficult to believe that such a result could at all times be depended upon, although it may be theoretically correct to assume that if the heating and extracting power of the ventilating flue from the urinal compartment is greater than those of the adjoining ward, the flow of air would, under certain conditions, be in the direction stated, but the opening of the windows, or even of the door leading into the adjoining staircase, would utterly reverse the conditions upon which such a theory would be tenable.

The water-closet fittings are "Jennings' patent valve closets," but the construction of them is evidently not understood by the Germans, for, at the time the building was visited, many of the valves were out of order and kept tight by ligatures of flannel; the urinals are the ordinary "lipped apparatus," and the slop sink is of enamelled iron and hemispherically shaped.

Water-closets and slop sinks are also placed in compartments leading off the corridors adjoining the separation wards.

Baths and Lavatories.—The lavatory is contained in a room situated to the left of the end of the large ward, and it corresponds in shape and size to the w.c. compartment last described; there are three zinc tip-up lavatory basins with hot and cold water supply to each. A portable zinc bath on wheels stands in this room for use when requisite at the

* "Die vom Krankensaal nach den Badestuben und Closets führenden Thüren sind in ihren unteren Füllungen mit Gittern versehen, durch welche sich die hier von der Ventilation abgesogene Luft vom Saale aus ersetzen kann. Bei dieser Einrichtung muss sich stets ein Luftstrom vom Saale aus nach den Bade-und Closet-Raümen bilden und es kann daher nie der Ueblestand eintreten dass eine in entgegengesetzter Richtung sich bildende Luftbewegung die Luft der Nebenräume in den Saal hineinführt."—*Das Städtische Allgemeine Krankenhaus im Friedrichshain zu Berlin.* Berlin, 1876.

bedside. Leading out of the lavatory room there are two bath rooms each about 6 feet by 7 feet, and containing an uncased cast-iron enamelled bath supplied with hot and cold water.

The water for the baths and lavatories is heated in a furnace placed in the basement, and it circulates through pipes similarly to the action of the heating apparatus; the pipes pass through a coil placed in a cupboard where the bath linen is warmed.

Day Room.—At the end of the large ward, and entered from it by glazed doors on either side of the fireplace, there is a day room, 26 feet 3 inches long, 23 feet extreme width and 16 feet high. The area of this room is 578 feet after allowing for irregularities in plan, and this gives about 20⅔ feet superficial and 360 cubic feet to each of the twenty-eight patients occupying the adjoining ward. The room is warmed by two coils of hot-water pipes and by an open fire.

Verandah.—Leading out of the day room there is an open covered verandah about 27 feet long and 11 feet wide, upon which the beds may be wheeled in fine weather either with or without the patients as the nature of their cases determine.

Separation Wards.—In the accompanying plan two separation wards are shewn to be placed upon the right-hand side of the entrance hall; they are respectively 10 and 9 feet wide by 14 feet long, and both are 13 feet high. Two other separation wards are situated upon the first floor, and these are on plan respectively 10 feet by 14 feet and 10 feet by 21 feet; both are 10 feet 6 inches high. Each of these rooms is intended for the reception of one patient only, so that the space allowed to each is respectively 140, 126, 140 and 210 superficial, and 1,820, 1,638, 1,470 and 2,205 cubic feet. It will, therefore, be seen that generally less cubic space is allowed to these isolated patients than to those occupying the larger ward; a reversal of the rule laid down by experts. All these surgical pavilions are not, so far as these end rooms are concerned, planned alike. In two of them the operation rooms are utilized as spare separation wards interchangeably with the others.

Operation Room.—An operating room is provided in two of these surgical pavilions. They are situated to the left of the entrance halls and staircases, and are each 21 feet long, 10 feet wide, and 13 feet high. It will be remembered that, although a position for an operating theatre has been designed (*see* M on block plan), this building has not at present been erected.

Receiving Ward.—Each pavilion has a receiving and examination room, 10 feet wide, 14 feet long, and 8 feet high, situated in the basement beneath one of the separation wards; it is fitted with an uncased enamelled iron bath. The adjoining lobby gives access to compartments containing a w.c. and slop sink.

Duty Room.—The duty room, "Theeküche," is situated to the left of the corridor forming the entrance to the large ward, and is a room 10 feet 6 inches long by 9 feet 6 inches wide, or about 100 feet superficial, and 15 feet high. It is fitted with a well devised gas-cooking apparatus.

Attendants' Rooms.—The nurses and attendants are not, as is now generally considered advisable, all located in buildings separated from the sick wards, but they are distributed in apartments about the various blocks.

In the pavilion now being described there is a nurses' sitting room adjoining the large ward, having an area of about 100 superficial feet; then in the front portion of the basement, beneath one of the separation wards, the operation room, and the duty room, there are other attendants' living rooms, having areas respectively of 140, 210 and 100 feet; and over the day room, and reached by a special staircase at that end of the building, there is another larger attendants' dwelling room, containing 578 superficial feet.

Assistant Surgeon's Rooms.—Two rooms situated over the entrance hall, and the adjoining separation ward, are fitted up as a sitting and bed room for an assistant surgeon. These rooms have an area respectively of 154 and 126 feet.

Clothes Store.—A store room, 170 feet area, for patients' clothing, fitted up with lattice work cupboards and shelves, is situated upon the upper floor, directly over the w.c. compartment adjoining the large ward. It may be reached by a staircase ascending from the basement.

Staircases.—There are staircases at the front and rear ends of the building having stone steps, respectively 4 feet and 3 feet wide.

Basement.—All the walls of the building are carried down to form a vaulted basement 9 feet high. The portion under the large ward is occupied by the heating and ventilating channels and a passage way connecting the rooms at the front and rear. Under the front ground floor rooms there are, besides the three attendants' rooms and the receiving ward previously described, a room for the storage of mineral waters. Under the day room at the rear there is a furnace room with a coal cellar and stoker's room adjoining.

Area.—The total area, including the outer walls covered by the ground floor of each pavilion, is 6,960 feet, or 217 feet per bed, but, if the verandah be included, the area is 7,314 feet, or 228 feet per bed.

Medical Pavilions.

Each of these six buildings is designed for the accommodation of 64 patients. The large sick wards, unlike those of the surgical pavilions, are two storeys in height, but it will be seen by the plan at page 102 that the disposition of the rooms generally is very similar. The projecting wings are smaller, and so the w.c. compartment and the bath rooms are more contracted, and the separation wards are made for the accommodation of two beds instead of one. The main staircase is so arranged as to be cut off from the sick wards on either floor by a wide cross-ventilated corridor, and the upper wards can therefore be reached from the outside without communication with the ground floor rooms.

Aspect.—The axes of these, like all other buildings placed upon the site, run north and south, so that the windows face east and west.

Relative Position.—The height of the pavilions above the ground floor level is 45 feet, and their distance apart 173 feet, or rather more than $3\frac{3}{4}$ times the height.

Large Wards.—The large sick ward is of the same size and holds the same number of patients as the large wards of the surgical pavilion, and therefore, like them, the superficial and cubic space is respectively 107 and 2,076 feet per bed, and the wall space 6 feet 11 inches per bed. The lower wards are 16 feet high only, and while, therefore, the superficial space is as before 108 feet, and the wall space 6 feet 11 inches per bed, the cubic space is reduced to 1,722 feet per bed.

Day Rooms.—The day rooms allow a superficial floor space of 24 feet to each patient occupying the adjoining large wards, and, both being 16 feet high, a cubic space of 384 feet.

Separation Wards.—There are four separation wards, each for the accommodation of two patients, one on the ground floor to the right of the entrance hall, two on the first floor, and one on the topmost floor. They are all 19 feet 6 inches long by 12 feet 6 inches wide, and their area, therefore, is at the rate of 122 feet per bed. Their height is respectively 16 feet, 13 feet 6 inches, and 10 feet, and the cubic space per patient therefore 1,952 feet, 1,647 feet, and 1,220 feet.

Doctors' and Attendants' Rooms.—There are three small nurses' and attendants' rooms only, but, as is the case in the surgical pavilions, living rooms are provided in the upper storey for an assistant doctor.

Basement.—The basement is planned very similarly to that of the surgical pavilions, with the exception that there are fewer attendants' rooms here, and that a dead-house and watch room are situated beneath one of the separation wards.

Construction.—The construction of the walls and floors is similar to that of the surgical pavilion excepting that the surface of the floor of the upper large ward is formed of painted pitch pine boards nailed to joists resting on brick arches. These arches are supported upon rivetted wrought-iron girders which rest upon the piers formed by each pair of windows of the ward below.

Ventilation.—The ventilating and heating of the buildings is similar in principle to that of the surgical pavilions, modified, of course, to suit the altered disposition of the rooms, and especially the superimposed position of the large upper ward. In this ward the foul air, instead of being carried away through gratings at the backs of the beds, is conveyed to an upright shaft running from floor to ceiling and standing in the centre of the room (*see b* on plan; this shaft is continued horizontally above the ceiling and carried into the extraction chimney situated at the end of the ward. The lower portion of the shaft forms an ornamental grated pedestal, and through this the air leaves the ward. It is lined with zinc inside, and is provided with regulating valves; a jet of gas assists the upward current when requisite.

Linen and Dust Shoots.—Earthenware pipes, 10 inches internal diameter, are built into the walls at either end of the main front corridor, and descending to the basement floor form shoots for the conveyance of dust and the soiled linen into boxes, which are kept locked and under the charge of a special attendant.

Area.—The total area, including the outer walls, covered by each floor of these pavilions is 7,105 feet, or 111 feet per bed, but, if the verandah be included, the area is 7,379 feet, or 115 feet per bed.

Infectious Wards.

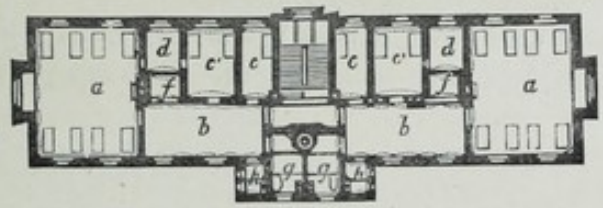
The two buildings forming blocks K K on the general plan are each designed for the accommodation of 44 patients of one sex, suffering from diseases of a contagious or infectious nature, and also for those cases of ophthalmia requiring treatment in dark rooms. It is not, however, intended that the more severe infectious diseases should, as a rule, be received into this institution, excepting in cases of epidemics or other unusual circumstances.

In order to provide for a proper separation of the various classes of disease it was necessary to so arrange the building that it should, as far as possible, be competent to place one, two, or more patients in separate rooms, and this has caused the plan to assume the form of a combined corridor and pavilion building.

The arrangement of the various apartments is in itself excellent, but it is difficult to understand why a building of this character was not designed as a one-storied pavilion, for there is no want of space on the site, and it is undoubtedly desirable to prevent such an intermixture of infectious and contagious disease germs as must necessarily take place in the buildings as now designed. It has not even been thought necessary, as it was in the medical wards, to so design the position of the staircase that a cross-ventilated passage should assist in preventing the air from the lower rooms ascending to those in the upper storey. One only of the medical officers, Dr. Quincke, who reported upon the projected plans of this building pointed out how desirable it was that this class of patient should be located in one-storied pavilions.

Relative Position.—The height of the buildings above the ground level is 38 feet, and their distance apart 134 feet, or about 3½ times their height.

Sick Wards.—The accompanying woodcut, *Fig.* 9, shews the ground floor plan of this



GROUND PLAN OF AN ISOLATION PAVILION.

Fig. 9.

a a, Sick Wards; b b, Day Rooms; c c c c, Separation Wards; d d, Waiting Rooms; f f, Duty Rooms (Theeküchen); g, Baths and Lavatories; h h, w.c.'s, Urinals, &c.

building, and it will be seen to consist of two wards of 8 beds, two of 2 beds, and two of 1 bed, with the necessary attached offices. The larger wards are 26 feet long by 32 feet 6 inches wide, and there is in each case a recessed or bay window at one end. They are 14 feet 6 inches high on the ground and 17 feet high on the first floor. The area is therefore 110 feet per bed, and the cubic space is respectively 1,595 and 1,855 feet per bed, the lineal wall space being 6 feet 6 inches in all cases. The building is two storeys in height above the basement, and the upper floor is planned in a precisely similar manner to the ground floor.

The wards holding two beds each are 17 feet 9 inches long, 12 feet wide, and 14 feet 6 inches high, thus giving 107 superficial and 1,544 cubic feet of space to each patient.

The wards, holding only one patient each, are 8 feet 6 inches wide by 17 feet 9 inches long and 14 feet 6 inches high, and thus 151 superficial and 2,187 cubic feet of space is provided to each.

Offices.—Leading out of each day room there is a bath room and lavatory, a w.c., a urinal, and a nurses' and duty room. There are dust and linen shafts descending to the basement, similar to those of the medical pavilion.

Day Room.—The corridors from which the wards on each floor are entered are 13 feet 6 inches wide, and they form day rooms 30 feet in length for the use of the occupants of the various rooms.

Heating and Ventilation.—The heating of the rooms and the corridors of this building is effected by means of two calorifer stoves placed in the basement, and the iron smoke pipes from them pass up the centres of brick shafts similarly to those of the medical and surgical pavilions, and in like manner there are horizontal ducts running from the various rooms into these shafts for the extraction of foul air. It is stated that this mode of heating by calorifer was chosen, in this instance, in preference to that of hot-water circulation chiefly because every division of the building might not always be fully occupied, and the fires, therefore, on occasions not requiring to be lighted, the pipes would be apt to freeze. The heating of the larger wards and day rooms is, in all cases, supplemented by open fireplaces.

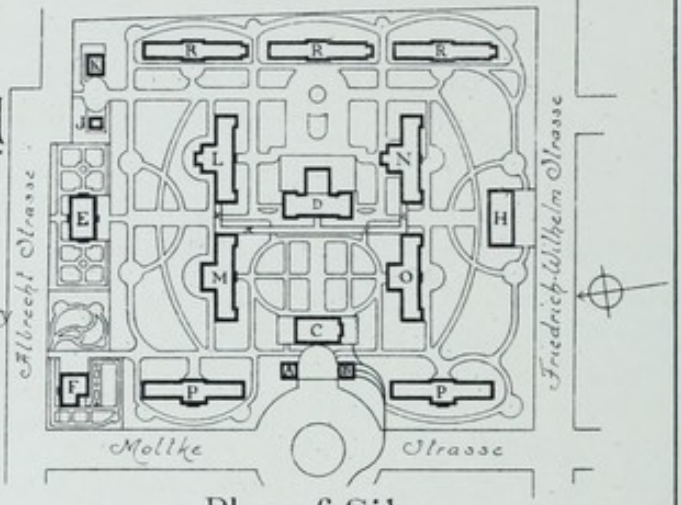
Flooring.—The floors on both storeys rest on brick vaulting, and the finished surfaces of the wards and day and nurses' rooms are of deal, whereas the remaining rooms and corridors are covered with "Mettlach" tile paving.

Basement.—The whole of the basement storey is devoted to cellarage, stores and furnaces and other heating and ventilating apparatus.

Area of Pavilions.—The total area covered by one floor of each pavilion, including its surrounding walls, is 5,554 feet, or an average space of 252 feet per patient.

Tempelhof Military Hospital Berlin

A. Guard House
B. Tram Car House
C. Receiving Rooms Offices Dispensary
D. Kitchen, Laundry, Engine House.
E. Married Officer Quarters
F. Medical Officer & Chief Inspectors Residence
H. Stores J. Ice House
K. Mortuary
L.M.N.O. Sick Wards (Corridor Plan)
R.R.R.R. Dillo (Pavilions)
P.P. Isolation Wards
x x x Corridors



Plan of Site

Scale of Feet



Section thro Ward



Ground Plan of Blocks P

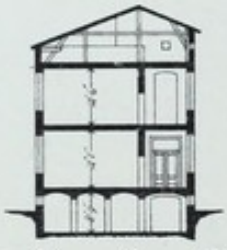


Elevation of Blocks P

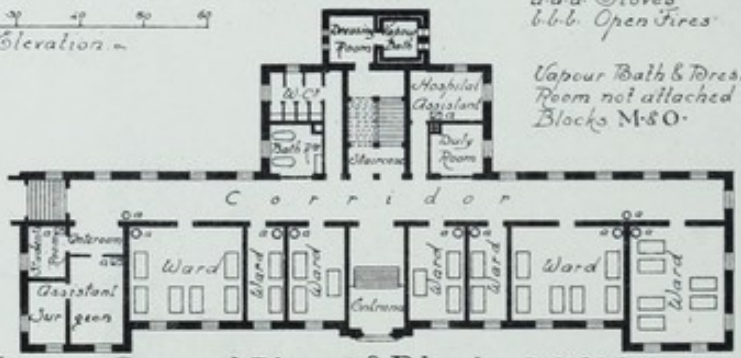
Scale of Feet to Elevation

a.a.a. Stoves
b.b.b. Open Fires

Vapour Bath & Dressing Room not attached to Blocks M & O



Section thro Ward



Ground Plan of Blocks L.M.N.O

Scale of Feet to Ground Plans & Sections

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

BERLIN MILITARY HOSPITAL,

TEMPELHOF, GERMANY.

THE increase of the garrison of this town and a desire upon the part of the military authorities to combine in one, the special hospitals previously attached to a building situated in the "Scharnhorststrasse," gave rise to a determination of erecting the building now about to be described. The question, as to whether the buildings should be erected upon the corridor or the pavilion principle, appears to have been much debated, but, ultimately, the conclusion was come to that although the latter system (comparatively recently introduced into Germany) had much to commend it, yet, in accordance with the opinions of a majority of the military authorities consulted, its exclusive application was not desirable, principally on account of special requirements of military invalid superintendence. Therefore, it was determined that this hospital should be erected upon the combined corridor and pavilion system.

This having been decided upon, instructions were drawn up and the architects, Messrs. Gropius and Schmieden, directed to prepare the necessary designs. These having been approved by the military authorities, the building was commenced in August 1875, and completed in April 1878.

It will be observed by the plan and description that an important feature in this building is the provision of depôts at the entrance, into which invalid tramcars can be run, and the construction of tramrails communicating with those traversing the town, whereby invalids from the various barracks can be better conveyed to and from the hospital.

Site.—The ground upon which the hospital is erected lies south of the Village of Tempelhof, about 656 feet east of the Berlin Cottbuser (Mariendorfer) Chaussee. It is situated in the centre of a property originally belonging to the "Dominion Tempelhof," acquired by an English company, and already laid out on an extensive scale for building operations prior to the occurrence of the commercial crisis. The principal entrance to the building, illustrated upon the accompanying plan, is from the Metz Platz, the southern side adjoins the Friedrich Wilhelm Strasse, and the northern side the Albrecht Strasse, whilst the rear boundary adjoins a new street not named at the time the building was erected. The height of the ground is 45 feet above zero point of the Berlin Mill-dam ("Damm Mühlen Pegel"); this appears to be the "Trinity high-water mark" of Berlin.

The extent of the site is 659,585 superficial feet, being 15 acres 22 perches, or nearly 1,309 superficial feet per bed.

Subsoil.—It is stated by the architects that the subsoil is clay interspersed with veins of wet sand, but that at a depth of between six and seven feet good clean sand ("guter reiner sand") is found.

General Arrangement.—The accompanying plate illustrates the general disposition of the buildings upon the site, and details of the principal sick wards.

The principal entrance to the establishment faces the Moltke Strasse. To the left is a building, marked A on plan, one storey in height, containing two rooms for the accommodation of a non-commissioned officer or porter. This building is also made use of as a telegraphic office for communication between the hospital and the town, and it contains a guard room.

To the right of the entrance, and corresponding to the building last described, there is a large chamber, marked B on plan, for the reception of tramcars, the lines from which are connected with the public tramways which run into the town.

Immediately opposite to the main entrance gates stands the administrative building, marked C on plan, containing on the right a large covered porch, into and under which the tramcars may be brought, and thus the patients can enter the adjoining reception room under cover. The ground floor of this administrative building is devoted to the principal offices, dispensary, drug store, &c. The basement is used as cellarage. The upper storeys contain sets of apartments for inspectors, assistants, engineer, stoker, and other officers.

Block D, two storeys in height, contains the kitchen, laundry, and boiler house, together with a laboratory and apartments for the cook and other officers.

Block F is a two-storied building containing on the ground floor the head surgeon's consulting room and surgery and the residence of the chief hospital inspector, consisting of four rooms and the usual offices. The upper storey is occupied by the apartments of the head surgeon, consisting of six rooms and the usual offices. This building has a separate entrance from the Albrecht Strasse.

Block E is the residence of the general employées of the establishment. This building was originally intended for married people only, and was constructed, therefore, on each of its three floors with four similar sets of apartments, consisting of sitting room, bed room, and kitchen. Accommodation was besides made for other hospital assistants. It has, however, been found desirable to alter the original arrangement.

Block H is a building four storeys in height, and is entirely devoted to the reception of field-hospital stores.

Block J is an ice house, "built upon the American system," and a plan, section, and elevation of it are shewn at page 128.

Block K is the mortuary, with post-mortem room, and a chapel 29 feet long and 19 feet 3 inches wide.

Blocks L, M, N, O each contain generally on the ground floor three sick wards of 6 beds each, two for 3, and two for 2 beds each, and on the upper floor four wards for 6, three for 3, and two for 2 beds each, but in blocks L and N these last rooms are intended for the reception of either prisoners or lunatics, and are accordingly specially constructed for these purposes. In block M the central rooms on the first floor are thrown into one to form a chapel, and the ground floor large ward is used as an operation ward, so that there is accommodation for fifteen less patients in this building. The number of patients accommodated in each of these blocks will therefore be seen to be respectively 65, 50, 65 and 65.

Blocks P P are two-storied pavilions, and each contain four sick wards for 16 beds each, and two separation wards for 2, and two for 3 beds each.

Blocks R R R are three pavilions for the isolation of infectious or contagious diseases; each one is one story only in height, and contains two sick wards for 16 beds each and two separation wards respectively for 2 and 3 beds each.

Total Accommodation.—Accommodation is thus provided for 504 patients, viz.:—

Patients in blocks L, N, O, in twelve wards with 2 beds in each, fifteen with 3 in each, and twenty-one with 6 in each	195
Patients in block M, in four wards with 2 beds in each, two with 3 in each, and six with 6 in each	50
Patients in blocks P P, in four wards with 2 beds in each, four with 3 in each, and eight with 16 in each	148
Contagious or isolation pavilions R R R, in three wards with 2 beds in each, three with 3 in each, and six with 16 in each	111
Total	504

Connecting Corridors.—The four pavilions L, M, N, and O are connected together and with the kitchen block D, by an enclosed glazed corridor, 9 feet 10 inches wide and 10 feet high. The sides of this corridor are fitted with sliding doors so as to be thrown open during the summer weather.

Water Supply.—For the supply of water to the establishment it has been necessary to sink two wells, each 9 feet 10 inches diameter, in the court-yard adjoining the kitchen department. Each well is 76 feet in depth, and the water rises to within 27 feet of the surface. After having been made to pass through a filter, the water is pumped up, by means of the machinery in the adjoining engine-house, into two tanks situated in a tower which rises from the centre of the kitchen and laundry departments, and capable of containing 27,000 gallons. The wells are connected together by an horizontal culvert, and the storage tanks are also connected, but valves are provided, so that either one may be shut off for a time for the purposes of cleaning without stopping the supply to the establishment. Provision is made for ascertaining the height at which the water stands in the tanks by means of a floating gauge. All the supply pipes are of iron, and a large number of valves are provided in various parts of the buildings for the purpose of shutting off any section as may be rendered necessary for the purpose of repairs. Besides ample provision for the attachment of the town brigade hose in case of fire, 21 hydrants are distributed about the ground for the watering of the gardens.

Drainage.—There are two systems of drainage, one carrying away two-thirds of rain-water from the buildings, and another for the conveyance of sewage and other foul water, together with (for flushing purposes) the remaining one-third of rain-water. All conduits are formed of earthenware pipes; the rain-water is discharged into a town sewer at the eastern end of the Albrecht Strasse, and then flows away into the Weidenpfuhl; the sewage is carried first into a large underground tank situated near to the block of building marked M on the plan of site, and from here it is raised by means of pumps to a higher level, and forced into the town sewer which runs across the Moltke Strasse.

The following account, given by the architects, as to the details of the drainage system and the considerations which led to their determinations, will probably be interesting, as affording a comparison with the systems now prevailing in this country.

The superficies of the roof, they say, is about 10,380 square metres, two-thirds (6,920 square metres) of the water from which was to be carried into the rain-water drains, and one-third (3,460 square metres) into the sewage drains. The total volume of water required to be thus drained was ascertained by taking a maximum rainfall of 0·015 metres per hour, in accordance with the instructions of the War Office, and upon this basis the following calculation was formed:—

Water from rain-water pipes	6,514 square metres
Ditto paved courts	1,228 ,, ,,
Ditto paved paths	3,914 ,, ,,
	11,656 square metres
	0,015
	174 cubic metres
Add for gravel paths and garden $\frac{1}{10}$th of their total superficies, $\frac{9}{10}$ths being considered to be carried away by evaporation or soakage into the ground	40 ,, ,,
Total per hour	214 cubic metres
Or 0·0594 cubic metres per second.	

The fall of the drains could not be made more than 1 in 300, and the minimum net diameter of the pipes would consequently require to be $\sqrt[5]{\left(\frac{0{\cdot}0594}{30}\right)^2} \times 300 = 0{\cdot}259$ metres, so for those nearest to the outlet it was decided that the diameter should be 0·4 metres, in the next main branches 22·5 centimetres, and in the subordinate ones 15 centimetres diameter.

For the sewage drains it was requisite to provide for carrying away

Water from the rain-water pipes, 3,866 square metres at 0·015 per hour ... ... =	58 cubic metres per hour
And sewage water calculated at about 100 cubic metres per 8 hours =	13 ,, ,, ,, ,,
Total per hour	71 ,, ,, ,, ,,
Or 0·02 cubic metres per second.	

This quantity would be carried away in nearly equal proportions by four lines of pipes, or $\frac{0{\cdot}02}{4} = 0{\cdot}005$ cubic metres per pipe. The maximum fall of the drains being in this case 1 in 200, the requisite minimum net diameter of the pipes is found, as before, to be $\sqrt[5]{\left(\frac{0{\cdot}005}{30}\right)^2} \times 200 = 0{\cdot}0889$ metres, so it was decided that generally they should be 15 centimetres diameter, increased, as the outlet was approached, to 22·5 centimetres.

For protection against frost all pipes were laid at a depth below the surface of 1 metre.

The rain-water drains are provided, at each inlet into them, with sand collectors (sandfänge) from 0·80 to 1 metre diameter in the clear, built with walls one brick thick and corbelled over to reduce the diameter of the upper part, where it is covered with a granite slab and wrought-iron moveable cover and key fastening; the sand pit is 0·50 metres in depth below the level of the inlet and outlet pipes; no traps are provided to this system of drainage.

Similar shafts to the above ("Revisionschächte") are provided for these wage drains, but in this case the granite slab and iron covers are laid about 0·40 metres below the ground to prevent the emission of noxious gases, and the lines of the pipes are continued through

the bottoms of these shafts in semicircular channels formed of cement and carefully curved to insure the velocity of the current being as little as possible affected by any change of direction.

In both systems of drainage, lamp shafts have been constructed at the junction of all pipes, and, in the middle of any long lengths, the top of each of these shafts is covered with a cast-iron box with movable lid, placed 0·50 metres below the surface.

The joints (" die dichtung ") of all pipes are made with tarred rope and puddled clay (" fetten geschlemmten thon.")

All the soil and waste pipes are continued upwards to above the level of the roof for the purposes of ventilation.

The tank into which the sewage is carried before it is pumped up into the town sewers is 4 metres in diameter ; the foundation is formed by a layer of limestone 25 centimetres thick, over which is a bed of concrete 0·30 metres thick, and lastly three courses of bricks laid flat, and then one edgeways completes the bottom. The lower part of the walls is of brickwork in cement 0·51 metres thick, and the upper part 0·38 metres thick. The top is covered with tarred oak planks on iron bearers, and a granite curb surrounds the whole.

At the bottom, and sunk below the level of the flooring of the tank, there is an iron vessel, one metre in diameter and 0·40 metres in depth, to catch sand or any other like heavy substances. The mouths of the suction pipes from the pumps are covered with fine wrought-iron gratings. This tank or cesspool has an overflow pipe, that, in case of stoppage or other necessity, would be capable of conveying away the surplus liquid sewage into the rain-water drain. Arrangements are made that the level of the liquid sewage in this tank may always be noted in the engine room.

For the purposes of this sewage pumping, as also the pumping of the water and supplying power to the laundry machinery, a twelve horse-power engine is required, but in order to provide against stoppage for repairs two such engines are provided. Steam for these engines and for laundry and kitchen purposes is generated in two Lancashire boilers, each of which is 5·20 metres in length and 1·80 metres in diameter, and they have two flues 0·68 metres diameter ; the heating surface of each is 34 square metres.

Area Covered.—The area of the various buildings at present placed upon the site is as follows, viz. :—

	Superficial feet.
Block A, guard house	1,012
,, B, tramcar house	1,012
,, C, receiving rooms and administrative offices	5,554
,, D, kitchen, laundry and engine house	8,331
,, L, M, N, O, sick wards	30,979
,, P P, ,, ,, ...	13,476
,, R R R, ,, ,, ...	18,988
Carried forward	79,352

	Superficial feet
Brought forward	79,352
Block E, officers' quarters and hospital assistants	4,349
,, F, surgeons' residence	3,197
,, H, store house...	5,134
,, J, ice house	605
,, K, mortuary	1,324
,, x x x, covered corridors	5,640
Total	99,599

The total area, therefore, covered by the buildings is 99,599 superficial feet, being nearly $\frac{3}{20}$ths of the site and about 198 feet per bed.

PRINCIPAL SICK WARDS.—BLOCKS L, M, N, O.

The main sick wards are comprised in the blocks marked L, M, N, O on the plan of site, they are buildings two storeys in height planned on the corridor principle, and are connected together, and with the kitchen building, by means of covered corridors x x. They are alike in all essential particulars, but blocks L and N have each in addition a vapour bath ; a low attached outbuilding. A ground floor plan and section of one of the buildings is illustrated upon the plate facing page 116.

Aspect.—The axes of these buildings run from W. by N. to E. by S., and the windows of the wards generally face the south nearly—*i.e.*, S. by E.

Size of Wards.—The principal wards have each accommodation for six beds, and are all nearly about the same size, 26 feet 3 inches long, 22 feet wide, and 13 feet 9 inches high, and they are each intended for the accommodation of six patients. The total superficial space of each ward is, therefore, 578 feet, or about 96 feet per bed, and the cubic contents 7,947 feet, or 1,324 feet per bed.

Warming and Ventilation.—Each room is warmed by two stoves of peculiar construction, and it would be difficult without the aid of detail drawings to properly describe the construction. They each consist, however, of a closed stove with an outer jacket, through which the fresh air from the outside is made to pass before it enters the room ; and there is another cased flue through which the foul air escapes.

Floors.—The flooring of the wards and the connecting corridors is formed of narrow pine planks, well saturated, before being laid, with hot linseed oil. The bath rooms, duty rooms, &c. are laid with 6-inch " Mettlach " tile paving.

Walls.—The walls, generally, are built of ordinary bricks with moulded facings and ornamental glazed tile friezes and bands of divers colours.

W.C.'s, Baths, &c.—The w.c.'s, baths, and other sanitary appliances are situated in a rear building projecting off from the corridor, and thus, in regard to position, they are a great improvement upon those of other like institutions in Germany. Each closet is 3 feet wide, 4 feet 6 inches long, and fitted with an earthenware apparatus ; the urinals are of earthenware and " lipped," and have slate divisions between each. There are two baths on each floor ; they are of copper, fixed without casings of any kind, and are supplied with hot and cold water, which, before being brought into the bath, is allowed to mingle, and so the flow is nearly of the temperature required for the patients' use. The lavatories are fitted with tip-up earthenware basins fixed in a slate shelf. The bath and lavatory room is 12 feet 6 inches long and 11 feet 6 inches wide.

In blocks L and N there is in each case an additional room on the ground floor for use as a vapour bath, with dressing room attached ; and for the production of steam there is, in the basement under, a boiler 18 inches diameter, 3 feet high, and having a heating surface of $7\frac{1}{2}$ square feet.

Duty Rooms.—On each floor, at the rear of the building, there is a duty room (" Theeküche "), 12 feet 6 inches long, 11 feet 6 inches wide, and 13 feet 9 inches high, being about 144 superficial and 1,980 cubic feet of space. It is fitted with a gas cooking stove and warming oven and a sink with hot and cold water supply, together with other usual arrangements for domestic purposes.

Nurses' Rooms.—Adjoining the duty room there is an apartment for a nurse or attendant (nursing in these institutions is mostly performed by men), 17 feet long, 11 feet 6 inches wide, and 13 feet 9 inches high.

Assistant Surgeon's Rooms.—On the ground floor at the extreme end of the corridor the space corresponding to the ward at the opposite end is divided into apartments for the use of an assistant surgeon.

Chapel.—The three central rooms on the first floor of block M are thrown into one and fitted up as a chapel for the general use of the hospital inmates. Through the munificence of the Emperor and Empress of Germany this room is fitted up with panelled walls and ceiling, and with paintings, stained glass, and ecclesiastical furniture of a more expensive kind than is usually found in such establishments as these.

Corridor.—The corridor on each floor runs the whole length of the building and gives access to the wards and to the water-closets and other offices; it is 9 feet 10 inches wide.

Staircases.—The staircases are situated in the centres and immediately opposite to the main entrances of the buildings, and each occupies an area of 318 feet. The steps are generally of stone faced with oak well soaked in linseed oil; the balusters are of iron with handrails of polished oak. The staircases leading from the first floors to the garrets are of pine.

Basement.—A basement about nine feet high, ceiled with brick vaulting, covers the whole of the site of each building, but is used only as cellarage, excepting that, in two of the blocks, bath rooms are fitted up for the use of the officials. The ground floor stands about 5 feet 6 inches above the outside pathway, and so there is ample opportunity for well lighting and ventilating this lower storey.

Area of Pavilions.—The average superficial area occupied by each pavilion floor (the two containing the vapour baths are larger, of course, than the other two), including its surrounding walls, is 7,745 feet, and the average number of beds on each floor of each block being 32, the area per bed is 242 feet. In this calculation of the number of beds, the space occupied by the chapel is not deducted.

Sick Wards.—Blocks P P.

These wards consist of two blocks of buildings planned on the pavilion system, and each two storeys in height. They are quite detached from all other buildings and from each other, and they are similar in their details. A ground floor plan elevation and section of one of these buildings is illustrated upon the plate facing page 116. It will be seen that they are arranged as double pavilions.

Aspect.—The axes of these pavilions run in an opposite direction to those of the buildings last described, or from N. by E. to S. by W.; therefore, the windows of the wards face nearly east and west, or more accurately W. by N. and E. by S.

Size of Wards.—Each main sick ward is of parallelogram shape, contains 16 beds, and is 52 feet long, 28 feet 6 inches wide, and 13 feet 9 inches high. The total superficial space is, therefore, 1,482 feet, or about 92 feet 6 inches per bed, and the cubic contents 20,378 feet, or about 1,273 feet per bed.

Bed Space.—The average lineal wall space per bed is 6 feet 6 inches, the beds being ranged in pairs between the windows.

Windows.—There are five windows in each side wall, and the total area of their effective glazed surface is 360 feet, or about 22·5 feet per bed. When they are all opened to their fullest extent, the total area through which air can be admitted by them into the wards is 375 feet or 23⅜ feet per bed. All sashes are double and are glazed with sheet glass. The lower parts of them are constructed as folding casements opening inwards, and the upper parts as fanlights hung on their lower rails and also opening inwards.

Warming and Ventilation.—Each of the large wards are warmed and ventilated by an ingeniously constructed apparatus standing in the centre of the room. It is impossible to attempt a description of it without the aid of elaborate drawings, but it may generally be described as the combination of a slow combustion jacketted cylindrical stove with fresh air induction and foul air extraction chambers. The flue pipe from the stove is of iron enclosed in another iron casing, and assists the action of the last-mentioned ventilating chambers. Fresh air from the outside is brought into the apparatus by means of an underground pipe shaft having an inlet in the external wall. In addition to the central stoves last described, there is at the extreme end of each ward an open fireplace, but it is seldom or ever used. In addition to the ventilation that may be effected by the opening of the windows, there is, in the upper wards, a ventilating ceiling channel running the full length of the room, with louvered sides, and having flaps hung on centres, and apparatus for opening and shutting when required.

Floors and Walls.—These are constructed in every respect similarly to those of blocks L, M, N, O, as described at page 120, but the floors in the lower wards are supported by four cast-iron columns ranged down the centres of each room.

W.C.'s, Baths, &c.—The w.c.'s, baths and other sanitary appliances are here found, almost for the first time, to be entirely detached from the wards, a step in the right direction, but they should also be detached from the building itself, by cross ventilated lobbies, for the foul air from them can now find its way into the corridors and staircases. The apparatus are generally similar to those described for blocks L, M, N, O. The bath rooms are 18 feet long and 9 feet wide.

Day Rooms.—At the extreme end of the large ward, to the right of the entrance, there is a day room, entered from the ward by two glazed doors on either side of the open fireplace. It is 28 feet 6 inches long, 16 feet wide, and 13 feet 9 inches high. The area is, therefore, 456 feet, and this gives 14¼ superficial and about 392 cubic feet to each patient occupying the adjoining ward; but, inasmuch as this day room is also used by those in the opposite ward, these figures should, perhaps, be taken only as 14¼ feet and 196 feet respectively.

Separation Wards.—At the extreme end of each of the wings, to the left of the entrance, and corresponding with the day room last described, there are two separation wards leading directly out of the large ward. One, for the accommodation of two beds, is 16 feet long, 11 feet wide, and 13 feet 9 inches high, and, therefore, contains 88 superficial and 1,210 cubic feet per patient; the other, for the accommodation of three beds, is 17 feet long, 16 feet wide, and 13 feet 9 inches high, thus giving in this case about 91 feet superficial and 1,246 cubic feet of space to each patient.

Duty Rooms.—Immediately adjoining the large ward to the right of the entrance hall, and entered from the cross corridor, there is a room 18 feet long 9 feet wide, or 162 superficial feet, that is used for the purposes of a duty room ("Theeküche"). It is fitted with a gas cooking stove and warming oven, and with a sink having both hot and cold water supply, and other usual domestic appliances.

Nurses' Rooms.—The nurses' duties in military hospitals are performed generally by men, though the director informed me that four sisters were attached to this establishment. There is, to the right of the entrance, a room for the use of a male nurse ("Warter"), and, in the corresponding space on the left, a hospital assistant's room ("Lazarethgehilfe"). Each of these rooms has an inspection window for overlooking the adjoining large ward; they are 17 feet 3 inches long, 10 feet 3 inches wide, and each contain, therefore, about 177 superficial feet. The room on the first floor, directly over the vestibule, is also available as an additional attendant's room, or, in case of need, as a separation ward.

Staircases.—The staircases are situated in the centres, and immediately opposite to the main entrances to the buildings, and each occupies an area of 334 feet. The steps are generally of rough stone, faced with oak well steeped in linseed oil. The balusters are of iron with handrails of polished oak. The staircases leading to the upper floors or garrets are of pine. The architects of the building are desirous that it should be known that the disposition of the main central staircases as executed was discordant to their wishes; they were desirous, as far as possible, to cut off the communication of foul air from the lower to the upper wards, and to obtain direct light to the staircase, and, with this view, they designed the staircase as shewn upon the accompanying *Fig.* 10.

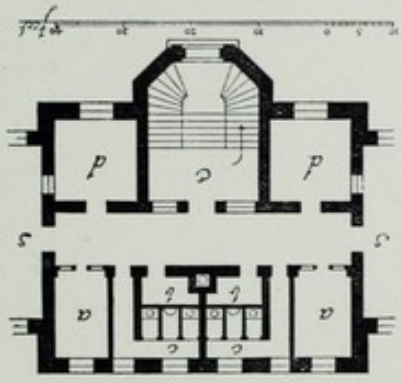


Fig. 10.

a, Bath and Lavatory; b, Duty Room ("Theeküche"); c, w.c.'s and Urinals; d, Nurses' Room; e, Staircases; s s, Sick Wards.

If this arrangement had been carried out, the first floor could have been reached from the outside without first passing through the lower corridor of communication. So far as regards the staircases this plan would, undoubtedly, have accomplished the desired object satisfactorily, but the planning of the duty rooms ("Theeküchen"), and the other adjoining offices, is by no means so good as that carried out.

Basement.—The central portion only of the building is carried down to form a basement, and this is used as cellarage.

Area of Pavilions.—The superficial area occupied by each pavilion floor, including its surrounding walls, is 6,738 feet, or 182 feet per bed.

ISOLATION SICK WARDS.—BLOCKS R R R.

The arrangements of these buildings are generally precisely the same as those of blocks P P last described; but they are one storey only in height, and the consequent absence of staircases necessitated an alteration in the disposition of the rooms placed in the rear of the central portions of the buildings. The only other noticeable deviation is the addition of verandahs, each 22 feet 3 inches long and 10 feet 10 inches wide, placed outside, and entered through the large central windows of the day rooms.

Area of Pavilions.—The superficial area occupied by each pavilion, including its surrounding walls, is 6,329 feet, or 171 feet per bed.

This building was visited in company with the architect, Herr Schmieden, in November 1882, and again in June 1883, and I have to express my thanks for the facilities afforded me for obtaining many of the foregoing details of the principal sick wards. Those who desire a fuller account of the details of the administrative buildings may consult a work entitled "Das Zweite Garnison-Lazareth für Berlin bei Tempelhof."*

* Ernst and Korn. Berlin, 1879.

KÖNIGSBERG MILITARY HOSPITAL,

GERMANY.

The erection of the Tempelhof Military Hospital last described was found to be so great a success in all its details that the military authorities subsequently commissioned the architects of that building, Messrs. Gropius and Schmieden, to prepare designs for four other garrison hospitals, the block plans of three of which, Königsberg, Dusseldorf, and Ehrenbreitstein, are illustrated at page 128. These being smaller establishments than the Tempelhof Hospital, and the details of the various structures nearly all of them similar to that building, it will be only necessary to give a short description of their main features.

The Königsberg Hospital (*see* plan of site at page 128) is designed for the accommodation of 374 patients, 300 of whom are located in three blocks of buildings, each three storeys in height, containing 100 beds, and marked "4" on plan of site, and 74 in two isolation pavilions, marked "5" on plan. These buildings generally correspond in their plan and details with blocks L, M, N, O, and R R of the Tempelhof Hospital, illustrated at page 116, excepting that the wards for the ordinary sick are three storeys in height.

The administrative building immediately faces the entrance to the establishment from the Alte Reiferbahn, and contains offices and residences for the head surgeon and the chief and surbordinate inspector, also the married officers, the dispenser, and general hospital assistants. At the rear of this building is a garden for the use of these head officers, and between it and the domestic offices there are three low buildings, used as a furnace-room, w.c.'s, dust-bin, &c. Then comes the domestic offices, marked "3" on plan, which combine in one building the kitchen, scullery, stores, wash-house, and apartments for some of the subordinate officials. The mortuary, "7" on plan, is situated at the extreme south-west corner of the ground, and an ice-house, "8" on plan, occupies the opposite corner.

The axes of the principal sick wards are almost due east and west, so that the ward windows face the south. The axes of the isolation pavilions are in an exactly opposite direction, and the windows of the wards in this case, therefore, face nearly east and west.

Water is supplied to the establishment by the municipal authorities, and cisterns are provided for the storage of about 15,000 gallons, or about 40 gallons per inmate.

The drainage of both rain water and sewage matter is discharged into a conduit leading into the river Pregel, but it is filtered and disinfected before being carried away from the building.

The extent of the site is stated to be 550,040 superficial feet, or 12 acres 2 roods 20 perches, being about 1,471 feet per bed. The total surface covered by buildings is 52,313 feet, or 140 feet per bed.

The building was erected under the superintendence of the military authorities, and cost £81,000 (1,620,000 marks), or £216 11s. 6d. per bed.

DÜSSELDORF MILITARY HOSPITAL.

The plan of site of the Military Hospital of Düsseldorf is illustrated at page 128. The building, as designed by the architects, Messrs. Gropius and Schmeiden, is for the accommodation of 150 patients, 65 of whom are located in a two-storied building, marked "4" on plan, and the details of which are similar to blocks P P of the Tempelhof Hospital, illustrated at page 116; 74 patients are provided for in two one-storied pavilions, marked "3" on plan, similar in detail to blocks R R of the Tempelhof Hospital, also illustrated at page 116, and twelve are located in an isolated building placed in the southern corner of the ground and marked "5" on plan of site.

The administrative building, immediately facing the entrances from the Fäber Strasse, contains the residences of the officers, and the kitchen, scullery, and all other domestic offices.

The wash-house and laundry, to which is attached a mortuary, are situated at the eastern corner of the ground, and in the rear of these buildings there is an ice-house.

The water supply and drainage is provided for by the adjoining mains and sewers belonging to the town authorities.

The extent of the site is stated to be 191,728 superficial feet, or 4 acres 1 rood and 24 perches, being about 1,278 feet per bed. The total surface covered by buildings is 27,706 feet, or nearly 185 feet per bed.

The axis of the central pavilion, which is planned on the corridor system, runs from W.S.W. to E.N.E., and the windows of the wards face S.S.E.

The axes of the side pavilions run in an opposite direction, so that the windows of them face W.S.W. and E.N.E.

The building was erected under the superintendence of the military authorities, and cost £29,880 (597,600 marks), or £199 4s. per bed.

EHRENBREITSTEIN MILITARY HOSPITAL.

At page 128 will be found a block plan of this establishment, together with a section showing how the peculiar position of the buildings upon the steep sloping sides of the site necessitated the construction of terraces. The restricted area of the site is much deplored by the architects, Messrs. Gropius and Schmieden, but it appears to have been unavoidable. The building is designed for the accommodation of 124 patients, 96 of whom are located in the central block, marked "2" on the plan, and the remaining 28 in an isolation block, marked "3." The main building is similar in plan to that of blocks M and O of the Tempelhof Hospital illustrated at page 116, but the plan of one floor of the isolation wards is shewn at page 128.

The axis of the main sick wards runs N.N.E. and S.S.W., and the windows of the wards, which are planned on the corridor system, face E.S.E. The question of aspect had to be made subservient to that of site, for if the windows of the wards had been placed W.N.W. they would have been hidden from the sun by the steep sides of the adjoining hill.

The administrative building is situated on the left of the entrance from Teichert-Weg. This is an old building refitted to accommodate all the residential and domestic offices and the general stores of the establishment. The wash-house and laundry, together with the mortuary, is placed in a building situated to the right of the entrance gates.

The water is supplied by a well, from which it is raised by a steam pump into a reservoir containing nearly 5,000 gallons, or about 40 gallons per patient. Both the rain water and the sewage is carried away from the establishment into the Rhine, but it is first filtered and disinfected; the solid residue is carted away.

The extent of the site is 45,209 superficial feet, or 1 acre and 6 perches, being about 365 feet per patient. The total surface covered by buildings is 16,327 feet, or 132 feet per patient.

In the reports as to these buildings, the military authorities pointedly remark that so small a site was chosen only after much deliberation, and as an exceptional matter.

The building was erected under the superintendence of the military authorities, and cost £28,200 (564,000 marks), or £227 8s. 4d. per bed.

CÜSTRIN MILITARY HOSPITAL.

A BLOCK PLAN of this establishment is shewn below, *Fig.* 11. It was designed by the architects, Messrs. Gropius and Schmieden, for the accommodation of 170 patients, but provision is made for increasing this number to 232 by the addition of another block of sick wards in the position indicated by dotted lines upon the plan.

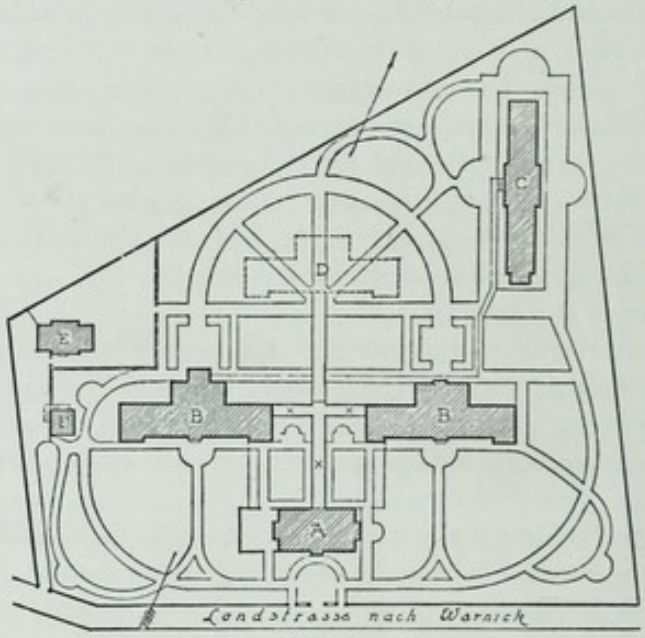


Fig. 11.

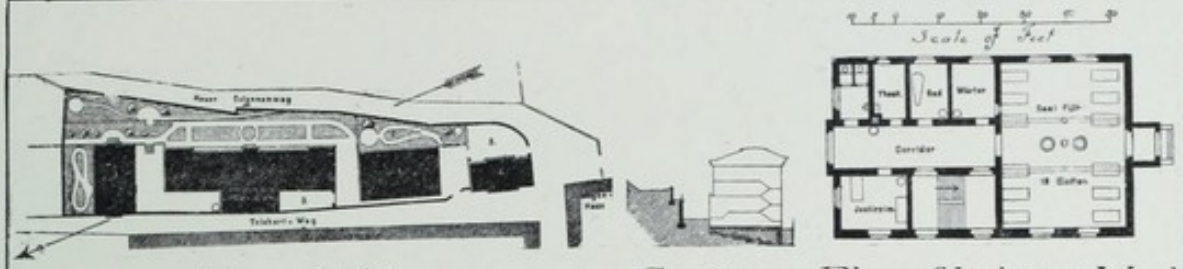
A, Administrative, Kitchen, and Domestic Offices; B, Sick Wards; C, Isolation Wards; D, Sick Wards to be erected hereafter; E, Washhouse, Laundry, and Mortuary; F, Ice-house; x x, Connecting Corridors.

The sick wards marked B B, two storeys in height, are planned upon the corridor principle, and can each contain 62 patients; they are similar in their details to those of blocks L, M, N, O of the Tempelhof Hospital, illustrated at page 116. The block of wards, marked "C" on the plan, contains isolation or contagious wards, one storey only in height, and it is planned similarly to those of blocks R R R, likewise illustrated at page 116. The laundry, wash-house, and mortuary, are placed under one roof, and occupy the extreme eastern corner of the ground. The administrative building immediately faces the entrance from "Landstrasse nach Warnick," and it contains all the residential and domestic offices, and the general stores of the establishment.

The water supply is obtained by a well, from which it is pumped up by an engine into tanks constructed to contain 6,600 gallons, or about 39 gallons per patient.

The drainage system is connected with the main sewer, which flows into the Warthe, but before leaving the establishment is filtered and disinfected.

The extent of the site is 278,949 superficial feet, or 6 acres 1 rood 24 perches, being about 1,641 feet per patient. The total surface covered by buildings, including the block D not yet erected, will be 39,887 superficial feet, or 172 feet per patient.


Scale of Feet
Ward
Bed
Corridor
Scale Pan
Bath
Scullery
Kaserne
Kaserne
Kaserne

DRESDEN PUBLIC HOSPITAL,

GERMANY.

SINCE my journeys to Germany for the purpose of inspecting its hospitals were undertaken, my attention has been called to the building now about to be described, by reading an account of its construction in a work entitled "Die Bauten Technischen und Industriellen Anlogen von Dresden," and it appeared to me to contain so much that was interesting that I applied to the publishers, C. C. Meinholm and Son, of Dresden, for their permission to have electrotypes taken of the illustrations, and they courteously acceded to my request.

As I could not, without unduly delaying the publication of this Work, visit the building in question, I am unable to give the details of it so satisfactorily as I could desire. All that can be learned, however, from the publication referred to, is, I believe, contained in the following account.

The origin of this hospital dates back to the sixteenth century, when a plague broke out with such great virulence that a temporary building was erected for the reception of the sick on the Viehweide, and this building was afterwards converted into a permanent hospital. After various enlargements it was, in the middle of the nineteenth century, abandoned, and another building erected upon the present site. It appears that in the year 1821 a large amount of money was devised to this hospital, and the inheritance so acquired had, by the year 1849, accumulated to the sum of 776,175 marks (£38,809). In the year 1845 the Town Council resolved to purchase, by means of this legacy, and at a cost of 204,000 marks (£10,200) the site of the "Marcolini'schen Palais," situated in the Friedrichstrasse, and to add to and rearrange this building for the purposes of an infirmary.

The site contains 857,277 square feet, being 19 acres 2 roods and 28 perches, or nearly 3,297 superficial feet per bed.

Thanks (says the description of this building) to its situation in the town, to its grounds planted for the most part with noble and umbrageous trees and partly laid out in pleasure gardens; thanks, also, to its spacious buildings and extensive area, leaving room for still further extensions, this site presented advantages for the construction of a hospital such as no other in Dresden could offer.

First of all, the palace was rearranged and partially rebuilt, and by this means, and at an expense of 210,000 marks (£10,500), accommodation was provided for 260 patients* in 53 sick wards, including two separation rooms for distinguished patients ("distinguirte"). In this building there are ten attendants' rooms, a dispensary, the kitchen and its offices, the wash-house and laundry, baths, furnace and boiler rooms, and numerous

* The records of the numbers of patients throughout the description, from which this account is quoted, give, first, the nominal, or proper numbers, and then the numbers that could be squeezed in, in case of epidemics or other like contingencies. I have neglected the latter figures

apartments for the officials. In the year 1857 there was added an isolated building for the reception of infectious diseases, in 1859 an addition was made to the east wing, in 1861 the mortuary and dissecting room were built, and in 1866 further buildings were added.

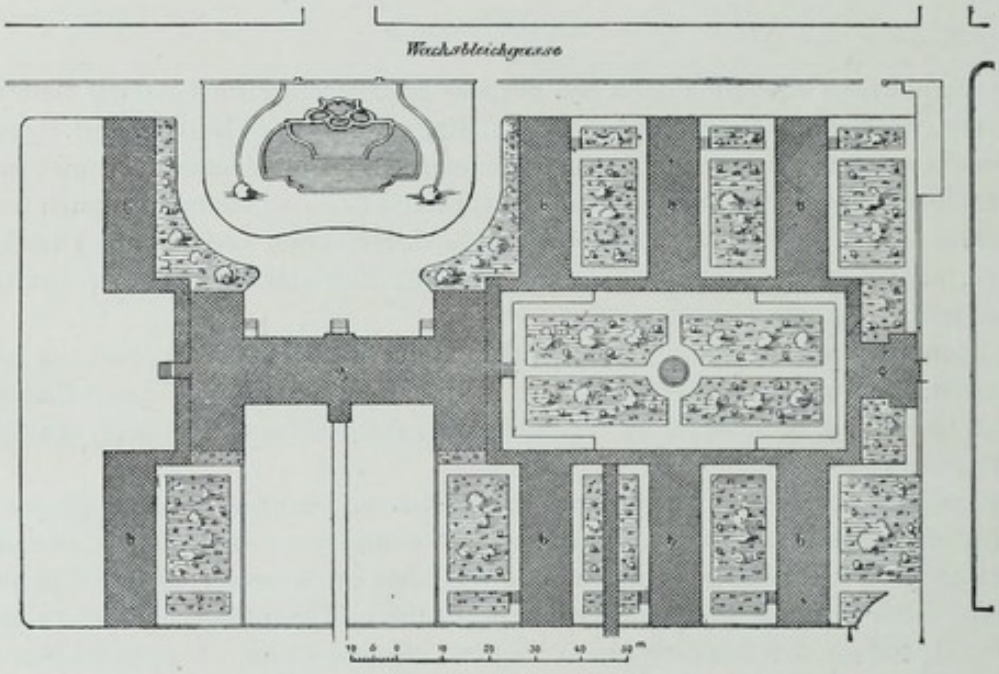


Fig. 12.

The accommodation then provided sufficed for many years, but, eventually, the numbers of patients had so much increased as to necessitate further extensions, and then, between the years 1870-76, the additions shewn upon the accompanying block-plan, *Fig.* 12, were commenced from the designs of the Town Architect, Herr Friedrich, and carried out under his superintendence.

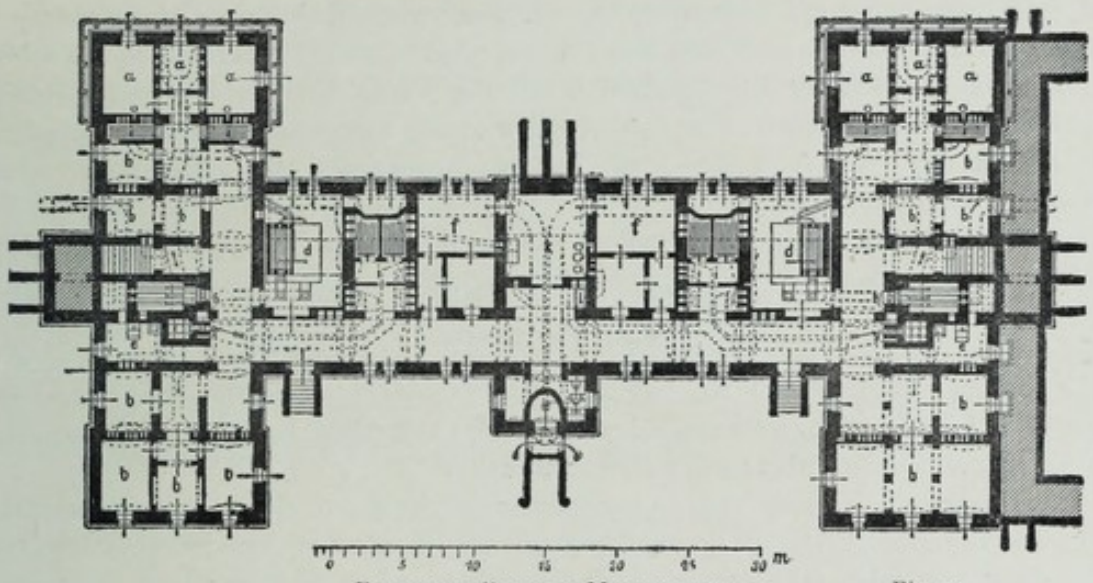
The Mutterhaus.

Of these buildings the Mutterhaus was the first erected. This structure is three storeys in height above the basement, and covers an area of 15,295 feet. It is intended for the reception of patients of both sexes, and two staircases were therefore necessary. Accommodation is provided here for 124 patients, there being twelve wards for 7 patients each, and one for 2 beds; three rooms for convalescents, with 4 beds each; ten rooms, each for one private patient; and sixteen single-bedded rooms for lunatics; besides day rooms. Then there are, in addition to the usual ward offices, six bath-rooms, two of which contain vapour baths, an operation and instrument room, attendants' rooms, and a residence for the assistant-surgeon.

The plan of the principal floor is shewn at *Fig.* 13; the sick wards for the most part face the south and east, but the principal corridors face the north.

The heating of the principal wards is effected by hot water circulating through pipes from four boilers situated in the basement. The staircases and corridors can also

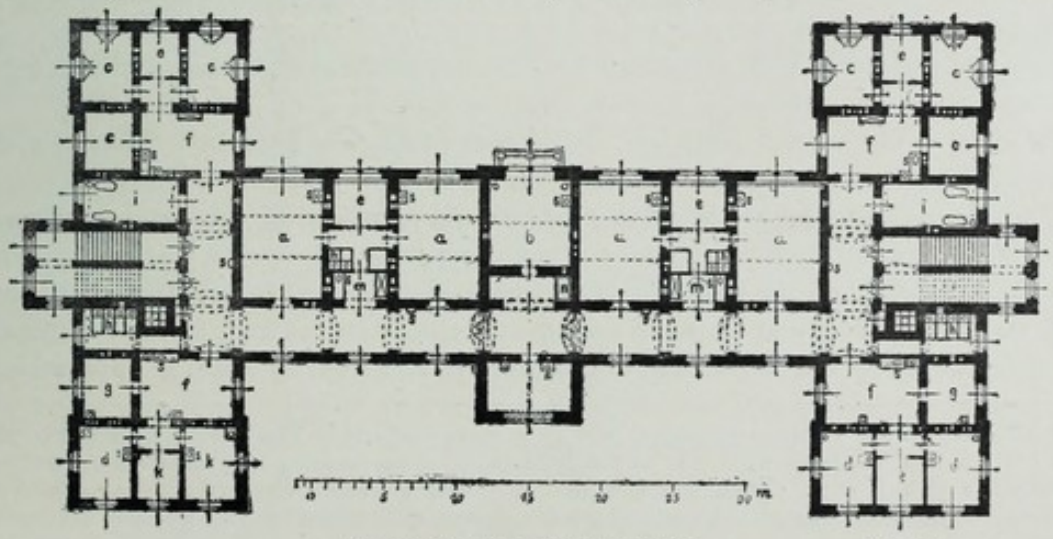
be kept heated to 12° Reaumur (59° Fahr.). The single rooms, which are only occasionally in use, are heated separately by stoves.



BASEMENT PLAN OF MUTTERHAUS. *Fig.* 13.

a, Living Rooms of Engineer, Stoker, &c.; b, Cellars and Stores; c, Engine Room and Ventilating Fans; d, Furnace Room; e, w.c.'s; f, Wash-house; h, Hot-air Furnaces for Stairs and Corridors; i, Steam Heating Apparatus; k, Occasional Kitchen; l, Lift.

Ventilation is effected by means of fans worked by a steam-engine of 3-horse power situated in the basement, whereby warmed air is propelled through flues into the various rooms of the establishment. The removal of foul air is effected by means of flues running from all the rooms downwards to the basement, where they enter extraction shafts, which, during the winter, are kept heated by the hot-water apparatus, and in summer by special furnaces. It is stated that the quantity of fresh air calculated to be introduced by these means into the wards per head per hour is 100 cubic metres



GROUND PLAN OF MUTTERHAUS. *Fig.* 14.

a, Sick Wards; b, Reading and Day Room; c, Imbecile Sick Wards; d, Private Patients; e, Nurses; f, Vestibules; g, Clothes Store; h, w.c.'s; i, Bath Rooms; k, Assistant Physician; m, Duty Rooms (Theeküchen); s, Hot and Cold Water Taps.

(3,532 feet), and that experiments shew this standard not only to have been maintained, but surpassed. It is also stated that when the outer temperature stands at 6° Reaumur (45° Fahr.) the rooms are sufficiently heated by the warmed air forced in by the ventilating apparatus. Warm and cold water is supplied in all the corridors, and (with the exception of the cells for the lunatics) in all the wards, and to the baths, closets, lavatories, and day rooms. The cost of the warming apparatus is said to have been 39,500 marks (£1,975). The plan of the basement containing this apparatus is shewn on the previous page, *Fig.* 13.

Cost.—The cost of this building (inclusive of machinery) was 543,548 marks (£27,177), or about £219 per bed.

The Pavilions.

In the year 1871 two of the pavilions, "b" upon the block plan, *Fig.* 12, shewn in detail at *Figs.* 15 to 19, were erected, then in 1873 two more, and it is understood that the erection of the four others will follow eventually.

These buildings are each one storey only in height above the basement, or rather above the ground storey, for the floors of the wards are raised nearly nine feet above the level of the ground outside. They are connected together, and to the Mutterhaus, by covered corridors.

Aspect.—The axes of these pavilions run north and south, so that the windows of the wards face east and west.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floor of the sick wards to the junctions of the sloping roofs with the upright lines of the outside walls, is 14 feet 9 inches, and the distance between each pavilion is 56 feet, or about four times the height.

Size of Wards.—Each main sick ward is of parallelogram shape and can properly accommodate 24 beds only.* The total superficial floor space is stated to be 2,864 feet, or about 119 feet per bed, and the cubic contents 48,929 feet, or 2,038 feet per bed. The opposite ends of each ward are divided off by low partitions, the one end to form two separation wards, and the other to form a duty room, w.c.'s and bath room, &c.

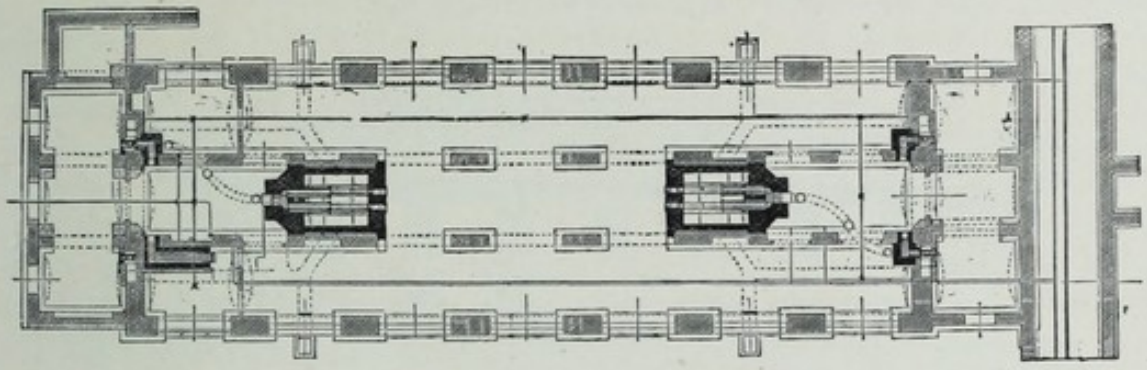
Bed Space.—The average lineal wall space per bed appears to be about 7 feet 1½ inches. This includes the spaces partitioned off to form separation wards.

Warming.—The rooms are heated by two calorifers placed in the basement beneath the main sick wards of each pavilion, and the outer fresh air as it is warmed is carried upwards through flues, the upper parts of which form stoves, with glazed earthenware sides, standing centrally in the room and upon the floor immediately above the furnaces. The temperature and the admission of fresh air are regulated by suitable apparatus, and

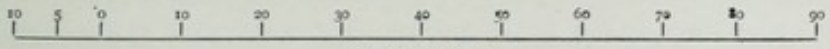
* The plan of one of these pavilions, *Fig.* 16, appears to indicate that four beds would be placed down the centre of the large ward, and in the description of the building it is stated that these wards accommodate 30 beds each. It cannot, however, be intended that such an arrangement should exist, excepting in cases of emergency, and, in the above calculations, it has been assumed therefore that the ward is intended for the accommodation of 24 beds only. The beds shewn upon the verandah would be wheeled out of the wards only when the weather would permit, and are, of course, not taken into account in a consideration of the number of patients.

evaporators ("wasserverdampfers") are placed in the interior of the stoves to secure the proper admixture of moisture with the incoming air.

Ventilation.—In winter time fresh air is introduced into the wards in the manner described in the last paragraph; in summer time the fresh air, as it passes through the flues into the wards, is made to flow past running water and sometimes ice, and by this

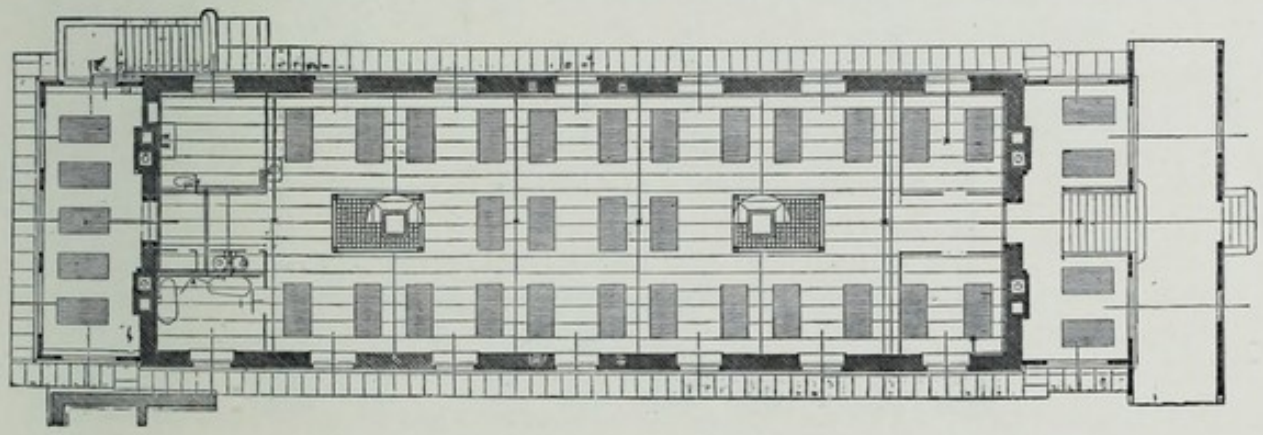


BASEMENT PLAN OF PAVILIONS. *Fig.* 15.

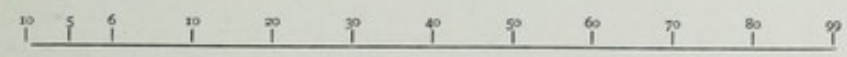


SCALE OF FEET.

means it is said that the temperature in the wards, even on the hottest days, does no exceed 18° R. (72·5 Fahr.). The withdrawal of air from the wards is provided for by four aspiration shafts in the end walls, as shewn upon the elevations and sections. Besides these artificial means of ventilation there are the windows in the side walls and the ten additional windows contained in the roof lantern, all of which are capable of being



GROUND PLAN OF PAVILIONS. *Fig.* 16.



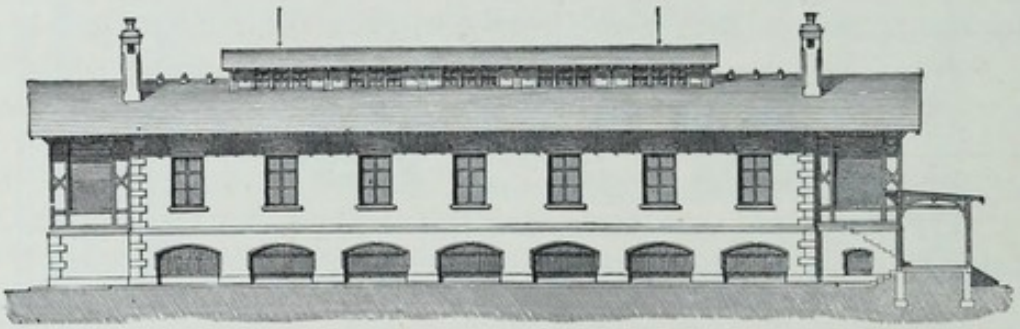
SCALE OF FEET.

opened simultaneously. These lantern lights are left open all night during the summer time. Experiment, it is said, has proved that the air in the pavilions, amounting to 1,515 cubic metres (53,505 feet), can easily, and without draught, be renewed more than

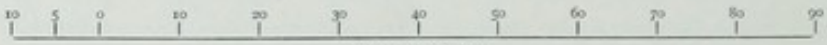
67 times in 24 hours, thus giving, when the building is occupied by 30 patients, 132 cubic metres (4,662 feet) per head per hour.

Lighting.—The whole of the buildings are lighted by gas, but no special provision is made for the removal of the products of combustion.

Floors.—The floors generally are formed of deal boarding, nailed to timber joisting, which rests upon the brickwork vaulting of the lower storey.



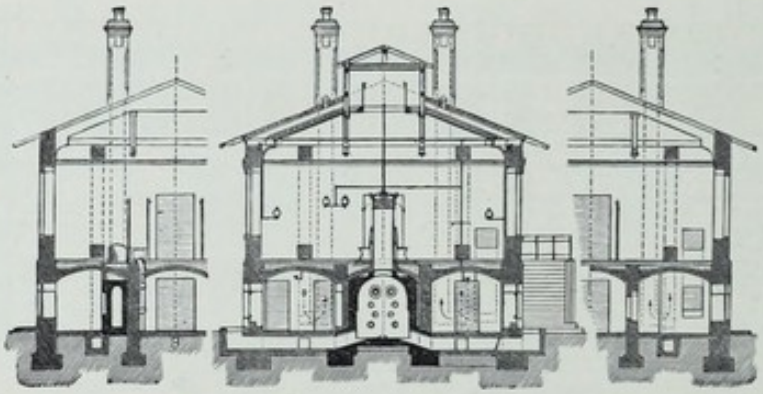
ELEVATION OF PAVILIONS. *Fig.* 17.



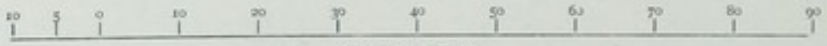
SCALE OF FEET.

Walls.—The lower or basement storey is built of sandstone, but the upper or ward floor walls are of brickwork.

W.C.'s, Baths, &c.—It is singular that the Germans, and most other Continental nations, appear until very lately to have entertained a profound indifference to the necessity for keeping the foul air of their latrines, w.c.'s, and urinals, from entering the sick wards adjoining them; and there are but few—if any—instances in Germany where



TRANVERSE SECTION THROUGH PAVILIONS. *Fig.* 18.



SCALE OF FEET.

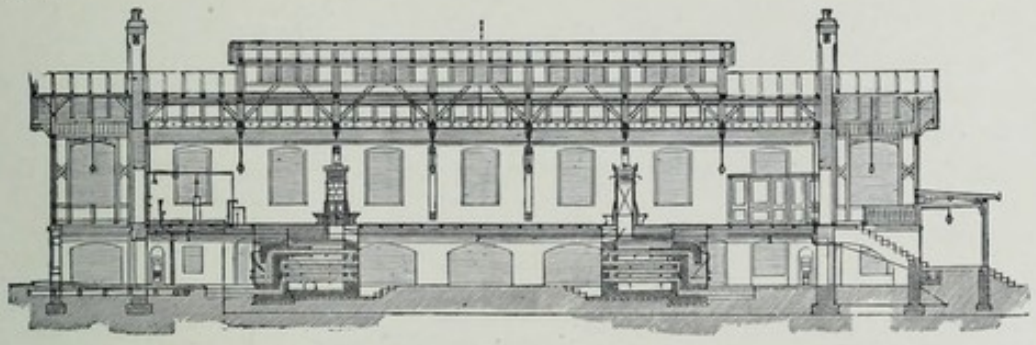
the compartments containing these apparatus are properly separated from the main building; but in the building now under discussion, the w.c.'s are not only not separated from the sick wards, but they actually stand inside of them, and are separated from the view of the patients only by a low partition! They receive both light and air

from the wards only, for they are placed in the centre of them, and away from the external walls. Comment upon such an extraordinary arrangement having been allowed is quite unnecessary, yet one cannot but express surprise that it should be permitted still to exist in these days of improved sanitary knowledge. The bath room is placed in a cubicle to the left of these sanitary offices.

Verandahs.—At both ends of the pavilions there are verandahs, upon which beds may be wheeled, with or without the patients in them, whenever the weather will permit. A similar arrangement exists at the Berlin Civil Hospital, and at others illustrated in this work. The verandah nearest to the entrance is divided into two by the flight of steps which ascends from the covered way connecting the various pavilions together.

Duty Room.—There is to the right of the passage-way leading from the end of the ward to the verandah a room which appears to be provided for the ordinary uses of a duty room (a "Wärmküche"), and it is fitted with a warming apparatus and other usual appurtenances.

Separation Wards.—On either side of the passage-way forming the entrance to the wards there are two cubicles, formed by low partitions, each of which is intended for the separate occupation of two patients; but they really form part of the large ward, and have been treated as such in the foregoing description of the interior planning of the building.



LONGITUDINAL SECTION OF PAVILIONS. *Fig.* 19.

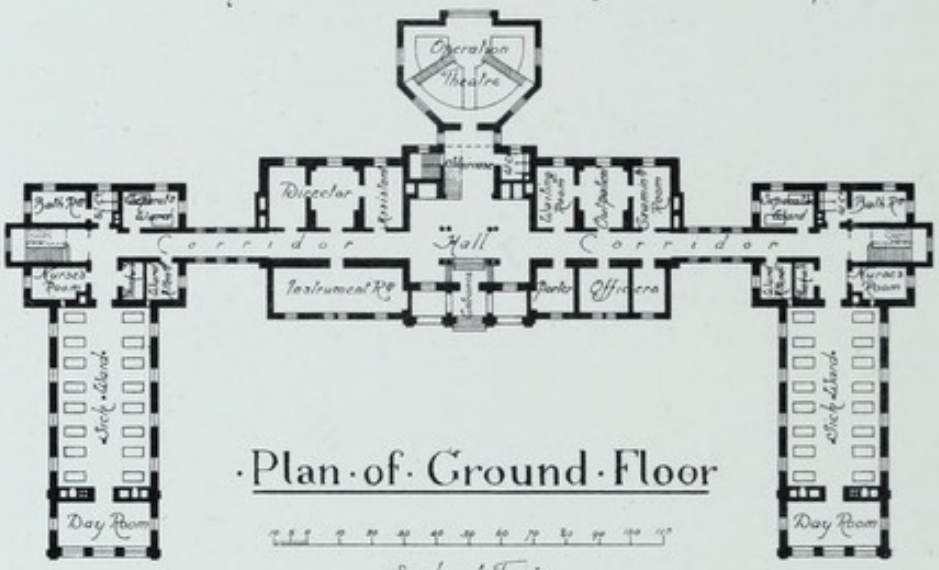
Basement.—The floors of the basements of these buildings are an average height of 7 feet 3 inches from floor to ceiling, and are little below the level of the outside ground; thus currents of air can continually play round all parts of the building. The outer basement walls are constructed with open piers and arches, but the openings so formed can, when desired, be closed by sliding shutters. In order to prevent the rising of damp and the penetration of cold air into the ward, the ceiling of this basement is constructed with brick arched vaulting; the portion under the verandahs is used as cellarage and store rooms.

Area of Pavilions.—The total area occupied by each pavilion, exclusive of the verandahs, is said to be 3,320 feet, or 138 feet per patient (24 in each); but, if the verandahs be included, the area is 4,150 feet, or 173 per patient.

There are many points about the design of these pavilions that appear to make them superior to many other like buildings lately erected in Germany; the elevation of the sick ward floor so far above the level of the ground and of the roof of the covered connecting corridors, and the entire freedom in the basements for currents of air to play beneath the floors of the wards make them in these respects approach, more nearly than others, the ideal representation of model pavilion sick wards.

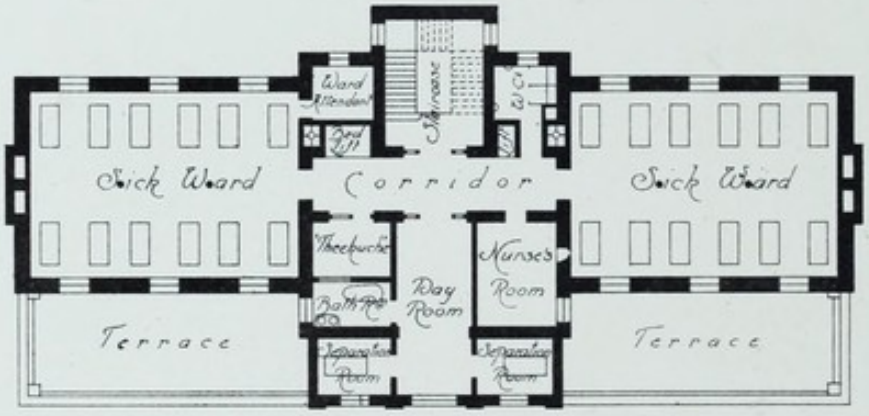
Certain of the interior arrangements previously referred to are, however, bad almost beyond precedent.

Strasburg · University · Hospital ·

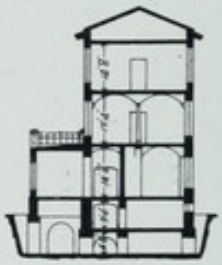


· Plan · of · Ground · Floor

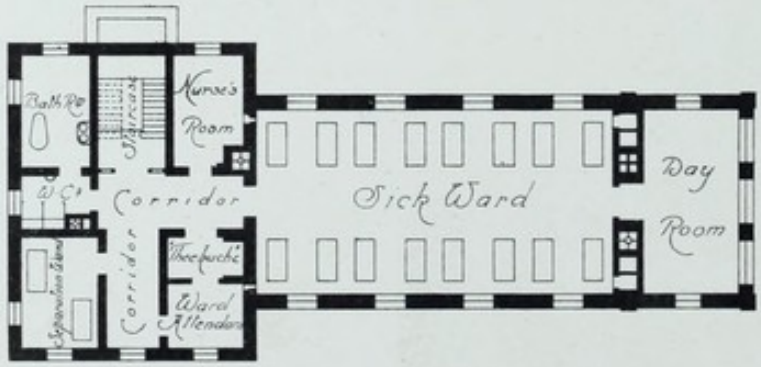
Scale of Feet



First · Floor · of · Central · Block ·

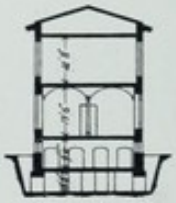


Section ·



First · Floor · of · Wings ·

Scale of Feet to First Floor Plans



Section ·

Scale of Feet to Sections

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del

STRASBURG UNIVERSITY HOSPITAL,

GERMANY.

This hospital was visited by Dr. F. J. Mouat, Mr. Percival Gordon Smith, and myself, in the latter part of the year 1882. I was not very favourably impressed with the structure generally, and did not consequently take so many notes of its details as in the case of other hospitals visited during the same journey and described in this work. Dr. Mouat, however, while admitting that the building is not as a whole satisfactory, considers it to be "superior in its arrangements to most of those of the surgical wards now to be seen in any of our great towns." Mr. Gordon Smith also considered it to be of sufficient importance to merit detailed description in the very valuable Report made by him to the Local Government Board on the subject of "Certain Hospitals in Germany and France,"* and it is to this report, and to the aid afforded by Mr. Smith's private notes, that I am principally indebted for my ability to give so full an account of the building. The accompanying detailed plans of the structure did not, however, form part of the report, and they have not to my knowledge been previously published in England or elsewhere.

This, the Clinical Surgery Hospital of the "Kaiser Wilhelm's Universität, Strasburg," is a newly-erected building in connection with the old City Hospital (Bürger Spital) and Medical School, which stand on the southern side of the city, just within the fortifications. It has been built as portion of a larger scheme for the reconstruction of the whole hospital from the designs of Herr H. Eggert, of Berlin, under advice from Dr. Lücke, and was opened about the beginning of the year 1881.

Site.—The site immediately belonging to the surgical hospital itself contains probably about 1½ acres of land, or 535 superficial feet per bed; but as it is for the present administered from the old hospital adjoining, where all the food is cooked, the general stores kept, and so forth, the limited extent of the site cannot be considered so serious as it otherwise would be.

General Arrangements.—The accompanying plans indicate the general arrangement of the buildings, which, it will be seen, comprise a central block three storeys in height above the basement floor, and, separated from it by short corridors, two pavilions, which jut out at either end of and at right angles to this central building. In the latter buildings the portions occupied by the main sick wards and day rooms are two storeys only in height.

The centre block contains, on the ground floor, a small out-patients' department, rooms for the medical officers, and a large room for instruments. There is a handsome central hall and staircase leading to the two upper floors, on each of which are wards for the accommodation of patients, with the usual attached offices. These larger wards will be described in more detail further on.

* *Eleventh Annual Report of the Local Government Board*, 1882. London.

The pavilions forming the two wings of the building contain sick wards on the ground and first floors. The third storeys of these buildings are carried over the staircase ends only, and contain accommodation for officers of the establishment.

The basements immediately below the ground floor of the buildings are about 9 feet in height, and are occupied as store and furnace rooms, but there is, beneath this, another, or sub-basement, about six feet high, the construction of which was probably necessitated by the nature of the ground.

Total Accommodation.—It will thus be seen that the accommodation provided for patients is as follows:—

Patients on first floor of central building, in two wards with 1 bed in each...									2
Do.	do.	do.	two	do.	12 beds in each ...				24
Do.	second floor	do.	two	do.	12	do. ...	...	...	24
Do.	ground floor of pavilions		two	do.	2	do. ...	...	...	4
Do.	do.	do.	two	do.	16	do. ...	...	...	32
Do.	first floor	do.	two	do.	2	do. ...	...	...	4
Do.	do.	do.	two	do.	16	do. ...	...	...	32
					Total	...	...	...	122

Drainage.—The sewage is said to be conveyed by drains to a cesspool, from which it is periodically removed by a steam pump.

Connecting Corridors.—The wings of the building are connected with the central block by short enclosed corridors, 8 feet wide and about 10 feet high.

Area Covered.—The area covered by buildings is 17,649 feet, or about $3\frac{7}{10}$ths of the site, and nearly 145 feet per bed.

Cost.—The cost of the building is said to have been 600,000 marks (£30,000), or about £246 per head, but it is not stated if this includes professional fees and superintendence, boundary walls, and other contingent matters.

Wards of Central Block.

These wards are situated on the first and second floors, and are directly over the directors' and porters' rooms and other offices situated upon the ground floor.

Aspect.—The axis of this building runs from W. by N. to E. by S., so that the windows of the wards face N. by E. and S. by W.

Size of Wards.—Each of the two principal wards is of parallelogram shape, and is designed to accommodate twelve patients. The length is 41 feet 4 inches, the width 28 feet 10 inches, and the average height 13 feet 10 inches. The total superficial floor space is therefore 1,192 feet, or about 99 feet per bed, and the cubic contents 16,489 feet, or 1,374 feet per bed.

Bed Space.—The average lineal wall space per bed is about 6 feet 10 inches.

Warming and Ventilation.—The building generally is warmed by means of calorifers placed in the basement, and the heated air rises into the wards through flues situated at the heads of the beds. Adjoining these flues, but at a higher level, there are other flues running upwards for the extraction of foul air. There are also in the end walls five air-extraction flues, heated by the iron furnace smoke pipes, which are made to pass through them.

Floors.—The whole of the floors are carried on brick vaulting, so that, in this respect, the building is fireproof.

W.C.'s and Baths.—The arrangement of the offices containing these apparatus is, as usual, unsatisfactory, but, inasmuch as they do not lead immediately out of the wards, they are somewhat less open to objection than those of other German hospitals.

The w.c. and slop sink compartments on each floor are contained in a room which leads by a short lobby out of the central corridor connecting the two main wards. The w.c.'s are each 4 feet long and 3 feet wide. A bath and lavatory room leads out of the central day room, and is 12 feet long and 7 feet wide. It is fitted with a metal bath and two lavatory basins.

Day Room.—The day room is situated centrally between the sick wards, and is 26 feet long, 12 feet wide, and 15 feet 4 inches high. The total area of the room is 312 feet, or 12 feet per patient occupying the adjacent wards. This room, unlike the others, is warmed by means of a stove.

Terrace.—The windows on the south side of these wards are casements, and open on to terraces, each 15 feet wide, running along the full length of the wards.

Separation Wards.—On the first floor, and leading out of the day room, there are two separation wards, each 11 feet 6 inches long, 9 feet wide, and 15 feet 3 inches high, and intended for the accommodation of one patient, each of whom would thus be provided with 103½ feet superficial and 1,578 cubic feet of space.

Duty Room.—Leading off the central corridor there is a duty room ("Theeküche") having an area of 102 feet. It is fitted with the usual apparatus for warming food, and other domestic appliances. This room is badly placed, as its only light is borrowed from the adjoining separation ward and corridor. It is artificially ventilated by inlet and outlet flues.

Nurses' Room.—The nurses' room adjoins the day room, and is entered from the central corridor. It is 16 feet long and 12 feet wide, and so has an area of 192 feet. A window in the side wall overlooks the adjoining large sick ward. There is, in addition, a smaller room for a "ward attendant," leading out of one of the large wards. It has an area of 79 feet. Both apartments are fitted as bed chambers.

Staircase.—The staircase is situated centrally between the two large sick wards and occupies an area of 306 feet. The steps are each 5 feet long, 11½ inches wide, and 7 inches high.

Lifts.—Leading off the central corridor, and to the right and left of the staircase, there are two lifts; one, 6 feet 10 inches long and 3 feet 3 inches wide, for patients; and the other, 3 feet 3 inches long and 2 feet 9 inches wide, for food, coals, &c.

Area of Building.—The total area covered by the first floor of this central building, including the outer walls, is 5,381 feet, or 207 feet per bed. The corresponding area of the top floor is 4,957 feet, or 206 feet per bed.

Pavilion Wings.

Aspect.—The axes of these pavilions run from N. by E. to S. by W., so that the windows of the wards face W. by N. and E. by S., or diametrically opposite to that of the central building last described.

Size of Wards.—Each large ward is of parallelogram shape, and is designed to accommodate 16 patients. The length is 55 feet, the width 28 feet 10 inches, and the average height 13 feet 9 inches. The total superficial floor space is therefore 1,586 feet, or about 99 feet per bed, and the cubic contents 21,808 feet, or about 1,363 feet per bed.

Bed Space.—The average lineal wall space per bed is 6 feet 10½ inches.

Floors.—The floors are carried on brick vaulting, for the support of which columns are ranged down the centre of the ground floor wards.

Warming and Ventilation.—The mode of warming these wing buildings is similar to that described for the central block.

W.C.'s, Baths, &c.—The water-closets are situated in a compartment entered from the adjoining corridor, and are each 4 feet 6 inches long and 3 feet wide. The bath room and lavatory is 16 feet 6 inches long, 10 feet wide, and is fitted with a metal bath and two lavatory basins.

Day Room.—At the extreme end, and leading out of each large sick ward, there is a day room, 28 feet 10 inches long, 14 feet wide, and 14 feet 3 inches high ; the total area is 404 feet, or about 25¼ feet per patient occupying the adjoining large ward.

Separation Ward.—The separation ward on each floor is designed for the accommodation of two patients ; it is 16 feet 6 inches long, 11 feet 3 inches wide, and an average height of 13 feet 9 inches. It contains, therefore, 186 superficial feet, or 93 feet per patient, and 2,558 cubic feet, or 1,272 feet per patient.

Duty Room.—This room (the "Theeküche") has an area of 67 feet, and like those of the central block is objectionably situated in the centre of the building, and without means of light excepting that to be obtained through a window looking into the adjoining ward attendant's room ; it is fitted with an apparatus for warming food, and other usual appliances.

Nurses' Room.—The nurses' room has an area of 157 feet, and is entered from the corridor ; it adjoins the larger ward, and has an inspection window overlooking it. There is also a smaller room, having an area of 111 feet, for the use of a ward attendant. Both of these apartments are fitted as bed chambers.

Staircase.—The staircase occupies an area of 181 feet. The steps are each 4 feet 7 inches long, 11½ inches wide, and 7 inches high. There are no lifts in these wing buildings.

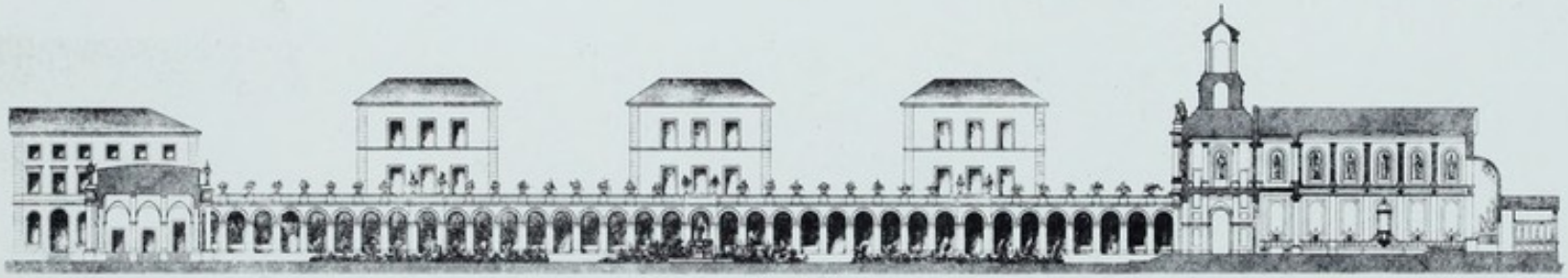
Area of Pavilion.—The total area covered by each floor of these wards with their offices, including the walls surrounding them, is 4,533 feet, or nearly 252 feet per bed.

·Lariboisière : Hospital·

·Paris·



Front Elevation.



Longitudinal Section.



Transverse Section.

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

LARIBOISIÈRE HOSPITAL,

PARIS, FRANCE.

Before commencing a description of the buildings selected as types of French Hospital Construction, I cannot refrain from expressing gratitude for the valuable aid afforded me in the course of my investigations by the Director of the "Administration Générale de l'Assistance Publique" at Paris. Not only were instructions issued to the architects and the chief controlling authorities of the various institutions visited, that every facility should be afforded me for taking the most detailed particulars, but, since my return, all written enquiries (and they have been numerous) that I have made to the Administration, as to matters of cost and other like details, have been answered with great promptness and in the fullest manner. Those only who have had occasion to be dependent upon the courtesy of individuals or public bodies for gathering together particulars, such as are required for a work of this kind, can appreciate the valuable assistance that has been thus afforded me.

To France is due the credit of having been one of the first to put in practice the principle of constructing hospital sick wards as detached pavilions, for no important building of the kind had been erected before the Lariboisière Hospital now about to be described.

Plans for the erection of this building were prepared by M. Gautbier, a member of the Institute, and it is stated that the instructions given to him were that the design should be made conformable with "the suggestions issued in 1788 by the Commissioners of the Academy of Sciences and the recommendations of M. Tenon in his work on the construction of hospitals."* It is admitted that this building carried out in every respect the views of the most experienced authorities of that time upon the subject of hospital construction.

There does not appear to be any reliable record of the date upon which the foundation stone of the building was laid, but it is stated that the first wing was formally opened by the Emperor Napoleon III. in the year 1853. The whole of the building was not, however, occupied until March of the following year.

The project for erecting the building was originated in the year 1839, and it was then decided to build it, under the name of the "Hôpital du Nord"; afterwards in the year 1841 it was changed to "Hôpital Louis Philippe," then in 1848 to "Hôpital de la République," and in 1852 the original name was reverted to; lastly, when the building was nearly completed, the name of "Hôpital Lariboisière" was given to it, in commemoration of the pious liberality of the Countess of Lariboisière, who about that time had given her entire fortune to the Administration of the "Assistance Publique." This legacy, when realized, amounted to the sum of 2,600,000 francs, or £104,000.

* For M. Tenon's recommendations, *see* Appendix.

The great interest attaching to this building naturally arises from the fact of its being the first large hospital erected upon the pavilion principle. It has formed a model for the design of numerous other hospital buildings, but, unfortunately, the many faults which exist, and which naturally might be expected to exist in so early an attempt, have been too faithfully copied in many like structures since erected.

Site.—The establishment is situated in the northern quarter of the city, within the ramparts, and close to the "Gare du Nord." The site is bounded towards the front by Rue Ambroise Paré, in the rear by Boulevard de la Chapelle, and on the sides by Rue Guy Paten and Rue de Maubeuge. The enclosed area is about 590,651* superficial feet, being 13 acres 2 roods 10 perches, or about 963 feet per bed.

Subsoil.—The building stands upon the site of an old stone quarry, and the foundations rest upon the solid rock.

General Arrangement.—The principal entrance to the building is through the centre of the block marked A on the general plan. This block is one storey only in height above the basement floor, and contains the director's, steward's, clerks' and porters' offices.

Block B is three storeys in height, and contains on the ground floor the out-patients' department, on the first floor the steward's residence, and on the second floor officers' rooms.

Block C is three storeys in height, and contains doctor's rooms on the ground floor, the director's residence on the first floor, and officers' rooms on the second floor.

Block D contains on the ground floor a general kitchen, with scullery, larders, and other offices, and also a drug room for the officers. The first and second floors are devoted to the use of officers.

Block E contains on the ground floor a dispensary and drug stores, on the first floor the priest's and the chief dispenser's residences, and on the second floor medical students' apartments.

Blocks F F F F F F each contain on the ground, first, and second floors the principal sick wards hereafter described. Each floor has one large ward for the accommodation of 32 patients, and one small ward for two patients. The blocks situated on the eastern side are occupied by men, and those on the western side by women. The first floor of one of the women's blocks is devoted to lying-in cases, and here the number of beds in the large ward is reduced to twenty-eight. The adjoining small ward is used as a lavatory and labor room.

Blocks G G were designed as libraries, but are now used as consultation rooms.

Blocks H H H H H H, one storey only in height, are intended for day rooms for the convalescents, but on both occasions when I visited the establishment it was so overcrowded that it had become necessary for four of these blocks to be used as additional sick wards, another as a crèche, and a sixth one as a bed store.

Block J is three storeys in height, and is entirely devoted to the use of the nurses.

Block K is also three storeys in height, and contains, on the ground and first floors, the wash-house, boiler room, and linen stores, and on the second floor servants' dormitories. The laundry is contained in the adjacent block S.

* This is much in excess of the amount stated by Husson and other writers, but agrees with the official measurements.

The blocks connected to and in the rear of the main building are all one storey in height, and they consist of L, the chapel; N N, lecture rooms; O O, coach-house and stabling; P, stores and stoker's apartments; Q, mortuary and dissecting room.

Blocks M M contain a very completely arranged set of baths for the general use of the patients; those on the left of the entrance are for females, and those on the right for males; each side consists of a room containing ten ordinary hot-water baths, divided from each other by curtains only, and another similar room for ten sulphur baths; there are also two large rooms fitted in the ordinary manner for vapour and douche baths, also a room containing baths for the officials of the establishment.

Block R is a lying-in ward for seven women, but is more especially devoted to puerperal fever cases, and will be described in detail further on.

The following outbuildings are one storey in height, and consist of—T, dust sheds; U, wood store; V, cart shed; W, yardman's residence; X, foul linen store and fire-engine shed; Y, covered shed with laundryman's sleeping room attached; Z, summer houses, conservatories, and covered sheds.

Total Accommodation.—The building was erected for the accommodation of 606 patients, but the lying-in ward, since added, raises the total number (exclusive of infants' cots) to 613 beds, as follows:—

Male patients in blocks F F F in nine wards with				32	beds in each	288
Do.	do.		do.	2	do.	18
Female patients	do.	eight	do.	32	do.	256
Do.	do.	one	do.	28	do.	28
Do.	do.	eight	do.	2	do.	16
Puerperal fever block R in seven wards with				1	bed in each	7
				Total		613

This number, however, is generally much exceeded; the day rooms are more often than not made use of as sick wards, and almost as a rule additional beds are placed down the centre of the large wards.*

Connecting Corridors.—The main corridors, marked x on site plan, connects together the various blocks of the main building; they are all one storey in height, 12 feet 7 inches wide, and 18 feet from floor to ceiling. They are closed in on both sides, and have windows and glazed doors opening on to the inner courtyard. The roofs are so constructed as to afford a means of external communication between the several pavilions at the first floor level and they are used as ambulatories by the patients.

Water Supply.—Greater part of the water used in this establishment is supplied by the city authorities, but some of it is pumped up from the Canal d'Ouercq. Iron storage cisterns are situated in various parts of the buildings, but their capacity is said to be very inadequate to the requirements of the institution.

Drainage.—The drainage of the building is effected generally by earthenware pipes, but that from the water-closets and other offices at the extreme ends of the large sick wards is carried into two masonry culverts, 3 feet 6 inches wide and 5 feet high, which run at right angles to the axes of the pavilions, and discharge into the city sewers. The

* This overcrowding has reached such a chronic state that the daily average number of patients during the years 1880-81 was 737, or 124 more than the building was designed to accommodate.

pipes conveying the soil from the water-closets pass into iron vessels situated in the basement beneath, and these vessels are so constructed as to retain the solid matter and allow the liquid portion only to run away into the adjoining sewer. They are removed and replaced by others when full. No means are provided for disinfecting the sewage.

Area Covered.—The total area covered by buildings is 129,503 feet, or nearly one-fifth of the site, and 211 feet per bed.

Cost.—The cost of the land is stated to have been £127,597, or about £9,410 per acre, and £208 per bed.

The cost of the buildings and their appurtenances amounted to £267,491, or about £436 per bed, so that the total outlay upon land and buildings was about £644 per bed. The following is a detail of the items of cost of the buildings forwarded to me by the Administration of the "Assistance Publique":—

	£	s.	d.
Excavator, bricklayer, and mason	155,134	16	0
Ironwork	22,640	12	9
Carpentry	3,824	17	8
Roofing	9,047	12	0
Joinery	10,596	5	8
Painting	2,037	7	2
Glazing	522	14	5
Chapel glazing	408	4	10
Furnaces and chimneys	658	0	10
Pavings	1,239	15	2
Plastering	2,885	18	5
Carving	820	7	2
Footways	1,101	2	5
Gardens and planting	1,036	3	2
Carried forward	211,953	17	8
Brought forward	211,953	17	8
Heating and ventilation	16,403	17	2
Asphalte	741	16	0
Gas lighting	325	0	0
Wash-house	2,359	17	8
Hydraulic pump	360	0	0
Water supply and service	2,706	4	0
Various fittings	4,653	1	11
Sundry expenses	287	18	5
Alteration of boundary walls, consequent upon increase of site	3,311	13	8
Extra works	12,424	9	10
The puerperal fever wards	1,282	0	0
Professional fees	10,680	15	8
Total	267,490	12	0

The original cost of the furniture was, for the main building, £24,000; and for the puerperal ward, £205; or, together, about £39 10s. per bed.

Principal Sick Wards.

The main sick wards of the building are contained on the first, second and third floors of blocks marked F, and they are connected together by staircases, and also on the ground floor by enclosed corridors.

Aspect.—The axes of the pavilions all run W.N.W. and E.S.E., so that the windows nearly face N. and S.

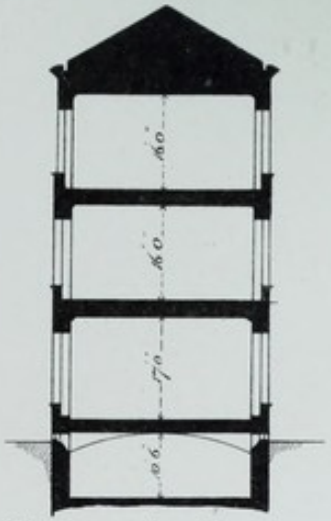
Relative Position of Pavilions—The height of the pavilions, as measured from the lower floor of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is about 59 feet, and the least distance between each pavilion is 68 feet, or about $1\frac{1}{6}$ of the above height.

Size of Wards.—Each of the large sick wards is of parallelogram shape, contains 32 beds, and is 125 feet 9 inches long and 29 feet 5 inches wide; the ground floor wards are 17 feet high, and those on the first and second floors an average height of 16 feet. The total superficial floor space is 3,695 feet, or 115 feet per bed, and the cubical contents on the ground and the first and second floors respectively 62,815 and 59,030 feet, or 1,963 and 1,845 feet per bed respectively.

Hospital Construction and Management.

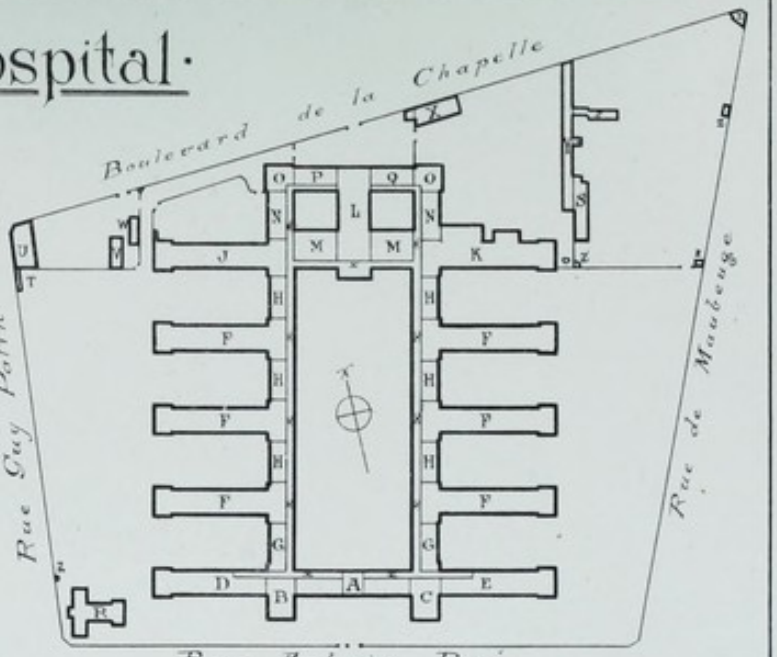
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· Paris ·

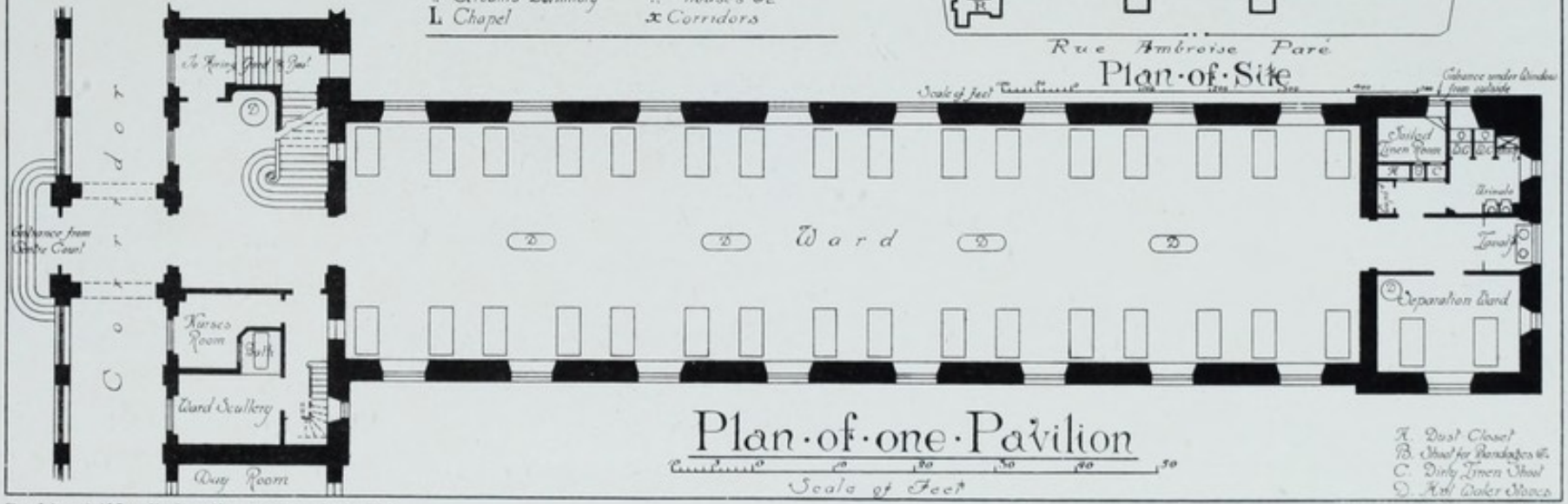


Section · thro · Pavilion

A Entrance, Director Offices
. Stewards Offices, Porter
B Outpatients department
. Steward's apartments
. Official's apartments
C Doctors room
. Director's apartments
. Officials apartments
D Kitchen, Dining halls
. Officials' apartments
E Dispensary, Priest &
. Chief Dispenser's apart.t
. Medical Students apart.t
F Sick Wards
G Libraries
H Day rooms
J Nurses apartments
K Bath house, Linen store
. Servants Dormitory
L Chapel
M General Baths
N Operating Theatres
O Stables & Coach houses
P Stores & Bakers apart.t
Q Mortuary, Dissecting room
R Maternity
S Laundry
T Dust-bins
U Wood store
V Carl shed
W Gardman's residence
X Dirty linen store
.. Fire Engine house
Y Covered shed in Laundry
.. yard and Gardmans
.. residence.
Z Conservatories, Seed-
.. sheds Summer-
.. houses &c.
x Corridors



Plan · of · Site



Plan · of · one · Pavilion

Scale of Feet

A. Dust Closet
B. Shoot for Bandages &c.
C. Dirty Linen Shoot
D. Hot Water Stores

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Bed Space.—The average lineal wall space per bed is eight feet.

Windows.—There are eight windows in each side wall, and the total area of their effective glazed surface is, on the lower, intermediate, and upper floors, 545, 516, and 477 feet, or 17, 16, and 15 feet per bed respectively.

When all the windows are opened to their fullest extent, the total area through which air can be admitted by them into the wards is 758, 725, and 661 feet, or 23½, 22½, and 20½ feet per bed respectively. The windows have folding casement sashes opening inwards, and they are divided into two heights by a wooden transom.

Warming and Ventilation.—The following description of the mode of heating and ventilating this building is extracted from an official account kindly forwarded by the "Administration Générale de l'Assistance Publique." I have examined this account, which was written in the year 1863, with the apparatus as now in use, and have noted any alterations that have since been made.

"Two distinct systems of ventilation and heating are in operation in the establishment, that of Messrs. Thomas and Laurens for ventilation, combined with the system of M. Grouvelle, for heating one side of the building, and that of M. Duvoir-Leblanc for both ventilation and heating upon the other side.

"Both apparatus were erected in 1853-54. They serve not only for heating and ventilating the sick wards and the dining rooms, but also the duty rooms, hot water distribution, bath and wash-house heating, ventilation of the 'Fosse d'aisance,' and the working of the hydraulic pump.

"In the pavilions to the right of the entrance are placed the steam apparatus, constructed by M. Farcot (a combination of the systems of the engineers Thomas, Laurens, and Grouvelle), for warming and ventilating by means of propulsion ('insufflation').

"In the left pavilions are the apparatus for hot water circulation of M. Duvoir-Leblanc, with a warm air chamber and aspiration chimney in the roof of each pavilion.

"Each of these systems, according to the terms of the agreement with their constructors, should give a mean temperature of from 16° C. to 18° C. (60·80° to 64·40° Fah.) in the wards, and a sustained ventilation of 60 cubic metres (2,119 feet) of air per hour per bed.

"It has since been proved, by a comparison of results, that a simultaneous test of the two systems was to the advantage of Messrs. Laurens, Thomas, and Grouvelle. This system gave sufficient warmth, and a ventilation day and night of 3,178 cubic feet of air per hour per bed; whilst the system Duvoir, with the same amount of warmth, gave (according to M. Grassi) only 1,059 cubic feet of air per bed per hour.

"These systems differ from one another as to the manner in which they effect the introduction of pure air and the expulsion of vitiated air to and from the various apartments.

"Duvoir draws off the vitiated air by uniting all the vertical flues into a common shaft, in which he places hot water stoves; the pure air enters the horizontal shafts of its own accord by reason of the vacuum caused by the drawing off of the vitiated air. On the other hand, Thomas and Laurens, by means of a fan, propel pure air into the wards, and this forces the vitiated air to go out by the vertical shafts. In the first case, it is ventilation by aspiration and difference of temperature; in the second case, it is ventilation by propulsion and by mechanical means. In the system Thomas-Laurens the fan is moved by a steam-engine.

"The methods employed for the warming of the wards by these inventors also differ from one another.

"Duvoir establishes a continuous circulation of warm water by means of pipes and water reservoirs, which he places in the wards and in an extraction shaft. The water is warmed in a furnace on the ground floor, mounts to the highest reservoir, and descends from it by other pipes passing through the reservoirs on each storey and returns to the furnace to be re-heated. The pure air is warmed by its contact with the pipes which it meets in the horizontal shafts, as well as the water reservoirs which take the place of stoves. Thomas and Laurens also have water reservoirs in the form of stoves; but they are warmed by means of steam carried to them in pipes from the boilers in the basement, and these pipes also pass through and warm the air in the horizontal shafts.

"So, by the system Duvoir, heating is accomplished by hot-water circulation; by the system Thomas and Laurens, by the aid of steam."

Here there is given the following detail of the first cost of erecting the apparatus, which reached £16,403 16s. 7d.; and a detail of the expense of fuel and other items of cost of working the apparatus.

"System Thomas and Laurens (Right Pavilions).			
"Apparatus generally			£9,814 16 0
"Heating the nurses' apartments			501 12 0
"Foundation of the large shaft			45 15 0
"Plaster partitions to enclose ventilation shafts			95 0 0
"Cast-iron plates in the floors of the sick wards			172 18 4
"Total first cost			£10,630 1 4
"The above sum at 5 per cent. per annum is			£531 10 0
"The cost of annual repairs and the working of the apparatus* is valued at ...			1,737 12 7
"This latter sum is made up as follows:—			
"An engineer with a salary of	£72 0 0		
"Lodging†	8 0 0	£81 16 0	
"Heating and lighting	1 16 0		
"Two stokers, each at £20 a year	40 0 0		
"Board	54 0 8		
"Heating and lighting	3 12 0	115 12 8	
"Linen and washing	2 0 0		
"Lodgings	16 0 0		
"A labourer	9 12 0		
"Board	21 10 11		
"Bed and Linen	1 2 5	32 18 3	
"Washing	0 12 11		
"Coal, about 832 tons	1,386 7 1		
"Various repairs, about	84 0 0		
"Miscellaneous expenses (oil, oakum, white lead,		1,507 5 8	
"borax, wood, soap, &c.) about	32 0 0		
"Lighting the apparatus	4 18 4		
		£1,737 12 7	
"Total cost of maintenance per annum			£2,269 2 7
"System Duvoir Leblanc (Left Pavilions).			
"Apparatus generally (original contract)			£5,600 0 0
"Experiments			26 0 0
"Ventilation of the three dirty linen depôts			128 2 5
"Ventilation and sanitation of two private water-closets			19 12 10
"Total first cost			£5,773 15 3

"*This cost may appear considerable if it is compared with the corresponding expense, Duvoir; but we must remark that the apparatus, Thomas and Laurens, independently of their chief use, serve for three auxiliary purposes; they warm the nurses' apartments, and provide warm water and steam for the baths and wash-house. The separate cost of these latter, according to M. Grassi, may be valued at £685 11s. 8d."

"† The sum which represents lodging, bed-linen, and washing, was fixed in conformity with the circular of the 22nd April 1861, which determines the money payment to which, according to their positions, the under-officers are entitled who do not receive grants; the food, according to the estimate of the dietary, at the average price of the provisions. Besides, we may observe that the employés of the professional service have no right to clothing, and that the appointments of the officers of the administrative service are given at their actual figure, and are susceptible of being modified in consequence of periodical increases. As to he amounts given for the servants' lodging in the house, they have been calculated from the net cost given by the accountant's office."

"The above sum at 5 per cent. per annum is		£288 13 9
"The cost of annual repairs and working of the apparatus is valued at ...		663 10 3
"This latter sum is made up as follows:—		
"Annual payment for keeping up the apparatus, including fuel ...	£628 2 10	
"'Journées de ventilation supplémentaire'	22 14 4	
"Lighting the apparatus	6 13 1	
"Lodging of a stoker	6 0 0	
	£663 10 3	
"Total cost of maintenance, per annum		£952 4 0
"Now, by adding to this last sum the annual cost of the other system		2,269 2 7
"We find that the annual cost of working both systems of heating and ventilation "comes to		£3,221 6 7

"This large first cost, and the not less important outlay for fuel and maintenance, which the daily working of the Thomas and Laurens apparatus necessitates, have long since decided the administration to consider another system of mechanical ventilation, less expensive, but sufficiently efficacious to secure a thorough renewal of the air in the wards. It has been shewn in Section II. of Husson's '*Etude sur les Hôpitaux*,' pages 57 and 58, which treats especially of the different methods of ventilation in use in hospitals, how the administration came to give the preference to the system of Dr. Van Hecke, on account of its simplicity and economical daily cost. M. Husson says:—

"'Van Hecke sends pure air through a hot-water heater before it comes into the ward.

"'The examining committees charged by the hospital administration to study the question have proved, by their interesting labours, that ventilation which is effected by means of air being forced in is preferable to that which is caused by air being drawn out, and it seems doubtful to us that the investigations, which the administration are again making, aided by a committee of scientific men, can possibly modify this first opinion.

"'On the other hand, the administration, without concealing from itself the imperfections of the system and certain errors in the application of it which have been made, is led to consider that the method of Dr. Van Hecke to this day deserves the preference.

"'The apparatus of this inventor are, in fact, simpler and less expensive, both in first cost and maintenance, and they have not the inconvenience of being above the ceiling and producing leakages of water and steam so detrimental to the buildings.'

"M. Grassi, whose special works on the ventilation of sick wards is well known, desired to ascertain the results produced by the different apparatus of the systems Duvoir, Thomas and Laurens, and Van Hecke, in relation to the first cost and maintenance of each. He has given, in relation to this, the figures shewn in the following table. We give it here under all reserve; for numerous experiments which followed, but whose results have not been definitely proved, apparently give noteworthy differences between the qualities of air renewed and those which are indicated by M. Grassi.

System.	Establishment where they were employed.	Quantity of air renewed per hour per bed.	Prime cost per bed.	Annual expense of fuel and maintenance per bed.	Net cost of the unit of ventilation (1 metre furnished per hour all the year round).
Devoir	Necker and Lariboisière	1,059 cubic feet	£19 4 0	£2 0 10	£0 2 8¼
Thomas & Laurens	Lariboisière	3,178 cubic feet	32 6 5	4 0 10	0 1 5
Van Hecke... ...	Beaujon and Necker ...	3,425 cubic feet	9 8 10	1 2 5	0 0 6

"The draught of the ventilating chimney, doubtless, brings into the ward more than 1,059 cubic feet; but M. Grassi has not taken into account the quantity of air which comes in through the cracks of the doors and windows, and which he considers as inefficacious for the salubrity of the wards."

Lighting.—The lighting at night of each ward on the ground and first floors is by means of seven pendant oil lamps, and on the second floor by two gas burners enclosed in a ground glass globe, fixed at the bottom of a metal tube about 2½ inches diameter,

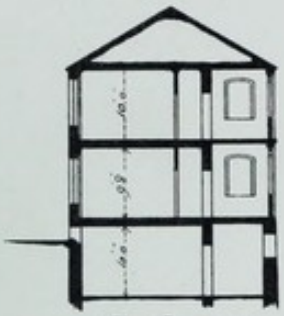
which passes through the ceiling into the roof, into which it opens. It was contemplated, at the time of my visit, to shortly introduce this system of gas lighting throughout all the building.

Floors.—The flooring of the wards is of oak boards about 4¼ inches wide, beeswaxed and polished, and these are laid on ordinary timber joisting. The ceilings are plastered and painted similarly to the walls.

Walls.—The outer walls are built of masonry 2 feet 8 inches thick on the ground, and 2 feet 3 inches thick on the first and second floors. The inside faces are finished with a plastering, "stuc," composed of a mixture of lime and powdered marble; this is painted in panels and varnished. Next the ceiling there is a moulded cornice, and at the level of the floor a wooden skirting 1½ inches thick and 13 inches high.

W.C.'s, Baths, &c.—The water-closets and other sanitary appliances are situated at the extreme ends of the wards, and are entered from a lobby or passage-way leading directly out of the ward. The end of this passage forms a lavatory, having a marble shelf in which are fixed two earthenware basins supplied with cold water only. To the left of these passages another lobby leads to the water-closet compartments and urinals. The w.c.'s are 2 feet 9 inches wide and 3 feet 6 inches long, and are fitted with an apparatus manufactured by J. Tournay, of Paris, and of somewhat similar construction to "Jennings' patent valve closets." The seats are of oak. The enclosures to these closets and the slop sink adjoining are formed of deal framing 7 feet high, having dwarf doors in front about 4 feet high and 12 inches above the floor; the side divisions, to a height of about 5 feet, are formed with glazed earthenware slabs. The slop sink is of glazed earthenware 3 feet long by 18 inches wide, enclosed by an iron casing; it is supplied with cold water only. Above this sink there is an iron rack for holding bed pans. There are two urinals of white earthenware with ordinary slate divisions and backs, and they are provided with a treadle flushing apparatus similar to those introduced into this country by Mr. Jennings. On the female side the slop sink takes the place of the urinals, and a bidet takes the place of the slop sink. The lobbies, giving access to these compartments, contain linen shoots and cupboards. The bath is placed in the duty room.

The position of these sanitary offices, closely adjoining the sick wards, without any separating cross-ventilated lobby, is much to be condemned. Both the French and German authorities are but just beginning to appreciate the value of this mode of severance, and are introducing it in only the most modern of their hospital buildings. In this building, not only does the foul air of these compartments communicate with the ward, but, no proper precautions have been taken to ventilate the compartments themselves; the one, for example, containing the w.c. apparatus, urinals, and slop sinks, is lighted by two small windows, and greater part of these are so contrived as to be incapable of being opened. There is a grating in the wall next the ceiling, which is said to lead to an extraction shaft, but the stench in the room I have always found to be too unbearable to allow me to believe in the action of this ventilator; the floor of the room, too, which is of wood, has every appearance of being saturated with the droppings of foul matter.



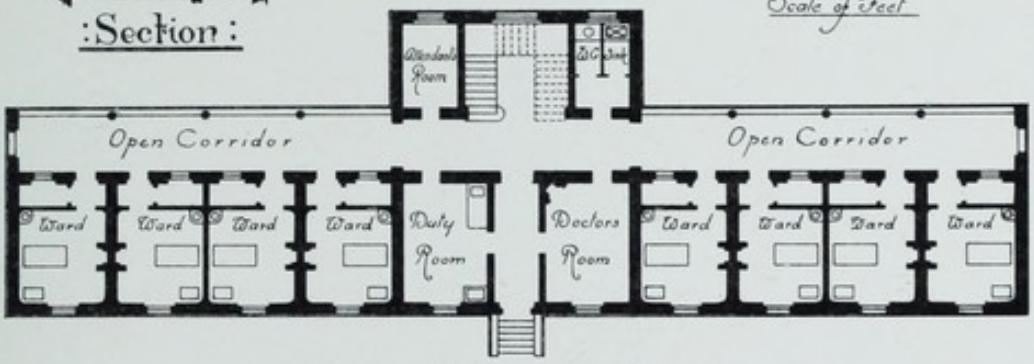
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:The :Maternity:

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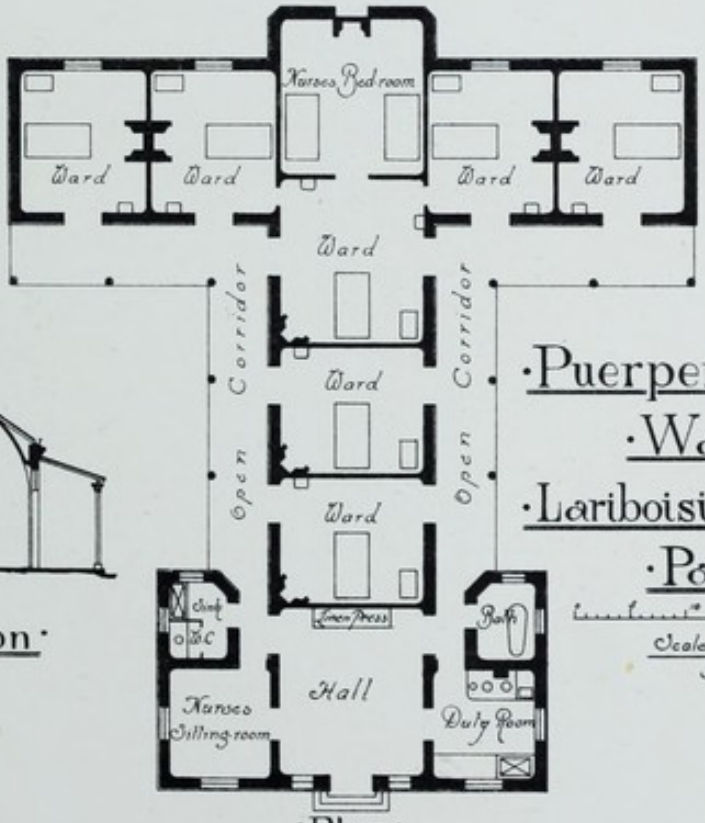
Scale of Feet



·Plan·of·Ground·Floor·



·Section·



·Plan·

·Puerperal·Fever·
·Wards·
·Lariboisière·Hospital·
·Paris:

Scale of Feet

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H. Saxon Snell del

Day Rooms.—On the ground floor, adjoining the entrance offices of each pavilion, there is a day room for the use of convalescent patients. They each have an area of 910 feet, which is at the rate of 9½ feet for each of the patients in the large wards of each block.

Separation Ward.—The corridor, which gives access to the w.c.'s, also leads to the separation ward. It is intended for the accommodation of two patients, and has an area of 212 feet, and an average height of 16 feet 4 inches, so that the occupants would each have 106 superficial and an average of 1,731 cubic feet of space. The position of these wards is bad, not only on account of their close proximity to the w.c.'s, but that they are so far removed from the nurses' rooms situated at the other end of the large ward.

Duty Room.—The nurses' duty room ("tisanerie") has an area of 115 feet, and is fitted with a stone sink supplied with hot and cold water, and an iron hot plate with ovens. A bath for the use of the patients is fixed in a recess 5 feet 4 inches long and 5 feet wide, which juts out from one side of this room. The bath is of metal, without casing, and is supplied with hot and cold water; it is 4 feet 6 inches long only inside and 2 feet wide.

Nurses' Rooms.—In addition to the duty room last described, there is a nurses' room of irregular shape, but having an area of 92 feet. It is not used as a sleeping apartment.

The duty and nurses' rooms are not carried up to the height of the adjoining wards, but a mezzanine is formed over them, and used as a store for patients' clothing, and as a students' cloak room.

Staircases.—The pavilion staircases generally occupy an area of 578 feet, and they are constructed of oak with steps 7 feet in length, and with treads 11½ inches wide, and risers 5 inches high; the balusters are of iron, with a wooden handrail.

Basements.—The basements are generally about 10 feet 6 inches high, and are variously occupied by furnace rooms, and lumber and coal stores.

Total Area of Pavilions.—The total area covered by each pavilion, including its surrounding walls, is 6,493 feet, or about 191 feet per bed.

Puerperal Fever Wards.

The mortality in the lying-in wards of this hospital had been so great for many years that it was at last determined to erect a separate building for the treatment of cases of puerperal fever. M. Tollet was consulted, and, after much careful consideration, his design, illustrated upon the accompanying plate, was adopted.

The building occupies the south-west corner of the site; it is in all parts one storey only in height, and consists of 7 wards, each 13 feet long and 11 feet 6 inches wide; each ward has an open fireplace, and is furnished with a bed for one woman, and adjoining it a child's cot, an iron chair, footstool and table (similar to those seen outside cafés), and a "table de nuit." The flooring is of cement, and without covering of any kind, excepting a small india-rubber mat 3 feet 4 inches by 2 feet. Against one of the walls there is fixed a sort of drinking-fountain, with cold water tap and waste pipe. Each ward is furnished with an electric bell.

There are no windows to three of the wards, excepting the fanlights over the two entrance doors leading from the adjoining verandah; the upper panels of all doors are

glazed with ordinary glass; the openings leading into the wards have all double doors, with double fanlights over them.

The windows of the other four wards are formed as double casements, opening inwards, and with fanlights over them, also hung as casements.

For the ventilation of each ward there is a hole about six inches in diameter in the centre of the ceiling, with a tube carried through the ridge, and terminating with a terra-cotta ornamental chimney. M. Tollet, who was so kind as to accompany me over the building, said that 80 cubic metres (2,825 feet) of air pass through this ventilator per hour.

The construction of the wards is, in section, that of a pointed arch, "à forme ogivale," so that the four side walls rise perpendicularly to a height of eight feet, and then, as they continue upwards, are made to converge towards the centres of the room at a considerable height (15 feet 9 inches) above the floor; it is at this central point that the ventilator described in the last paragraph is fixed. M. Tollet asserts that this formation of the sides of the room induces steady and constant ventilation in the simplest and most perfect manner, and he also points out that there are no surfaces for the lodgment of dust and organic matter.

It will be seen by the plan that each ward is entered from the outside, under the cover of a verandah, six feet wide, and therefore complete isolation is effected.

The administrative portion of this building comprises an entrance hall, 13 feet by 15 feet 6 inches, and, to the left of this hall, there is a room, 9 feet 6 inches by 10 feet 6 inches, originally intended for a doctor's room, but apparently now used as a sitting room for the nurse; adjoining this room there are two water-closets. To the right of the entrance hall there is a kitchen, 10 feet 6 inches by 9 feet 6 inches, furnished with a very complete cooking apparatus ("fourneau de cuisine"), having two ovens and a hot plate, besides a hot closet for linen and a cistern for heating the bath water; then there is in this room a stove, sink and dresser, and other like fittings. The bath room, 7 feet by 6 feet adjoins the kitchen and is fitted with a metal uncased fixed bath. The nurses' dormitory is situated in the rear of the building and centrally between the various wards, three of which it overlooks; it is 14 feet long and 13 feet wide.

The construction generally is similar to that of the Hospital of St. Denis, described in another part of this work.

The total area covered, including the verandahs, is 2,770 feet, or 396 feet per patient.

The cost of the building was £1,282, or about £183 per bed; the furniture cost £204, or about £29 per bed.

It was completed and opened on 1st July 1871, and it is stated that no deaths had, after twelve months' use, occurred in it.

To M. Grandjacquet, the present acting architect, and to M. Tollet, I am much indebted for the facilities kindly afforded me for obtaining much of the information contained in the foregoing account.

:Hôtel·Dieu: Paris:

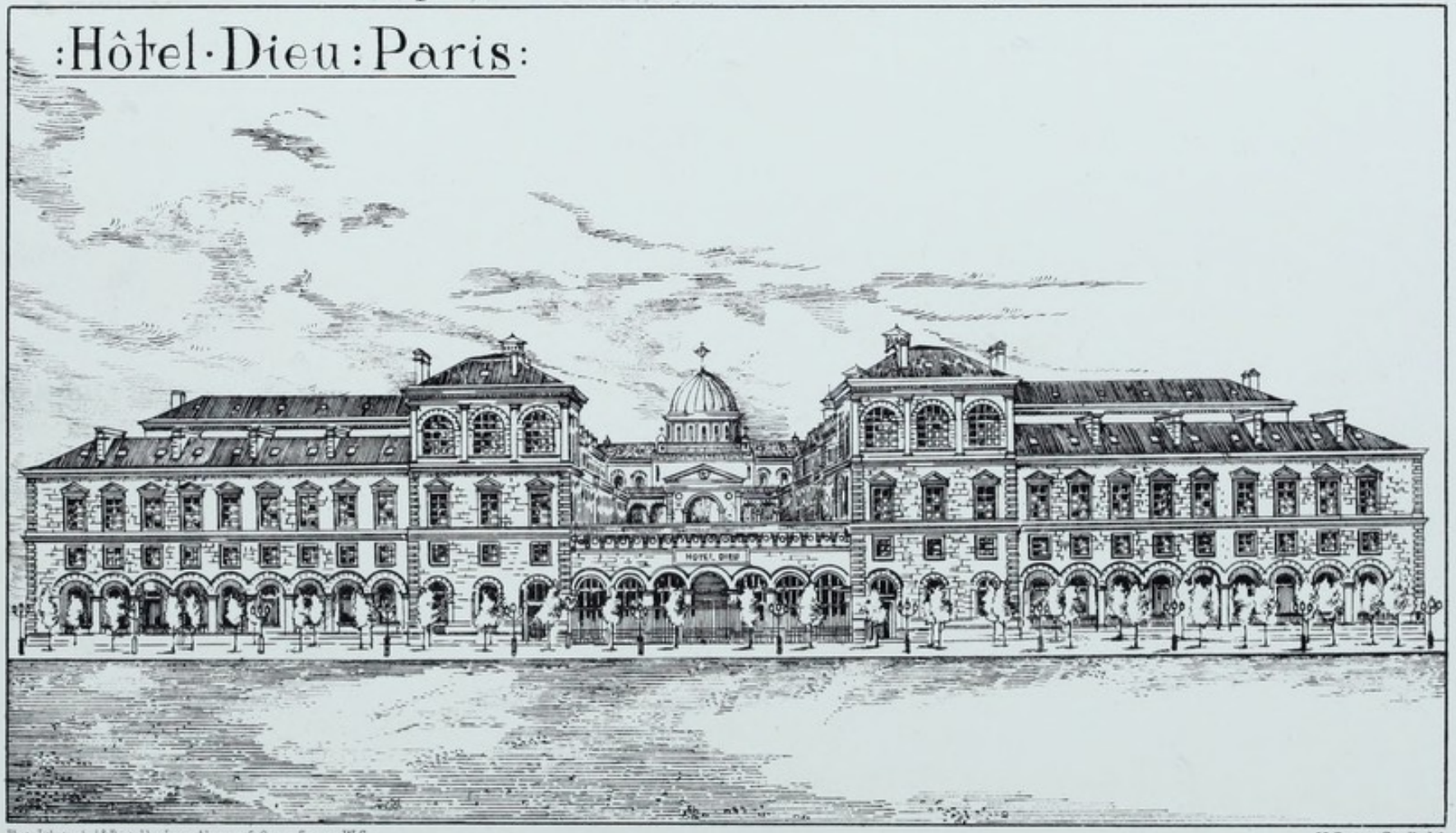


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H. Saxon Snell del.

HÔTEL DIEU,

PARIS, FRANCE.

PLANS for the erection of this establishment were prepared by the architect, M. Diet, in the year 1864, and, having received the sanction of the late Emperor Napoleon III., the foundation stone was laid without ceremony in January 1866. It was not, however, until ten years after, July 1876, that it was opened by Marshal MacMahon, the then President of the new Republic, in the presence of the Directeur de l'Assistance Publique and his staff, the Municipal Council, and other distinguished visitors. Even then it was only partially completed, and to this date it is unfinished. The painful necessity for the erection of this building, which took the place of the old Hôtel Dieu, is pointed out by Dr. De Chaumont, who says—

"It can be shewn that outbreaks of disease are co-incident with individual overcrowding, whether the hospital be large or small. Thus the terrible mortality of the Hôtel Dieu, of Paris, in the last century was due as much to actual overcrowding as to the enormous aggregation of patients. The extraordinary spectacle was to be seen of two or three small-pox patients and several surgical cases, and sometimes even four parturient women lying in one bed. A large proportion of the beds were purposely made for four patients, and six were frequently crowded in." *

This statement is confirmed, to a great extent, by the following extracts given in M. Husson's "Etude sur les Hôpitaux,"† where it is indisputably shewn, by the records of the establishment, that the authorities had allowed such an agglomeration of the sick and maimed in the wards as would render them unfit for the habitation of so large a number of cattle, much less human beings:—

"Much has been said about beds having been constructed with two shelves one over the other, in which as many as eight and even twelve sick were said to have lain. Nothing in the Archives justifies such an assertion. This tradition, derived from M. de Pastoret, doubtless originated in one of the passages of the Report of the Commissioners of the Académie des Sciences (1786, p. 19), where it is said that in the year 1752 the sick were lying four and six in the same bed, and that some were lying on the testers of the beds, 'according to the testimony of a physician of the Hôtel Dieu, who witnessed it.' This testimony is the more curious because the 'Mémoire of the Physicians of the Hôtel Dieu,' presented in 1756, makes no allusion to the circumstance, although a description of the form of the beds occupies a very large share of the Report.

"That, at times of extraordinary overcrowding, some of the sick should have been placed even on the wooden roofs of the beds, as in 1752, when the Hôtel Dieu had to receive more than 4,000 sick, is not very surprising; but this was a temporary expedient, and could only have taken place, if it did take place, during part of the seventeenth century; for before that period the beds of the Hôtel Dieu had no testers, and then the sick lay in beds, or, rather, were heaped up in them. In 1515, there were only 303 beds at the Hôtel Dieu, 'in each of which, from want of space, are ordinarily seen eight, ten, and twelve poor in one bed, so crowded were they that it is pitiable to see them.'"—(*Letters Patent of Francis I., March 14th* 1515.)—(*Archives of the Assistance Publique.*)

"One hundred beds were placed in the new ward built by Cardinal Duprat in 1530. The following is an extract from the agreement made for the construction of these beds:—'Jehan Morel, carpenter, living at Paris, has bargained with the Governors to make proper beds for furnishing the new ward which M. le Légat is constructing to adjoin Lostel-Dieu, *i.e.*, to the number of 100 beds, made as follows:—Each bed is

* *Encyclopædia Britannica*, Ninth Edition, vol. xii., page 302. † Paris, 1862.

to be 6 feet long by 4 feet wide, the back 4 feet high with a division the same height, all in plain panels, and with framed and open bottoms; in the front of the beds two horizontal panels, ... on the pillows of these beds there shall be boards 6 inches in breadth, or thereabouts, for the use of the poor, and under each of these beds there shall be a slightly raised bench the length of the said beds, capable of being drawn out to rest the said poor.'—(*Extract from the Registers of the Bureau of the Hôtel Dieu, 21st May* 1533.) The sick, being too many to lie all together at the same time in the beds, had necessarily to relieve each other, and this little bench was, no doubt, destined to serve as a seat for those waiting their turn to lie down.

"In the seventeenth century, the beds of the Hôtel Dieu were covered with testers standing upon four massive feet, with curtains capable of completely enveloping the beds.

"In April 1781, Louis XVI. forbade the placing of more than two sick in the same bed, and he ordered that these were to be separated by a division. This was not satisfactory to the physicians of the Hôtel Dieu, and, as the result of their observations, it was decided—

"1. That all the beds, single and double, should be 6½ feet high.

"2. That the extreme length of all beds, single and double, should be 6 feet.

"3. That the extreme width of all single beds should be uniformly 3 feet.

"4. That the extreme width of all double beds should be, without distinction, 5 feet 2 inches.

"5. That the testers of all the said beds should be fitted with a strong cross-beam, having a cord solidly fastened, by which the sick could raise themselves.—*(Deliberations of the Bureau of the Hôtel Dieu, 17th March, 6th April, 12th April, 16th May, and 1st June* 1781.)

"In 1791 the number of beds was still far from sufficient for the requirements of the establishment, as stated in a Report of the Commission of Hospitals. In the month of April 1791, that is to say, at the time this Commission was appointed, there were only 1,630 to 1,700 beds in the Hôtel Dieu, of which 580 to 590 were large beds; reckoning these as two, as well as those with divisions, the 1,700 beds afforded accommodation for 2,300 sick; the sick who had a separate bed being only 1,700, 1,100 others lay two, three, and even more in the large beds."—(*Report of the Measures adopted for the Accommodation at the Hôtel Dieu, during the winter of* 1792, *for 2,500 sick, of whom 2,000 were to be placed alone in small beds, and 500 in large beds, only two together.*)—(*Archives of the Assistance Publique.*)

The history of the erection of the new building is an unusually eventful one, and a volume might be filled with an account of the various episodes of the controversy which raged for nearly thirteen years between the many authorities whose duty it was to advise as to the carrying out of the scheme. Little, however, is generally known in this country of the matter, and, although I have visited the building many times and "interviewed" the architect and various other officials, I should have gathered little information but for the assistance of my friend, Mr. Arthur Cates, who kindly put me upon the right track.

It would appear that in the year 1864 the plans of the new building, having been prepared according to the order of the Prefect of the Seine, were submitted by the administration to a Sub-Commission for examination and report. This Commission, composed of Messrs. Grissolle, Tardieu, Guérard, Cullerier, Danyau, Regnauld, Blondel, and Broca, "rapporteur," generally condemned the scheme, and gave it as their opinion that if so many as 600 beds were to be placed upon the site the buildings could not properly be planned upon the parallel pavilion principle. The design, moreover, appeared to contemplate the possibility of extending the number of beds to 800 by the addition of a larger number of storeys, but this was strongly condemned by the Commission, which stated that if it was determined that the general planning of the building, as submitted to them, were to be adopted, then the length of the pavilions should be reduced and the longitudinal buildings running at right angles to them should be replaced by open corridors, as in the Lariboisière Hospital; then the building would only have accommodated 360 patients. The *résumé* of this report is as follows:—

"1. That the site selected for the future Hôtel Dieu is conveniently situated.

"2. This site has only a superficial measurement of 21,600 square metres, but the hospital will benefit by the immense vacant spaces which border it on the north and south, and will be enabled to receive a greater number of patients than would otherwise be possible under the disadvantages of the restricted space.

"3. We express the wish that the land between the Rue de la Cité, the Tribunal de Commerce, and the Avenue Constantine should not be built over, but that the idea of converting it into a flower market may be carried out.

"4. Even in the event of the Hôtel Dieu being entirely isolated, the maximum number of beds should not exceed 600, and this number should never be increased.

"5. All those portions of the plan which concern the arrangement of the various services, the dimensions, and the interior fittings of the rooms, may be carried out.

"6. On the other hand, the arrangement of the buildings destined to be occupied by the sick is defective. The system of parallel pavilions will necessitate a space far greater than the site permits.

"7. Consequently, steps should be taken to ascertain in what manner the advantages mentioned in this report can be realised, while at the same time avoiding the objections."

Notwithstanding this strong protest, the building was erected upon a plan which was, in almost every respect, diametrically opposed to the suggestions contained in the report referred to; indeed, all the faults stated to exist in the original design were but aggravated in the one carried out.

When the building was partially completed, the Société des Médecines et Chirurgiens des Hôpitaux de Paris, a society composed of *all* the medical men attached to the Parisian hospitals, appointed a commission of nine of its members to visit the new structure, and the following report of the discussion and the conclusions arrived at is valuable and interesting, not only in its reference to the Hôtel Dieu, but that it contains the opinions of these high authorities upon many important questions of general hospital construction, and shews clearly how much the principles they advocated were in accord with all those who, in other countries, have likewise made a special study of the subject:—

"The Society presided over by Professor Bouilland, at its sitting of Saturday, the 6th January 1872, appointed a Commission of nine members to visit the new 'Hôtel Dieu,' in order that they should make a report thereon as to its hygienic advantages.

"The nine members appointed to this Commission were—Messrs. Lailler, Lorain, Hérard, Broca, Trélat, Giraldès, Marjolin, Hardy, and Vidal.

"Professor Hardy was appointed president, and on the following day, the 7th January, the members proceeded to the structure known as the 'New Hôtel Dieu.' The Commissioners were accompanied by the architect, M. Diet, and by the contractors.

"After having viewed this immense and still unfinished structure, and enquired into the proposed internal arrangements, the members of the Commission held a sitting, at which each one expressed his opinion and views. It was decided that M. Lorain, the secretary, should report, *in extenso* and literally, the speech made by each individual member. This report was read before a full meeting of the Physicians and Surgeons of the Hospitals at the sitting of Tuesday, the 9th January 1872.

"Full Report of the Sitting of Sunday 7th January 1872.

"M. Marjolin said: 'Although this hospital has been constructed at so great an expense and on so gigantic a scale, various reasons may be given in opposition to the proposed occupation of it by invalids, be their number great or small. Among these reasons I may mention those by which my opinion is chiefly influenced.

"'In the first place, I altogether deny the assumed necessity for a central hospital, for, from whatever light it may be viewed, an institution in such a situation should be avoided.

"'Let me first take the humanitarian side of the question. If we gather together in one centre a vast number of sick people, coming from all parts of the city, we remove them from the proximity of their families, who thus have to suffer lamentable loss of time when they desire to visit relatives who may be confined in the hospital.

" 'Statistics clearly show that by far the greater number of the sick people who are admitted to the "Hôtel Dieu" do not belong to the quarter in which that establishment is situated. This objection will have still greater force when what remains of this once populous, but now unfrequented, district shall have been renovated and improved, as has been the case with the narrow and pestiferous streets adjoining the Church of St. Severin and extending from the left bank of the Seine to the Boulevard Saint Germain. My second objection is that large barracks have recently been constructed in the "Cité" in close proximity to the new "Hôtel Dieu." For many reasons this is a most dangerous position, whether we regard it as a question of health, or in the light (unfortunately, too well founded) of popular *émeutes*.

" 'For the men who are confined to these barracks, the immediate neighbourhood of the hospital places them in a most insalubrious position; they will form, so to speak, a ready-made centre or hot-bed of contagion and epidemic. At Bordeaux, in spite of the great precautions which had been taken against the propagation of contagious diseases, such as small-pox, it was one day discovered that many of the garrison belonging to the same regiment were afflicted with that disease. An investigation as to the cause of this outbreak was immediately instituted, and the origin of it was not far to seek: the regiment was in barracks immediately in the neighbourhood of the Saint André Hospital!

" 'My objections, therefore, to the proposed scheme are threefold:—

" '1st. The distance by which the invalids and their families would be separated. 2ndly. The depopulation of this district, thereby rendering the construction of a great hospital unnecessary. 3rdly. The danger of bringing into close proximity a hospital and a barrack.

" 'If we admit that the construction and maintenance of hospitals in the centres of towns is a necessity, then under no circumstances should the patients number more than 200 or 300, and it is certainly not in the "Cité" that such an establishment should be located; for do we not already find here hospitals built long since, such as "La Pitié," "Les Cliniques," and "La Charité," which amply suffice for all the requirements of the district? There really can be no need for collecting together all the sick people in this so-called central position.

" 'Touching upon another point, which has more immediate reference to the special object of our enquiry, if we may pass an opinion upon the structure which we have been inspecting, we must feel convinced that the architect, whose talent I have the greatest pleasure in recognising, fully appreciated how incompatible with common sense, was the idea to which he had to give effect, and I must here express my regret that the Director of Works and the Council of the Hospitals have not taken active measures to prevent the realisation of this most pernicious scheme, and that the only one who at the time represented us at the Municipal Council did not take steps that the expression of our opinion might be elicited, the consequence being that we who, above all, are competent to decide upon such a question, have not even been consulted.

" 'However, whatever sums have been expended in the erection of this magnificent structure, I am bound to say, honestly and sincerely, that I consider it unfitted and inappropriate to the purposes for which it has been constructed. It is unfitted for the reception of patients, for it does not combine any of the requisite conditions of hygiene. In it all the faults of the Lariboisière Hospital are exaggerated, and it is not possible to remedy these faults; modifications could only be carried out at an incalculable expense, and, after all, would scarcely produce any appreciable amelioration.'

" M. Giraldès said: 'I adopt the arguments and conclusions of M. Marjolin. My common sense is opposed to the idea that this building should be occupied by invalids. I find that actual necessities are wanting. There neither is light, nor can there be circulation of air. Stretching in a line from north to south, and constructed in blocks, the one lying in the shadow of the other, and with the central part closed in, this hospital can neither be illumined by the rays of the sun nor refreshed by constantly renewed currents of air. The spaces between each block are narrow and dark, and, in fact, are nothing but cellars; this fact alone is a decisive and sufficient reason for rejecting the hospital.

" 'Inspection of the interior arrangements shows that the requirements are altogether insufficient: the operation theatres have been constructed on lines which cannot be accepted—contrary both to the teachings of science and of practice. The theatre of autopsy and the dead-house are insufficient, and in no way suit the purposes to which they are to be appropriated.

" 'It is said that it is contemplated to place 500, 600, or even 700 people in this building, and also to make it a lying-in hospital. Such projects as these are altogether incompatible with the arrangement of the blocks. I have, therefore, to say that my opinion is perfectly in accordance with that expressed by M. Marjolin—namely, that this structure is inappropriate to the reception of invalids and patients.'

"M. Hérard: 'I regret to find that my opinion does not agree with those of Messrs. Marjolin and Giraldès, and that I cannot find myself in accord with the exclusive and radical views they have expressed. It is true that if an idealistic view of the case be taken, there might be a concurrence of opinion, for we all should, if it were possible, desire our hospitals in the midst of parks, perhaps in the country, and to give a separate room to each patient; but we are practical men, who have been taught the social necessities of the case by experience, and we perceive that our task is to arrive at a practical solution of the question. I propose to show, first, the actual necessity for a central hospital.

"'Have we not already in the existing "Hôtel Dieu" 800 patients, for whom room must be found, and who require attention? There they are! The old "Hôtel Dieu" will soon disappear, and it must be replaced. This is an absolute certainty. I willingly agree with the view that it would be better that these patients should receive our care in the country; but do not let us indulge in impossible dreams. We have to look in the face the fact that these patients are there, and that accommodation must be found for them.

"'This central hospital, which I believe to be a necessity, is in no way affected by the fact of there being other local hospitals. Beside this question of the necessity of providing hospital accommodation, arises another which interests the Society in no smaller degree, namely, the requirements of the students to be educated to the profession. It is necessary that medical students should receive instruction, and to this end theatres for clinical lectures are requisite. If now you suppress this central hospital, which has existed from the earliest times, and which is well established, how will you deal with those physicians whose seniority and acquired rights have placed them in enviable positions, only to be attained at the end of a long and laborious career? I will not, however, dwell upon this argument, which might perhaps savour of too much personality. It is, then, my opinion that a central hospital is necessary and indispensable. There can be no doubt that, in common with yourselves, I protest against those steps which have been taken without our participation. Had I been consulted, I should have framed views and ideas conformable to the true principles of hygiene, and should probably have suggested another plan. With you I express my regret as to the method in which this scheme has been carried out, but, in giving expression to this opinion, I reserve to myself the right of examining whether, as has been truly said, *all* has been faulty in its execution. Let us take, for instance, the question of its situation.

"'Throughout the whole of this district was there a single site preferable to that which has been selected? I do not think that any such could be found. Would it have been advisable, as has been suggested in one of the numerous mooted projects, to place this hospital on the left bank, in the Rue de la Huette? Most certainly not. There, both air and light would have been absolutely wanting, and, in order to render the scheme efficacious, an enormous appropriation of land would have been necessary. It was an undoubted necessity that the old 'Hôtel Dieu' should be replaced by a new one, and I cannot see that any other situation could have been selected rivalling that which has been chosen.

"'Mention has been made of a barrack which is in the neighbourhood of the hospital. There is truth in the statement, but it is adjacent only at one small part, and instead of the wards for the patients being situated at that point, we find the quarters of the employés and members of the hospital staff. But with this exception, what do we find? To the north is the wide arm of the Seine, the quays, the "Place de l'Hôtel de Ville," a vast open and airy space; to the south a broad frontage, which, when cleared of all the actual building of the old "Hôtel Dieu," will have before it a extensive square, and the lesser branch of the Seine. Thus both, north and south, the principal fronts of the structure will look into broad and open spaces. On the western side no building faces the hospital; it is bounded by the quay, the flower market, and the "Place du Palais de Justice."

"'If we investigate the system of blocks, which has hitherto been adopted, we cannot fail to approve of it. I have had considerable experience of this arrangement during the many years I passed at the Lariboisière Hospital, where the blocks have abundance of air and light, and are cheerful to dwell in.

"'Much has been said about deep shadows, and the angles of the buildings impeding the free circulation of the air. For my part, I am free to admit that I pay more attention to the inside than to the out; there are not to my knowledge more than two or three points that have to be strictly guarded against in the construction of an hospital, such, for example, as overcrowding in the wards, and the transmission of contagious and infectious disease. Now, we have here broad and lofty wards, holding but a small number of beds, and lighted by numerous large windows. All this I hold to be eminently healthy. It is not so much the air of the more or less narrow courts that I dread; it is the air of the wards themselves, for that alone is infectious. As we shall not have any overcrowding here, we shall not bring together that great

collection of sick people by means of which infection is produced. There will be amply sufficient space between the beds and the cubical air capacity will be considerable.

" 'I am well aware that surgeons set forth statistics of mortality, from which they adduce formal conclusions; but I venture to say, that sufficient light has not yet been thrown upon the question why one dies here and not there; it is impossible in our present state of knowledge to state exactly the causes. At any rate, the question has been debated for more than 2,000 years and has not yet been solved; certainly the shape of the wards has nothing to do with the question, nor the rectangular arrangement of the buildings. The true questions are—skill and attention, the manner of preparing the dressings and the method of applying them. I also attach great importance to interior ventilation and to light, and under these heads we have nothing to find fault with in the wards of which I am speaking. Again, an agreeable arrangement of the sick wards cannot be held to be a matter of indifference; indeed, in this respect, it would be preferable to err on the side of excess.

" 'On the whole, however, I admit that the hospital is not perfect, nor such an one as we should have desired; I should have preferred less elevation given to the buildings, and I am of opinion that too great a number of patients should not be placed in them. The numbers originally proposed appear to me to be too high, but I accept 500 beds, and think, besides, that libraries might advantageously be established, and also theatres suitable for instruction. If this be done we should have a central hospital, which is in itself a necessity, and we should then be able to offer to medical students and to foreigners a hospital establishment of which our national *amour propre* need in no way be ashamed.

" 'My opinion, therefore, is that the hospital building should be retained, but improved upon.'

" M. Lailler: 'Gentlemen, I characterise the newly-projected Hôtel Dieu in the following words—"*It is a magnificent structure and a detestable hospital.*" It must necessarily be so, for to place so large a number as 600 patients in so confined a space is to set at defiance all the laws of hygiène. It is unnecessary to discuss the question of vast hospitals, for the system has been already universally condemned. No hospital should contain more than 200, or, at the outside, 250 beds.

" 'You have been told that it was necessary to found or to support a "central" hospital. Now, is there not a contradiction between the proposition for this "central" hospital and the fact that the working population is "centrifugal"? Your attention has been drawn to the demands of medical education at some central point. Would it not be possible for the medical students to move to those places where they know that the requisite teaching is to be obtained? Is there not instruction, and do we not find students, at the Beaujon Hospital, at the St. Antoine, at Necker, and at the St. Louis Hospital, all of them hospitals remote from the "centre"? If you desire to keep students in these scattered hospitals, let it be done by offering them the inducement of a practical and complete course of study; give them back the right of hospital dissection, and then they will no longer mass together, as they now do, in the Quartier Latin, and which, for more reasons than one, is by no means to their advantage.

" 'It is not for us to enter into the question of the ultimate position of the physicians of the Hôtel Dieu; *we must not forget that this is a matter concerning the patients and not ourselves, and we must remember that the hospitals are built for them.* Do not let us fear that the zeal of the medical man will be weakened by the fact that the hospitals stand in out-of-the-way quarters and districts, and in those spots where misery and sickness abound. Physicians will have no difficulty in finding their way to wherever their duties may call them. And, above all, do not let us forget that small hospitals alone conform to the rules of hygiène, because you never find in them an excess of patients; where there are 500 or 600 beds we have an excess. Again, if we consider the special details of the structure which we have just been visiting, we find them wanting: ventilation is impossible, light is imperfect; in many places the ground floor, indeed, will never see the rays of the sun; the courts are so many wells, and are even worse than those of Lariboisière. For all this there is no remedy, and it would not avail if even one of the floors were done away with.

" 'As to the suggestion or argument which has been brought forward, that we shall have no grounds for congratulation in our ability to shew a presentable Hôtel Dieu to strangers, I have nothing whatever to say. *Our object is to heal people who are ill, and not to shine in the eyes of others. Let us have simple, plain, quiet hospitals—brick-built barracks if you will—that we may pull down, renew, remove, and deal with in such way and to such ends as the social necessities of the hour may require. In fact, what I want to see is a useful, not a monumental, hospital.*

" 'My concluding remark strikes at the root. If you accept this hospital, you will commit an error.'

"M. Vidal: 'My opinion agrees with that just expressed by M. Lailler. The principle should be maintained that the larger the hospital the more unhealthy it is. Now, it would appear that this new hospital has been constructed to hold 700 or 800 beds; and we have been told to-day, and as if in anticipation of our objections on this point, that only 400, or at the most 450, would be placed there; but, in cases such as this, experience has taught us that such a foothold, so to speak, is slippery; good intentions may be thwarted, urgent necessities will present themselves, and one's hand being then forced—we yield. Call only to mind the Lariboisière Hospital, with its altered plans, and its buildings as ultimately extended These facts must remain before our eyes as historic examples which it behoves us not to forget.

"'The argument as to the desirability of foreigners, guests of France, being brought to express approval of our hospital establishments, appears really to turn against the gentleman who expressed it; for which hospital was it that, during the troublous period through which we have recently passed, actually attracted the greatest amount of foreign attention? It was the American Hospital, which, so far from being a monumental structure, was an hospital of tents. We have no lack of monumental structures, and you are aware how vast establishments, transformed into temporary hospitals such as the Grand Hotel, l'Ecole des Ponts et Chaussés, the churches, &c., proved as inefficient in their operations and results as the large permanent hospitals. Were I called upon to classify in the order of their real merit the various styles of hospital, I should arrange them thus: *1st, the tent; 2nd, the hut; and 3rd, the block—blocks, however, entirely isolated and open to the action of the air.* But, in the instance before us, what do we find? A courtyard, if indeed it may be called a courtyard, narrow and gloomy, a perfect miasmatic reservoir; and here a singular hygiènic error has been fallen into, for, so far from joining the various blocks together by a central 'corps de logis,' they should have been kept isolated. During times of epidemic, this hospital would become a terrible hot-bed of infection.

"'I agree also with the argument as to the proximity of the barracks; they form two groups, two centres which unite and reciprocally infect one another. We are certainly all interested in the teaching of medical science, but why should we be in favour of one place more than of another?

"'I trust to no longer have to blush for our laboratories, which are, as is but too well known, inferior to all other European ones. I should wish to see all our hospitals provided with these laboratories, and that they should be found elsewhere than in this pretentious Hôtel Dieu under the pretext that it is "central."

"'Medical students, we well enough know, will go wherever instruction is to be obtained; for have we not seen them quit certain central hospitals, go further off to others remote when impelled to do so by the requirements of their courses of study? I also express myself in favour of the revival of "dissections," and the supply of greater facilities of study in all our hospitals.'

"'My conclusion strikes at the root. It will not do to accept as a hospital the edifice which it is now proposed shall become the new Hôtel Dieu, a building which, subject to certain modifications, might be admirably suited to the purposes of a new treasury office, but which can only form a bad hospital.'

"M. Trélat: 'A considerable number of the questions now under discussion have already been examined into, and, six years ago, afforded matter for serious consideration. We now find ourselves confronted by a proposition, the carrying out of which does not actually rest with us, but yet which is immediately impending; time presses, and it behoves us to lose none in tendering our advice. What I would now say is, that I formally take exception to all the arguments set forth by M. Hérard. I look upon what he has said in regard to chirurgical statistics and ventilation as being both anti-statistical and anti-scientific. Much praise has justly been bestowed on the American system, on tents, huts, and abundance of ventilation, and I will not dwell on points so well understood. All that has been said and done during the last twenty years, all the experience which we have gained from the last campaign, points absolutely against those teachings, to which I am myself opposed. I will not make an effort to once more prove what has already been demonstrated; but, referring to the discussions of our Society of Surgeons and to my own individual publications, I would observe that the external and interior arrangements of the new Hôtel Dieu are directly opposed to hospital hygiène. Looking at the question from a purely scientific point of view, I declare that none of the necessary conditions have been fulfilled. *It is scarcely necessary to say that this question in no way regards the position of that distinguished architect, M. Diet, who has had to turn those remarkable talents, of which we have already expressed our warmest appreciation, to the ungrateful task of carrying out a bad plan.* I share the views of Messieurs Marjolin, Giraldès, Lailler, and Vidal. What course is to be pursued?

"'The radical solution would be to say—I, the "Assistance Publique," have been compelled to obey. I had no desire to erect this hospital. I am the victim; return me the money which has been so badly

employed. But if the appeal be rejected, and it is said, "take it," what shall we do with it? If there be nothing left for us but to take this structure and to make the best use of it as far as may be for the purposes of a hospital, I would then demand that the Society of Physicians and Surgeons should hold a meeting and express its feelings. The Society would, doubtless, say that 700 beds must not be put in this hospital, but a much smaller number. The Society would name a Commission; this Commission would hand in its report, and the conclusions thereon arrived at should be obligatory on the "Assistance Publique." I cannot too emphatically reiterate my opinion *that the plan of this hospital is detestable and unheard of; this monument is nothing but a luxurious tomb—a mausoleum. Foreigners will wonder what mad freak has taken possession of France. Everywhere in Europe and America small hospitals are erected; this structure is a colossal monument of ignorance, whether it be regarded politically, socially, or in the light of its requirements as a hospital. It is real distress under the guise of splendour.*

" 'If then this protest be insufficient, and if it is actually incumbent upon us to pass an opinion, not now upon the principle, but upon its application, we will say, "Do not put there more than 400 beds, and let the medical staff be called upon to formulate practical and technical expressions such as they have, perhaps, never before been asked for." By this means would be gathered together views as to the proper arrangement of the interior in the amphitheatres, in the wards, and in the baths.

" 'I would add, that should the question of isolation cases, of acute infectious diseases, and of those which are easily contagious, be viewed in a proper spirit, it would be well to set aside for that purpose the buildings, when restored, of the old Hôtel Dieu, which stands on the Quai on the left bank of the lesser arm of the Seine.'

" M. Lorain agrees with Messieurs Marjolin, Giraldès, Lailler, Vidal, and Trèlat, that the system of vast hospitals is hopelessly condemned, and that on this of principle all argument is out of the question. It is neither our *esprit de corps*, nor any special regard for our privileges, which impels us to claim the sole right to formulate the laws of hygiène, and on that head to combat the competence of the administrators. We are, above all, influenced by the sense of our moral responsibility, nor do we forget that we are advocates for the poor.

" No doubt the people will be deceived. *Populus vult decipi:* do not let us add *decipiatur*. Surgeons have plainly set forth the rules, hitherto accepted by the savants of all countries, as to the hygiène of wounded people. Doctors have told over and over again of what must be the result where cases of child-birth, and contagious and infectious disorders, are all indiscriminately huddled together, without proper precautions or regard for sufferers from other ailments, in the vast wards of hospitals. All that need be said on the question has been said. We have to fulfil two duties. The first is to proclaim, without fear or reticence, that the new Hôtel Dieu has been from its inception a political rather than a hospital question. Our second duty is to prevent, if not all the evil, at least as much of it as lies in our power; and if, at the last moment, our recommendations are ignored, and if the cruel necessities of the time, unprecedented in our history, compel us involuntarily to take the step, then should we call together all the physicians and surgeons of the various hospitals in order that they may plead the cause of good sense, of science, and of honesty, with a view to obtaining these two important concessions, the first being that, relatively speaking, a very small number of patients shall be admitted to the hospital, and the second that the buildings shall be modified in certain points where alterations in the arrangements are essentially necessary.

" M. Hardy, the President, said, 'I will now submit to you two lines of ideas, the one having a general bearing, and the other one relating more particularly to the object of our deliberations. The general idea upon which we are all agreed relates to the danger of large hospitals. We must pay attention to the necessity for hospitals being neither too large nor too incumbered. Nevertheless, circumstances will arise to which it is sometimes necessary to yield. In a large city like Paris we *must* have large hospitals. The Hôtel Dieu is not waiting to be built, it already exists, and it is a vast hospital; La Pitié is also a large hospital. There are two points that we must not lose sight of, namely, the necessity of economy on the part of the administrative departments, and also that provision must be made for the instruction of medical students; but, notwithstanding this, the large hospitals ought to be reduced so as not to admit more than 400, 500, or at the outside 600 patients.

" 'At the Hospital of St. Louis we have 700 patients and but little mortality, but these patients are of a particular class and most unlikely to form a hot-bed or centre of miasmatic infection.

" 'I do not then hold any very strong feeling as to the Hôtel Dieu. In a large city there must always be a necessity for barracks, markets, colleges, and hospitals, and these must be on a scale proportionate to their dimensions. I should never have advised that the Hôtel Dieu should be built as it has been. I

consider that in regard to its surroundings there are too many buildings. There is not a sufficient circulation of air. The courts are mere blocked-up passages instead of being open ways; but, notwithstanding all this, the hospital has been built, then what must be done with it? It can scarcely be made use for any other purpose, and I recognise the necessity of a central hospital. Now, the old Hôtel Dieu is falling to ruin. It is no longer habitable. Then where shall we locate the numerous patients who are now lodged there? It has been suggested that a new hospital shall be erected at Menilmontant, which would likewise be a great hospital, This is, however, but a project which has not yet been carried out. But this necessary central hospital actually exists, and what has to be done is to utilise it in the best way we can for the purposes for which it was constructed.

" 'The question of medical instruction also demands your attention. It is necessary that our students should have hospital instruction in immediate proximity to their places of study, and also amphitheatres for dissection. I would, therefore, take possession of the new buildings which are offered to us, but I would restrict the number of beds to 400; there is one storey too many, and so I would establish there libraries, museums, collections, and laboratories. In a word, I would set up scientific courses, and, in order to diminish the chances of miasmatic infection, I propose that a large proportion of the patients admitted into this hospital should be those who are not suffering from acute febrile maladies, but special and non-infectious cases, such as venereal diseases and skin affections. I would further establish a special department of ophthalmic surgery. We should thus have about 150 beds occupied by patients from whom would be no fear of epidemics arising. I would place in the new Hôtel Dieu 400 or 500 beds, but 400 would be preferable, and I would form a hospital for general instruction.

" 'Of course, we ought to reserve to ourselves the right of correcting the defects of the original plan by sacrificing one storey if necessary, ventilating and lighting the underground rooms, bringing daylight into the bath rooms, and modifying the arrangement of the amphitheatres. A Special Commission, selected from the physicians and surgeons of the hospitals and from the professors of the faculty, should afford its advice on these various subjects.

" 'M. Marjolin says in reply, that such a hospital as "La Pitié" exists, having 600 beds, is a matter for regret, but yet the number of the beds in that hospital is justified by the necessities of the quarter in which it is situated, whereas in regard to the Hôtel Dieu no such necessity exists. It should be known by all "savants" that this new Hôtel Dieu was built in accordance with the will of one individual—"*Hoc volo-sic jubeo-sit pro ratione voluntas.*"

" 'M. Maxime du Camp was in error when he stated in print that learned bodies had been consulted as to the construction of this building, for neither the hospitals, nor the faculty, nor the societies of hygiène had been called upon to give their advice.

" 'It has been said that the square of the flower market provides a large open space in proximity to the hospital, but how do we know that this land will not be sold and covered with houses?

" 'In the construction of the Hôtel Dieu the Lariboisière system has been followed, but all its defects have been aggravated.

" 'It is a well-known fact that in all large towns, when the beds of the various hospitals are all of them constantly occupied, there is excessive mortality. You must not, therefore, suppose that the only reasons for increased or diminished mortality among surgical cases depends solely on the skill of the operator and on the care with which the bandages and dressings are applied. The necessity for spare wards is proved in commerce in the case of stores for preserved meats, for when a building has been used for this purpose for several years, it has either to be quitted or the temperature must be raised some degrees. The experiments made at Mans, in a workshop where "Appert's" process is employed, will form the subject of a special communication on my part.

" 'We must admit, therefore, that under certain conditions buildings become miasmatically poisoned, and this condition becomes intensified to a high degree in the wards of a hospital.'

" Messieurs Giraldès, Hérard, Trélat, and Lailler, then briefly replied, and M. Hardy summed up the discussion.

" M. Broca having, unfortunately, been prevented by circumstances beyond his control from attending the sitting of the Commission, formulated his opinion in the following terms:—'My opinion is the same as that expressed by M. Trélat. The new Hôtel Dieu as it now stands cannot be used as an hospital, but if, in spite of everything, it is insisted on turning it into an hospital it will be indisputably necessary to make such alterations as will reduce the present number of beds by one-half. As regards the hygiènic arrangements of this hospital they are simply detestable, and it would be impossible to conceive

anything worse. I did not express myself in such energetic terms in the report which I had the honour of drawing up in 1864 for the Commission to whom the Administration submitted or rather presented the plan of the future Hôtel Dieu, but this plan was far less defective than the one which was later on adopted by the Prefect, and forced upon the Administration and its architect.

"'Do not suppose that the Commission restricted themselves to useless objections. I have just re-read my report, and I am almost astonished at the severity of the criticisms that the Commission of which I was the head had accumulated against the general system of the construction as proposed to them, and, above all, as to the particular application they wished to make of this system.

"'The system proposed we formally rejected as being essentially bad, as it was impossible to put up the beds and the necessary accessories for a hospital of 800 patients in such a narrow space in parallel and isolated buildings; consequently they had joined these by two longitudinal buildings which reduced the size of the central court by twenty-five metres. It was in vain that we protested against the immense inconvenience of these longitudinal buildings which should only have been one storey high; and, to give you an idea of the favour with which our remarks were listened to, it will suffice if I say that the Prefect of the Seine doubled the height of the buildings which we requested to have reduced. The building is incomparably worse than the one the plans for which were laid before us, and I find it so utterly bad that I declare it to be impossible to turn it into either a large or small hospital in its present form. In this report I entirely share the views of those of our colleagues who have expressed a radical opinion, and, if it depended on me, I should absolutely condemn this defective hospital.

"'Will this solution be accepted by the city and by the Administration? We can only hope so, but cannot calculate on it, and, to my mind, I think it would be well to consider if, in the face of all opposition, the new Hôtel Dieu is turned into an hospital, whether it will not in some manner be possible to ameliorate its condition in some way. It must not be concealed that the present circumstances are not calculated to alleviate the misery, for the number of necessitous sick does not decrease. There are 800 beds in the old Hôtel Dieu; and the people must have beds. If the longitudinal buildings of the new Hôtel Dieu are done away with, and if the parallel buildings are reduced by one floor, the hospital will be rendered tolerable, but it will then only be able to accommodate 400 sick; and then, what are we to do with the others? Shall we keep them back for the Menilmontant Hospital, the construction of which has been recognised as necessary? If so, then until the time it is finished, I suppose, they must be left in the streets. Besides which, the "Administration de l'Assistance Publique" is ruined, all its resources have been swallowed up in the construction of this building—even including those to come, and including the old debt to the city, which came from the sale of the slaughter-houses, and which amounted to twelve millions three hundred thousand francs. This sum, the interest of which the city paid to the hospital, and which should have been handed over to them in accordance with the contract of sale in 1874, has been paid them in advance by compelling the administration to construct the New Hôtel Dieu. By this act of violent oppression the "Administration" has lost the greater part of its revenue, and it is now in the position of being absolutely unable to build a new hospital, and, as it is not possible to lodge 800 sick persons in the new Hôtel Dieu, and as they cannot reduce the number of beds to 400, they find themselves placed in a serious dilemma. In order to extricate themselves from this dilemma there is no other way than to say to the city, "Give me back the twelve millions three hundred thousand francs which we have been despoiled of on your account." This legitimate restitution would enable the "Administration" to face the difficulty. One part of the money would go towards enlarging the buildings in the "Huchette Quartier," and, at a very moderate expense, enable them to erect an "Hôtel Dieu" on the left bank, which, though small, would be healthy, and contain 400 beds, and would be perfectly sufficient for the requirements of the poor in that quarter. With the balance of the money, if all ideas of monumental buildings were put aside, they could easily construct the much-required hospital of Menilmontant, with 500 beds, so that, after having pulled down the old buildings at the "Cité," they would then have 100 beds more at their disposal than at present. If the Administration is wise, and if the city is just and enlightened, this will be the solution of the difficulty. It is perfectly true the city would have to spend a large sum of money, but we must not forget that they have seven millions francs in hand entirely at their disposal for laying out for completing the Hôtel Dieu. The actual outlay would, therefore, be from five to six millions, and this the city would be well compensated for by the acquisition of that monument which goes by the name of the New Hôtel Dieu.

"'But it is to be presumed that the Administration will be forced to give up the idea of this restitution, and therefore that they must use this building. What are they going to do, then? As it stands at present, with its central court, "the court of honor," twenty-five metres in size, surrounded by high buildings which

almost exclude the sun-light, the hospital is useless. The two longitudinal buildings should be done away with. This will necessitate much work, as it is there that, so to say, all the vital organs for the breathing and circulation of the hospital are situated, such as gas-pipes, conduits for ventilation, conduits for water, &c.; these would have to be carried over light bridges; and then it would be possible to lodge 400, or even 450, sick in the reduced buildings if, as advanced by M. Hardy, some of the salons are given up to the use of special cases of sickness. This number of 400 to 450 beds is lower than the number accepted by the Commission of 1864. We thought that with care, and by adopting a plain style of building, that the number of beds could be increased to 600. But we observed, that if the proposed system of parallel buildings were carried out, the maximum number of beds should not exceed 468.

"'The system of parallel buildings proposed by Tenon at the latter end of the last century was never designed to economise space, but, on the contrary, required more ground than any other system. These buildings, to which we have given the name parallel—being the only name we can now give them—Tenon called them isolated buildings, and he required a vast space for their isolation. This system would have been employed in the new Hôtel Dieu, but there was not sufficient room, and, as it was absolutely necessary to find places for 800 beds, they imitated the "Munch" battery, in which a blade of zinc folded over and over again gives a very large surface with very little volume; they increased the number of the buildings, and, when these were found insufficient, they joined them together by other longitudinal buildings, so that, finally, they ceased to be isolated; and this is how they carried out Tenon's plans!

"'The longitudinal buildings must be pulled down; the parallel buildings are too crowded, but then they are at least isolated, and so the hospital might be made tolerable. To conclude, I only can see two alternatives which I give as follows:—

"'Either obtain from the city the restitution of the sum of 12,300,000 francs, which will be a sufficient amount for the most urgent wants of the Administration of the public charities; or, if at all hazards it is forced to accept the new Hôtel Dieu, then return to the system of isolated buildings, and thus reduce the number of beds to 400.'

"After having discussed these points, the Society unanimously passed the following resolution:—

"'*As it at present stands the new Hôtel Dieu is so constructed as to be absolutely contrary to the fundamental principles of hospital sanitary law.*'"

The effect produced by this strong protest upon the part of those most competent to give an opinion as to the new structure, was that orders were given for the removal of the upper storey of the building, then in greater part erected, but this only partially met the objections raised to the general planning of the structure, and it was still condemned as unfit for the reception of the sick. The building was, however, slowly completed, and the idea of devoting it to hospital purposes ostensibly abandoned. It was to take the place of the Hôtel de Ville, destroyed by the Commune, it was to be utilized for barrack purposes, and many other such propositions were put forward and seriously debated; but, ultimately, it was announced that the building would be opened as a hospital for 500 patients only. Since then, however, many of the rooms, said to be intended for day rooms, have been utilized as sick wards, a purpose for which it is evident they were originally intended, and the nominal number of beds is now, therefore, 566, as will be shewn hereafter. Seldom, however, are there less than 600 patients in the building.

It will be observed by the foregoing report that the "Administration Generalé de l'Assistance Publique," of Paris, is in no way to blame for the defective construction of this building; it was handed over to that authority only when finished, and the Administration has since then performed the unthankful task of maintaining the building as a hospital.

The following are some extracts from a "Report of the *Lancet* Special Commission" on the building.* The report generally is condemnatory of the structure.

* *Lancet*, September 15th 1877.

"The space in the building, which is of no other use than to increase expenditure, might almost be measured by the acre. . . . . The new building, however, has its political aspects. It may be that the expenditure has been purposely lavish to counterbalance, as it were, the cost of the new Opera House. The French peasant is intended to see that his sufferings form a subject of consideration equally with the luxuries of the rich. He will luxuriate in the gorgeous *salons*, and will feel content, perhaps, with all the governments who have had a hand in the construction of the new building. He will shout 'Vive Somebody'; and it may be, therefore, that the political value of the new Hôtel Dieu will be of great service to that party which is sufficiently adroit to take advantage of it."

Site.—The buildings are situated on the island formed by two arms of the river Seine and known as La Cité. The principal or entrance front faces the Parvis Notre Dame, the rear front faces the Quai Napoleon, and the two sides the Rue de la Cité and the Rue d'Arcole. The extent of the site is 231,305 superficial feet, being 5 acres 1 rood 9½ poles, or about 409 feet per bed.

Subsoil.—The architect states that the soil immediately below the surface is of a sandy nature, and that the foundations of the building had consequently to be taken to below the level of the bottom of the adjoining river.

General Arrangement.—The accompanying plate shews, by a block plan, the general arrangement of the buildings upon the site, and likewise detailed plans of one set of wards with their offices.

The building is entered through the central block A, which is one storey in height, and constitutes a large and handsome vestibule. Carriages pass through this vestibule into the entrance-court "A," at the opposite end of which there is a handsome flight of steps leading up to a collonade which gives access right and left to the principal floor of the building.

Block B is four storeys in height, and contains, on the ground floor, the out-patients' department; on the first and second floors, the apartments of the priest, the steward, and other officials; and on the attic floor, the domestics' dormitories.

Block C is also four storeys in height, and contains, on the ground floor, the directors', stewards', and clerks' offices; on the first and second floors, apartments occupied by the resident students and officials; and on the attic floor, additional domestics' dormitories.

Block D is two storeys in height, and contains workshops on the ground floor, with sleeping apartments for workmen on the first floor.

Block E is two storeys in height, and contains stabling and coach-house on the ground floor, and apartments for the cook and storekeeper on the first floor.

Block F is five storeys in height, and contains, on the ground floor, the porters' office, dispensers' room, doctors' cloak room, and a day room for the use of the students on duty; on the first and second floors, the chief dispenser's apartments and two operating theatres for ophthalmic and surgical cases respectively; on the third floor, three sick wards for the accommodation of 6, 7, and 8 beds respectively; the attic storey is used for nurses' rooms and stores.

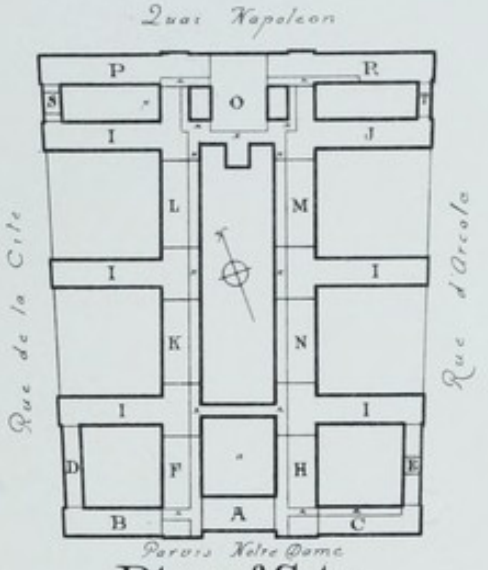
Block H is likewise five storeys in height, and contains, on the ground floor, a general waiting room, students' rooms and library; on the first and second floors, the directors' and other officials' apartments, an operating theatre for special diseases of women, and a

:Hôtel:Dieu:

:Paris:

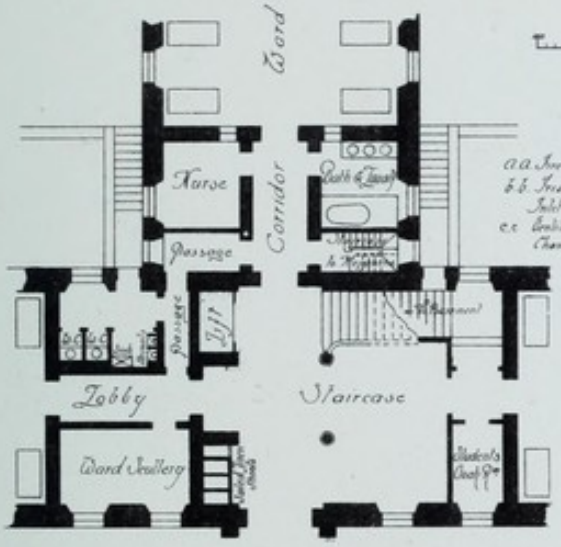
A Entrance Vestibule.
B Outpatients Department Residence of Stewards apartments.
C Administrative Offices, Officers Apartments
D Workshops
E Stables and Coach house
F Porters Office, Dispensers Room Students Room Chief Dispensers Apartt Operating Theatres, Separation Wards
H General Waiting Room Students Rooms Library Directors Apartt Operating Theatre Lecture Room Separation Wards
I Sick Wards
x Corridors

J Linen Store Sisters Chapel Residence Dormitory, Dirty Linen store
K Separation Wards & Day Rooms
L Separation Wards Day Rooms and Male General Baths
M Separation Wards Day Rooms and Female General Baths
N Opthalmic departmt Separation Wards Day Rooms & General Kitchen.
O Chapel
P Pathological depart, Mortuary &c.
R Officials depart, Patients Clothing store
S Entry into Courtyard, &c.
T Garden House for Officials



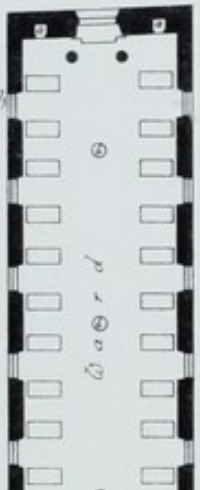
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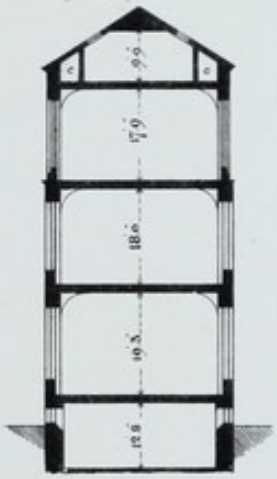
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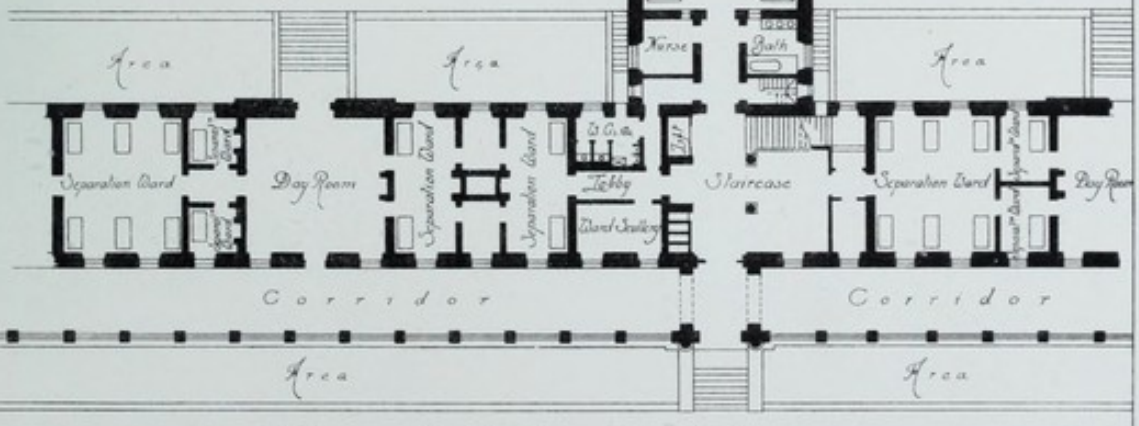
:Detail:of:Offices:

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H. Saxon Snell del.

clinical lecture room; on the third floor, three sick wards for the accommodation of 6, 7, and 8 beds respectively; the attic storey is used for nurses' rooms and stores.

The pavilions I I I I I are four storeys in height above the basement, and they contain, on each of the ground, first, and second floors, a ward intended for 24 beds; the attic floors are used as store rooms and nurses' dormitories; the basements of these pavilions are, generally, occupied as store rooms, excepting in one instance where it is used as a dining room for the under servants. Up to the time of my last visit, the central chapel, block O, had not been erected, and a ward of one of the blocks last described had, therefore, been made use of for religious purposes.

Block J is designed similarly to those of blocks I last described; it is not, however, devoted to the use of the sick patients, but is fitted up on the ground floor as a linen store, on the first floor as a chapel for the use of the sisters, and on the second floor as a dormitory for the novitiates; the basement is used as a dirty linen store, and the attic as store rooms and nurses' dormitories.

Block K is four storeys in height above the basement, and contains, on each of the ground and first floors, a small or separation sick ward for 6 beds, two for 2 beds each, and two for 1 bed each respectively, besides a day room; and on the second floor, one ward for 8 beds, one for 6 beds, and two for 1 bed each, besides a day room; the basement floor is occupied by the dispensary, and the attic floor as nurses' dormitories and stores.

Block L is four storeys in height above the basement, and contains, on each of the ground and first floors, two small or separation male sick wards for 6 beds each and four for 1 bed each, besides a day room; and on the second floor, two wards for 6 beds each, one for 2 beds, and two for 1 bed each; on the basement there are twelve bath cubicles for the general use of the male patients, besides a douche and a vapour bath, and also a private bath room for the use of the officials; the attic floor is used as store rooms and nurses' dormitories.

Block M is similar in all respects to block L, but is occupied by female patients.

Block N is four storeys in height above the basement, and contains, on the ground floor, the ophthalmic waiting and consultation rooms; on the first floor, a small or separation female sick ward for 6 beds, two wards for 2 beds each, and two for 1 bed each, also a day room; on the second floor there is one ward for 8, one for 6 beds, and two for 1 bed each, besides a day room. The basement storey contains the general kitchen of the establishment, and the attic storey is used as stores and nurses' dormitories.

Block O, the chapel, is not yet erected.

Block P, three storeys in height above the basement, contains an unusually complete pathological department, and a mortuary and post-mortem room. In the basement, at one end, there are boiler and engine rooms for the general purposes of the establishment, and these are continued for some distance under the adjoining yard "P."

Block R, three storeys in height above the basement, is generally devoted to the use of the officers of the establishment, excepting that the basement is used as a patients' clothing store.

Block S is a workmen's entrance to the adjoining courtyard.

Block T is a kind of arbour, or summer-house, for the officials.

Total Accommodation.—It will then be seen that the accommodation provided for patients in the various blocks is as follows, viz.:—

In the five blocks I, on the ground, first, and second floors, three wards (in each block) for 24 beds each	360
In block K, on the ground floor, one ward for 6 beds, two for 2 beds each, and two for 1 bed each	12
In block K, on the first floor do.	12
Do. second floor, one ward for 8 beds, one for 6 beds, and two for 1 bed each	16
In blocks L and M, on the ground floor of each, two wards for 6 beds each and four for 1 bed each	32
In blocks L and M, on the first floor of each, two wards for 6 beds each and four for 1 bed each	32
In blocks L and M, on the second floor of each, two wards for 6 beds each, one for 2 beds, and two for 1 bed each	32
In block N, on the first floor, one ward for 6 beds, two for 2 beds each, and two for 1 bed each	12
In block N, on the second floor, one ward for 8 beds, one for 6 beds, and two for 1 bed each	16
In block F, on the third floor, three wards respectively for 6, 7, and 8 beds each	21
In block H, do. do. do.	21
Total	566

But here we find, as in nearly all other Parisian hospitals, overcrowding exists, for the normal accommodation, above enumerated, is more often than not largely supplemented by temporary trestle beds placed in the wards and day rooms; for example, on the day that these detailed particulars were taken, the number of patients occupying the building was 604 instead of 566.

Connecting Corridors.—Two superposed corridors on the ground and first floors run down either side and across the end of the inner central quadrangle, and connect together the various blocks of buildings; these corridors are closed in by glass on the ground floor, but are open on the first floor, they are each 12 feet wide and 18 feet high. The roofs of the upper corridors also afford a means of external communication between the various blocks at the second floor level, and they may also be used by the patients as ambulatories.

Water Supply.—The whole of the water used in the establishment is supplied by the Municipal authorities, and is delivered into large cisterns for distribution over various parts of the building.

Drainage.—The drainage of the building is effected in a manner almost exactly similar to that of the Laraboisière, described at page 144, and need not, therefore, be again detailed here.

Area Covered.—The area covered by the buildings is 111,071 feet, or somewhat less than one-half of the site, and about 196 feet per bed.

Cost.—The cost of the land, including all compensations, amounted, as I am informed by the architect, to £720,000, being about £135,592 (18,000,000 francs) per acre, or £1,272 per bed. The cost of the buildings, so far as at present ascertained, is £687,690 (17,192,248 francs), but whether it will be more than this is dependent upon the result of a pending law suit between the Government and the contractor. At this sum,

the cost is at the rate of exactly £1,215 per bed; so that the total cost of land and buildings together has been at least £1,407,690, or £2,487 per bed. The original cost of the furniture was £13,682 (342,053 francs), or about £23 4s. perbed.*

PRINCIPAL SICK WARDS.

The following description refers more particularly to the ground floor of the central block of male sick wards. It will be seen that, owing to the irregular shape of the ground, the other pavilions are either slightly more or less in length than this one.

Aspect.—The axes of all the pavilions run W. N. W. and E. S. E., so that the windows of the wards face N. N. E. and S. S. W.

Relative Positions of Pavilions.—The height of the pavilions, as measured from the floors of the lowest sick wards to the junctions of the upright lines of the outer side walls with the sloping lines of the roofs, is about 62 feet, and the distance between the walls of any two pavilions is 123 feet, or about twice the height. The two pavilions nearest to the Quai Napoleon, and the blocks P and R, are, however, very much closer together than this.

Size of Wards.—The principal sick wards are of parallelogram shape, and they are designed to contain 24 beds. Their average length is 102 feet 9 inches, and their width 29 feet 3 inches. The height of the ground, first, and second floors are respectively 19 feet 3 inches, 18 feet, and 17 feet 9 inches. The superficial floor space, in each case, is, therefore, 3,006 feet, or about 125 feet per bed, and the cubical contents on the ground, first, and second floors are 57,866, 54,108, and 53,357 feet, or about 2,411, 2,254, and 2,223 feet per bed respectively.

Bed Space.—The average lineal wall space per bed is 8 feet 4 inches.

Windows.—There are six windows in each side wall, and their total effective glazed surface is on the ground, first, and second floors 471, 442, and 382 feet, or about 19½, 18½, and 16 feet per bed respectively. If, however, the end windows be taken into account, the effective glazed surface is 526, 496, and 434 feet, or about 22, 20½, and 18 feet per bed respectively. When all the windows are open to their fullest extent, the total area through which air can be admitted by them into the wards is 680, 655, and 584 feet, or about 28½, 27¼, and 24½ feet per bed respectively. Each window is divided into two heights by a wooden transom, and consists of ordinary casement sashes, the espagniolette bolt of the lower part being fitted with a lock and key. The sashes are, generally, glazed with ordinary 21-ounce sheet glass, but the end windows are glazed with rolled and fluted glass.

Warming.—The warming of the wards, like that at the Tenon Hospital, is effected by means of fans placed in a sub-basement beneath the engine-house, and these draw the outer fresh air through a large inlet opening, and then force it along subways which run beneath the main corridors of the building to the basements of the pavilions, in each of which there are placed six coils of steam pipes enclosed in iron casings, through which the air passes, and, becoming heated by impingement against the steam pipes, it is carried vertically through flues in the walls and then horizontally through the floors, and, ultimately, discharges itself through ornamental pedestals which stand in the centres

* These figures have been kindly furnished to me by the Director of the "Assistance Publique."

of the wards. There is also an ordinary fire-place in each ward beneath the end windows.

Ventilation.—The ventilation of the wards is effected in a manner similar to that of the Tenon Hospital, described at page 172, and need not, therefore, be repeated here.

Lighting.—The arrangements for lighting the wards are also similar to those of the Tenon Hospital, as described hereafter.

Floors.—The flooring of the wards is constructed with wrought-iron girders and joists, filled in between with hollow brickwork and concrete, on which is laid timber joisting; the upper surface is finished with oak parquetry boarding beeswaxed and polished. The ceilings are plastered and finished similarly to the walls.

Walls.—The outer walls are built of masonry, 2 feet 8 inches thick on the ground and first floors, and 1 foot 6 inches thick on the upper floors. The inside faces are formed with a plastering "stuc" composed of lime and powdered marble, and finished with a floated surface. The junctions of the plastering of the walls and ceilings are formed by curves 4 feet 6 inches radius; at the level of the floor there is a wood skirting 9 inches high.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated adjoining the offices at the entrance ends of the large wards, and they are entered from the passage connecting these offices; the water-closets are each 2 feet 11 inches wide and 3 feet 9 niches long, and are fitted with an apparatus similar in construction to Jennings' patent valve closet; they are manufactured by "Dumuis," of Paris. The enclosures to these closets are formed of deal framing 7 feet high, having dwarf doors in front 4 feet 3 inches high and 12 inches above the floor. The side divisions are 5 feet 6 inches high only and 12 inches above the floor, and are formed of glazed slabs of white earthenware. The slop-sink is of glazed earthenware, 2 feet 4 inches long by 1 feet 8 inches wide, enclosed by an iron casing; it is supplied with cold water only. Above this sink there is a wooden rack for holding bed pans. There are two urinals of white earthenware, with ordinary slate divisions and backs, and they are provided with a treadle flushing apparatus similar to those introduced into this country by Mr. Jennings. On the female side a bidet takes the place of the urinals. The position of these offices, adjoining as they do the passages leading to the wards without any cross-ventilated lobby, is very objectionable, and is, therefore, like those of the Lariboisière and Tenon Hospitals, much to be condemned.

The bath and lavatory room leads off the entrance passage way, and it has an area of 101 feet; it is fitted with a copper bath supplied with hot and cold water, and likewise with three "tip-up" white glazed earthenware lavatory basins sunk in a white marble shelf and supplied with cold water only.

The soil and waste pipes are generally of iron about 9 inches diameter, with short curved branches from the various apparatus, each about $3\frac{1}{2}$ inches diameter; there is, however, a separate pipe from the urinals about 4 inches in diameter; they are all carried down the inside of the walls without enclosure of any kind, and it is stated that they are not ventilated at the top; they descend into a room in the basement, and discharge themselves into iron receptacles which retain the solid and fœcal matter and

pass away the liquid portion by an overflow pipe into the drain, as described under the head of "*Drainage.*"

Day Rooms.—Midway between each pair of pavilions there is a day room for the use of convalescent patients, access to which is obtained from the main corridors, or by passing through the smaller sick wards; they each have an area of 690 feet. Each of these day rooms is used jointly by the patients of two or more pavilions; and, as there are eleven in all, the average superficial space per patient is about 13½ feet.

Separation Wards.—There are five small and separation wards adjoining the front offices of each pavilion. One ward is for the accommodation of 6 patients, two for 2 patients, and two for 1 patient, and the superficial areas of each are 592 feet, 299 feet, and 78 feet, or about 99 feet, 149 feet, and 78 feet per bed respectively; the height of each is 19 feet 3 inches, so that their cubic contents per bed would be 1,899, 2,878, and 1,506 feet respectively.

Duty Room.—The nurses' duty room (the "Tisanerie") leads off the passage way, giving access to the small ward, and has an area of 150 feet; it is fitted with a stone sink supplied with cold water only, as also an iron hot-plate with ovens and hot-water boilers.

Nurses' Room.—In addition to the duty room, last described, there is a nurses' room adjoining the large ward and having an area of 101 feet; it is not used as a sleeping apartment.

Lifts.—Leading off the main staircase there is a lift opening, 7 feet 10 inches long by 4 feet 6 inches wide; the cage, which ascends from the basement to the various floors of each pavilion, is constructed of iron, and is worked by hydraulic power.

Staircases.—The principal staircases occupy an area of 888 feet, and they are constructed of oak, 6 feet 6 inches in length, and with treads 12 inches wide, and risers 6 inches high. There are smaller staircases adjoining the larger ones, which lead to a mezzanine storey, situated over the bath and nurses' rooms, and used for stores.

Basement.—The basements under the pavilions, 12 feet 8 inches high, are variously occupied, and are more particularly described under the head of "*General Arrangement.*"

Total Area of Pavilion.—The total area of this pavilion, including one of the adjoining day rooms, the five separation wards, and also the walls surrounding them, is 9,564 feet, or about 266 feet per bed.

TENON HOSPITAL,

MENILMONTANT, PARIS, FRANCE.

THIS building is situated upon a small eminence within the ramparts surrounding the city, and in one of the healthiest quarters of Paris. The architect of it is M. Billon, and, although the design cannot, as a whole, be admitted to be a perfect specimen of good hospital planning, it is undoubtedly one of the best types erected prior to the recent adoption by France of the more modern principles now universally recommended by all writers upon the subject of hospital construction. It is without doubt one of the largest and most important hospitals in the city.

The foundation stone of the building was laid without ceremony 1st July 1872, and it was formally opened on 12th November 1878 by M. de Marcère, Minister of the Interior, accompanied by M. Lepère, Under-Secretary of State; M. Boucher-Cadart, Director of the "Sûreté Générale;" M. Ferdinand Duval, the Prefect of the Seine; M. Michel Moring, the Director of the "Assistance Publique;" and the architect.

Site.—The buildings stand upon a plot of ground shaped like an elongated trapezium, and bounded on the south-west by Rue de la Chine, on the north-east by Rue Pelleport, on the west by Rue de la Dhuys, and on the south by Rue Sorbier. The extent of the site is 567,951 superficial feet, or 13 acres and 6 perches, being about 782 feet per bed.

Subsoil.—The foundations of the buildings rest upon a substratum of chalk, but they were carried through the overlying brick earth, in some cases it is stated as much as 48 feet in thickness.

General Arrangement.—The plate at page 170 shews by a block plan the general disposition of the various blocks of buildings upon the site; also a plan of the principal floor of one double pavilion, and details of the attached offices. A perspective bird's-eye view is also illustrated on the opposite page.

The establishment is entered through the central block of buildings marked A on the plan. This block, which is four storeys in height, contains on the ground floor the directors', stewards', and porters' offices, and a waiting room. The directors' apartments and medical officers' rooms occupy the first floor; the dispensers', priest's, and steward's apartments the second floor; and the apartments of the night duty officers the third floor.

Block B is one storey only in height, and contains additional offices for the steward, the students' library, and hat and cloak rooms. The corresponding block C contains the out-patients' department and consultation rooms.

Blocks D D are double pavilions, four storeys in height, containing wards devoted to the treatment of surgical cases; they each contain on the ground floor six separation wards, for 4 beds each, together with the usual attached offices and a doctors' consulting room. The first and second floors each contain two large wards, each for the accommodation of 22 patients, two separation wards for 3 beds each, and two for 1 each.

Hospital Construction and Management.

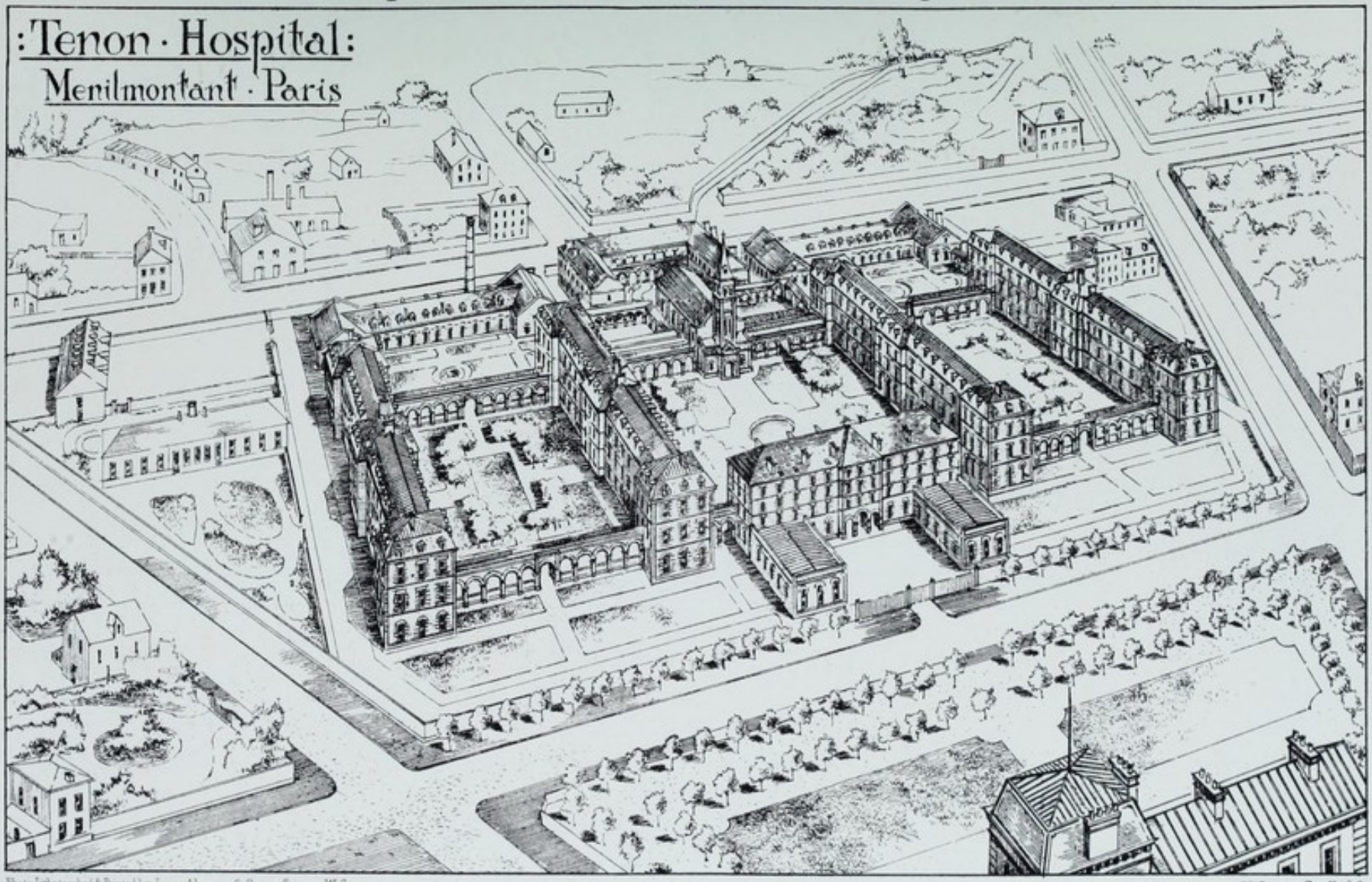


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H. Saxon Snell del.

On the third or attic storey there are two large wards capable of accommodating 12 patients, two separation wards, each for 2, and two similar wards for 1 patient each.

This estimate of numbers on the third floor is based on the supposition that the same cubic space is allotted to each patient as in the wards below. The account forwarded to me by the Director of the "Assistance Publique" does not include these rooms at all in the calculation of the numbers of patients for which the building was erected, for it was intended that this attic storey should only be used in cases of epidemics. As a matter of fact, however, they are generally in use during about six months in each year, and then a much larger number of beds are obliged to be crowded into them than stated above. The basements of these pavilions are made use of as store, lumber, and furnace rooms.

Blocks E E are similar double pavilions, devoted to the treatment of medical patients, but they have no corridor running through the ground floor as in the case of blocks D D; they are four storeys in height, and contain on each of the ground, first, and second floors two large wards, each for the accommodation of 22 patients; on the ground floor two separation wards for 1 and 2 patients each respectively; and on each of the first and second floors two separation wards for 3 beds and two for 1 bed each. Both of the top or attic storeys are, as in blocks D D, capable of properly accommodating 12 beds in each of their two large wards. There are also on each of these floors two separation wards for the accommodation of 2, and two for 1 patient each.

Blocks F F are one storey only in height, and contain a very completely arranged male and female bathing establishment; they are made use of, not only by the inmates, but, under certain restrictions, by the outside public. On each side there are twenty bath rooms or cubicles, fitted with ten ordinary and ten sulphur baths, besides a private room for the use of the officials of the establishment; also a douche, and a vapour bath and "sweating" rooms.

Block H is a chapel.

Block I is two storeys in height above the basement floor, and provides accommodation for the night nurses and general domestic servants; it also contains very large linen stores. The basement is used for cellarage.

Block J is two storeys in height above the basement, and contains on the ground floor the principal kitchen, together with its scullery and other offices; also a large dining room for the officers of the establishment. The basement beneath the kitchen is occupied by the engine house and boiler rooms, and the other portion by cellarage. The first floor contains apartments for the use of various officials.

Block K is two storeys in height above the basement; the dispensary, with its offices, is placed on the ground floor, and there is also a students' laboratory and an operation theatre. The first floor of this building contains dormitories for the use of the male servants of the establishment. The dispensary stores are contained in the basement.

Block L is two storeys in height, and consists of general workshops, fire-engine house, stable and coach-house, as also a small laundry for washing the officials' caps, aprons, and other smaller articles of apparel.

Block M is a large shed, containing a disinfecting closet.

Block N contains the infectious wards, and is, generally, one storey in height, but the centre portion is carried up and forms sleeping apartments for nurses employed in this department. The ground floor contains two wards, each for the accommodation of 16 patients, and the usual offices are attached.

Block O contains the maternity, and will be more particularly described further on. It is, generally, two storeys in height, but the centre portion is carried up one floor higher. The ground and first floors each contain eight wards, each for the occupation of one woman only, and her child. The basement floor is used for cellarage.

Block P consists of a mortuary, a post-mortem room, and a Protestant and a Roman Catholic chapel. Adjoining this building there is a caretaker's residence.

There is no general laundry in this building, all the clothes being sent to Bicêtre and Ivry to be washed.

Total Accommodation.—It will, then, be seen that the accommodation for patients provided in the various blocks, exclusive of infants, is as follows :—

In blocks D D, on the ground floor, six wards (in each block) for 4 beds each	48
Do. do. on each of the first and second floors in each block, two wards for 22 beds each, two for 3 beds each, and two for 1 bed each	208
In blocks D D, on the third floor in each block, two wards for 12 beds each, two for 2 beds each, and two for 1 each...	60
In blocks E E, on the ground floor, two wards (in each block) for 22 beds, one for 2 beds, and one for 1 bed	94
In blocks E E, on the first and second floors, two wards (in each block) for 22 beds each, two for 3 beds each, and two for 1 bed each	208
In blocks E E, on third floor, two wards (in each block) for 12 beds each, two for 2 beds each, and two for 1 bed each	60
In block N, two wards for 16 beds each	32
In block O, on each of the ground and first floors, eight wards for 1 bed each	16
Total	726

Like most other of the Parisian hospitals, however, overcrowding exists, as shewn by the daily average number of patients during the years 1880-81 having amounted to 742.

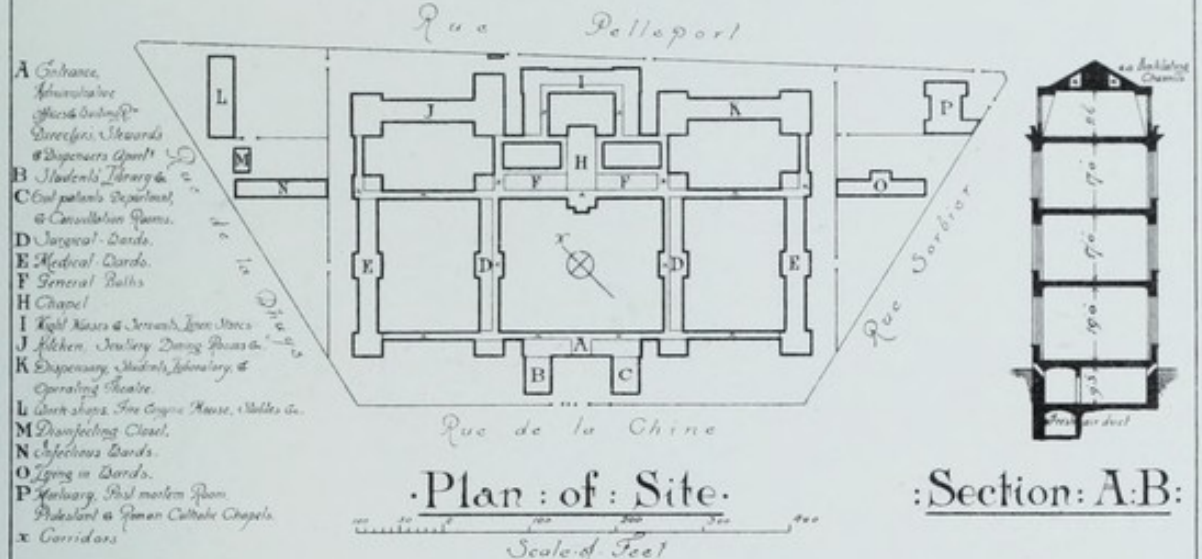
Connecting Corridors.—The four principal pavilion blocks are connected together at either end by covered corridors, x x on plan, having one side closed with glazed framing, and the other, next the inner courtyards, quite open. They are 10 feet 3 inches wide and 19 feet high, and the roofs form a means of open-air communication between the pavilions on the first floor and ambulatories for the use of the patients. Smaller corridors branch off, and give access to the various administrative departments. On the ground floor of blocks D D there are connecting corridors, x x on plan, 8 feet 6 inches wide and 19 feet high, the upper parts of which are covered by the wards above.

Water Supply.—The water used in this institution is supplied by the Municipality, and is conveyed into tanks situated in various parts of the building. The water supplying the hydraulic lifts enters the building by a separate system of pipes, and is brought directly from the reservoir at Belleville.

Drainage.—The drainage is effected by almost exactly similar means to that described for the Lariboisière Hospital, but it is stated that the smaller pipes are all of them of iron instead of earthenware.

:Tenon: Hospital:

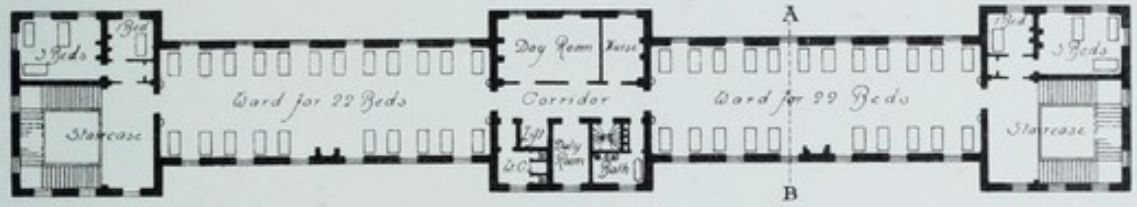
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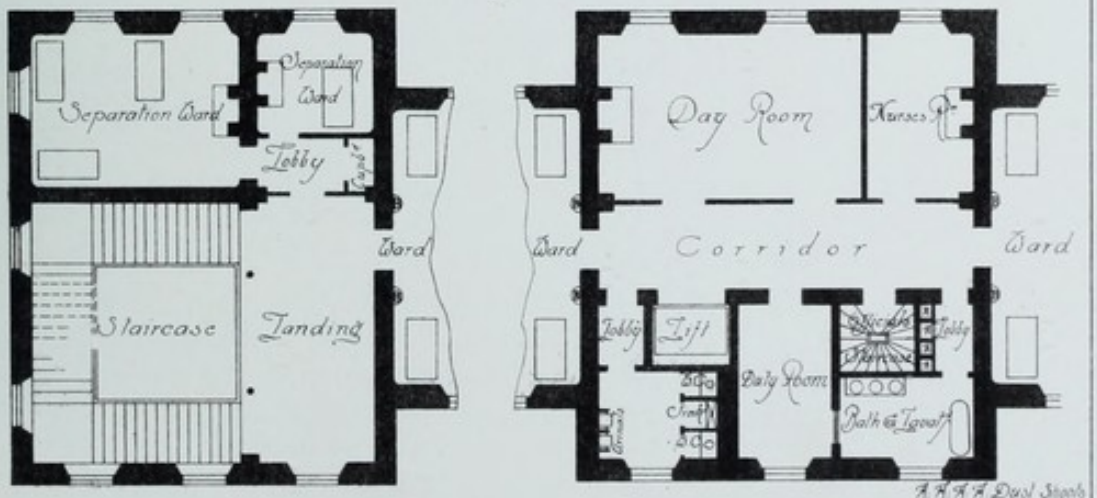
Scale of Feet

:Section: A:B:



:Plan: of: one: Pavilion:

Scale of Feet



:Detail: of: one: of: End: Blocks: :Detail: of: Central: Block:

Scale of Feet

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Area Covered.—The area covered by the building is 136,041 feet, or about one-fifth of the site, and about 187 feet per bed.

Cost.—The cost of the land is stated to have been £63,120 (1,578,000 francs), which is at the rate of about £4,841 per acre, or £87 per bed.

The cost of the buildings and their appurtenances amounted to £304,284 (7,607,099 francs), or about £419 per bed, so that the total outlay upon land and buildings was about £506 per bed.

The cost of the furniture was £24,640 (615,985 francs), or about £34 per bed.*

PRINCIPAL SICK WARDS.

The following description refers more particularly to the medical pavilions, but the others are almost precisely similar.

Aspect.—The axes of all the principal pavilions run N.E. and S.W., so that the windows face N.W. and S.E.

Relative Positions of Pavilions.—The height of the pavilions, as measured from the lower floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines drawn from the angles of the mansard roofs, is about 70 feet, and the least distance between each pavilion is 157 feet, or about 2¼ times the above height.

Size of Wards.—Each main sick ward is of parallelogram shape, contains 22 beds, and is 84 feet 8 inches long, 27 feet 9 inches wide, and 19 feet high on the ground and 17 feet high on the first and second floors. The total superficial space is therefore 2,350 feet, or about 107 feet per bed, and the cubic contents 44,650 feet on the ground and 39,950 feet on the first and second floors, or 2,030 feet and 1,816 feet per bed respectively.

Bed Space.—The average lineal wall space per bed is 7 feet.

Windows.—There are six windows in each side wall, and their total effective glazed surface is on the ground floor 419 and on the first and second floors 388 superficial feet, or 19 and 17¾ feet per bed respectively. When all the windows are opened to their fullest extent the total area through which air can be admitted by them into the wards is 624 superficial feet on the ground floor, and 586 superficial feet on the first and second floors, or 28½ and 26½ feet per bed respectively. The lower portion of each window consists of a folding casement opening inwards, but the upper portion is formed with two tiers of casement sashes, also opening inwards, and fixed between transoms and mullions. They are all glazed with ordinary sheet glass.

Warming.—The warming of the wards is effected by means of fans placed in a basement beneath the engine-house, and these draw the outer fresh air through a large inlet opening situated in the rear of block J, and then force it along subways which run beneath the various corridors of the buildings to the basements of the pavilions, in each of which there are placed six coils of steam pipes, enclosed in casings through which the air passes, and becoming heated by impingement against the steam pipes, is carried vertically through flues in the walls, and ultimately discharges itself into the wards through ornamented pedestals which are placed on either side of the entrance doors.

* The above figures are furnished me by the Director of the "Assistance Publique."

There are also additional inlets formed by the projecting jambs of the fireplaces. These are ordinary fireplaces, and have large open grates, but are seldom, if ever, used.

Ventilation.—The outer fresh air being forced into the wards in the manner described in the last paragraph, the removal of the foul air from the rooms is a comparatively simple matter. There are outlet openings at both the level of the ceilings and the floors which communicate with vertical shafts that ascend in the outer walls into two channels which run longitudinally along the centre of the roof, and these channels, when they reach the centre of the building, enter a chamber that is heated by hot air, for the purpose of further inducing an upward current, and assisting the eventual discharge of the foul air through the sides of the fléche which surmounts the roof of the building.

Lighting.—The lighting of the large wards is effected at night by gas in a manner precisely similar to that described at page 148, as in use in the upper wards of the Lariboisière Hospital, excepting that the ventilating pipes are carried horizontally in the thickness of the floor, and then upwards in the outer walls into the foul air channels passing along the roof, and described in the last paragraph.

Floors.—The flooring of the wards is constructed with wrought-iron girders and joists, filled in between with hollow brickwork and concrete, on which is laid timber joisting. The surface of the floors is finished with oak boarding four inches wide, beeswaxed and polished; the ceilings are plastered, and finished similarly to the walls.

Walls.—The outer walls are built of masonry, and are generally 2 feet 3 inches thick; the inside faces are finished with a plastering "stuc" composed of lime and powdered marble, and the finished surface appears to have been treated by a process somewhat similar to that adopted in this country for the production of "scagliola." All the angles formed by the junction of the walls one with another, and with the plastered ceilings, are rounded to a radius of about six inches; at the level of the floor there is a wooden skirting about nine inches high.

W.C.'s, Baths, &c.—The water-closets, baths, and other sanitary appliances are situated midway between the two large wards, and are entered from a passage-way connecting the two. The w.c.'s are 2 feet 9 inches wide and 3 feet 6 inches long, and are fitted with an apparatus somewhat similar in construction to Jennings' patent valve closet. The enclosures to these closets are formed of deal framing 7 feet high, having dwarf doors in front 4 feet high and 12 inches above the floor; the slop sink is of glazed earthenware, 2 feet 8 inches long and 1 foot 6 inches wide, enclosed by an iron casing; it is supplied with cold water only; above this sink there is an iron rack for holding bed-pans. There are two urinals of white earthenware, with ordinary slate divisions and backs, and they are provided with a treadle flushing apparatus similar to those introduced into this country by Mr. Jennings. On the female side the slop sink takes the place of the urinals, and a bidet is fixed in this compartment. The planning of these offices is open to all the objections made on page 148 to those at the Lariboisière Hospital, and cannot, therefore, be too strongly condemned. The bath and lavatory room has an area of 109 feet, and is fitted with a metal bath and three "tip-up" white earthenware basins sunk in a white marble shelf. The bath and basins are all supplied with hot and cold water.

The soil and waste pipes are of iron 9 inches diameter, with short curved branches from the various apparatus, each 4½ inches diameter. They are carried down the inside of the wards without enclosure of any kind, and it is stated that they are not ventilated at the top; they descend into a room in the basement, and discharge themselves into iron receptacles, which retain the solid and fœcal matter and pass away the liquid portion by an overflow pipe into the drains (*see Drainage*).

In the passage-way leading to the bath room there are foul linen shoots descending from the various floors to the basement.

Day Rooms.—Situated centrally between the two large wards, and entered from the passage which connects them, there is a day room for the use of convalescent patients. It has an area of 431 feet, which is at the rate of about 9¾ feet for the patients occupying the adjoining large wards.

Separation Wards.—At either end of each block, and leading off the two principal staircases, there are two separation wards (four in all); two of them are for the accommodation of 3 patients each, and afford a space of 108 superficial and about 1,842 cubic feet per bed; and the other two are for the accommodation of 1 patient each, with about 120 superficial and 2,040 cubic feet per bed.

Duty Rooms.—The nurses' duty room (the "tisanerie") is situated in the central block between the two large wards. It has an area of 149 feet, and is fitted with a stone sink, supplied with cold water only, as also an iron hot-plate, with ovens and hot-water boilers.

Nurses' Rooms.—In addition to the duty room last described, there is a nurses' room adjoining the day room, and having an area of 178 feet. It is not used as a sleeping apartment.

Staircases.—The pavilion staircases generally occupy an area of 900 feet, and there are two of them to each double block, one at either end of the building. They are constructed of oak treads and iron risers, 6 feet 6 inches in length, 13½ inches wide, and 6 inches high. There is also in the central block a small winding staircase having an area of about 50 feet, for the exclusive use of the officials.

Lifts.—At the side of the passage-way in the central block there is a lift opening 7 feet 9 inches long and 6 feet wide; the cage, which ascends from the basement to the various floors, is constructed of iron, and is worked by hydraulic power.

Basement.—The basements generally are about 9 feet 2 inches high, and are variously occupied as lumber and store rooms; but running under the main ground floor corridors there is another corridor 10 feet wide, having a tramway communication with the kitchen and other domestic offices.

Total Area of Pavilions.—The total area covered by each double pavilion, including its surrounding walls, is 11,048 feet, or about 212½ feet per bed.

The Maternity.

The erection of isolated blocks of buildings for the reception of lying-in patients is a thing almost unknown in England, for here the mortality amongst this class of patients is not so great as it is in the ordinary hospitals of France. In the case of the Lariboisière Hospital, wards have lately been built specially for cases of puerperal fever (*see* page 148),

but in this, the Tenon Hospital, an isolated building is erected for the accommodation of the lying-in patients generally. A plan and section of this building is also shewn at page 148. It contains on the ground floor eight rooms, each for the reception of one parturient woman and her child, and there is a similar arrangement upon the first floor. Each of these rooms is 12 feet 9 inches long, 11 feet 9 inches wide, and 9 feet 10 inches average height; so that the superficial floor space is 149 feet 9 inches, and the cubical capacity about 1,472 feet.

The windows are ordinary casements, opening inwards; the superficial extent of their glazed surface is 14 feet, and when these windows and the doors are opened to their fullest extent the area through which air can be admitted into the room by them is 42 feet. There are no other special means of ventilation, excepting that each room has an open fireplace, and that there is an opening in one corner through which air warmed in the basement can be brought in. The floors of the ground storey wards are of cement, but those on the first floor are of marble mosaic. The walls are of stone, and 19 inches thick; they are plastered and painted on the inside; the plastered ceilings are also painted, and the angles formed by the junctions of the walls and ceilings are curved to a radius of about 6 inches. Each ward is furnished with a bedstead for one woman, and adjoining it a child's cot, an arm-chair, an ordinary chair, a footstool, a round table, and a *chambre de nuit*, all of iron; there is in one of the corners of each room a fixed lavatory basin, supplied with hot and cold water; at the head of each bed there is an electric bell button, communicating with the nurses' duty room.

Each ward is entered through a lobby from an open corridor 8 feet wide that runs along the whole length of the building forming a covered verandah, so that the rooms are isolated from one another. To the right or left of each entrance lobby there is a small closet, the use of which is not apparent, and, indeed, does not seem to be understood by the officials.

The administrative offices are situated in the centre of the building, and they consist of, on the ground floor, a doctors' room to the right of the entrance-passage, 16 feet 6 inches long and 11 feet 6 inches wide, and on the left a nurses' duty room (a "tisanerie") of the same size. In the rear there is the staircase, and to the left of it an attendants' room, and to the right a w.c. and slop sink. On the first floor there is another duty room, and a matron's room, as also a w.c. and slop sink.

The central portion of the building is carried up one floor higher than the side wings, and the additional storey so formed is occupied as a crèche or nursery for infants whose mothers have died or are unable to suckle them; there is also on this floor accommodation for the night nurses of the establishment.

The total area covered by this building is 4,440 feet, or 555 feet per bed.

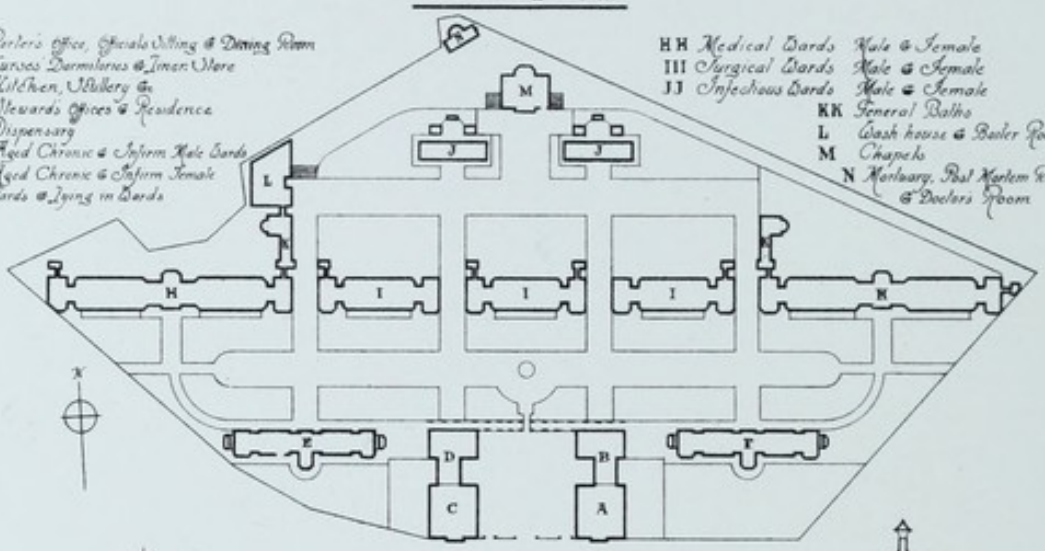
My especial thanks are due to M. Vibert, the architect at present in charge of the building; this gentleman afforded me every facility for making a detailed examination of the structure. I am also indebted to M. Pety, now an architect, but who at the time of the erection of the building acted as clerk of works.

:S[T] Denis: Hospital:

:Near: Paris:

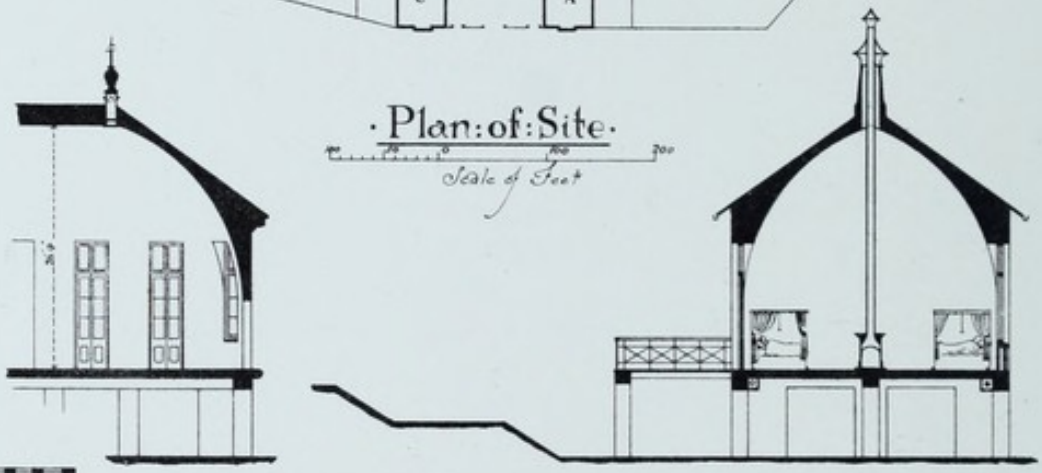
A Porter's office, Officials Sitting & Dining Room
Nurses Dormitories & Linen Store
B Kitchen, Pantry &c.
C Stewards Offices & Residence
D Dispensary
E Aged Chronic & Infirm Male Wards
F Aged Chronic & Infirm Female Wards & Lying in Wards

HH Medical Wards Male & Female
III Surgical Wards Male & Female
JJ Infectious Wards Male & Female
KK General Baths
L Wash house & Boiler Room
M Chapels
N Mortuary, Post Mortem Room & Doctors Room



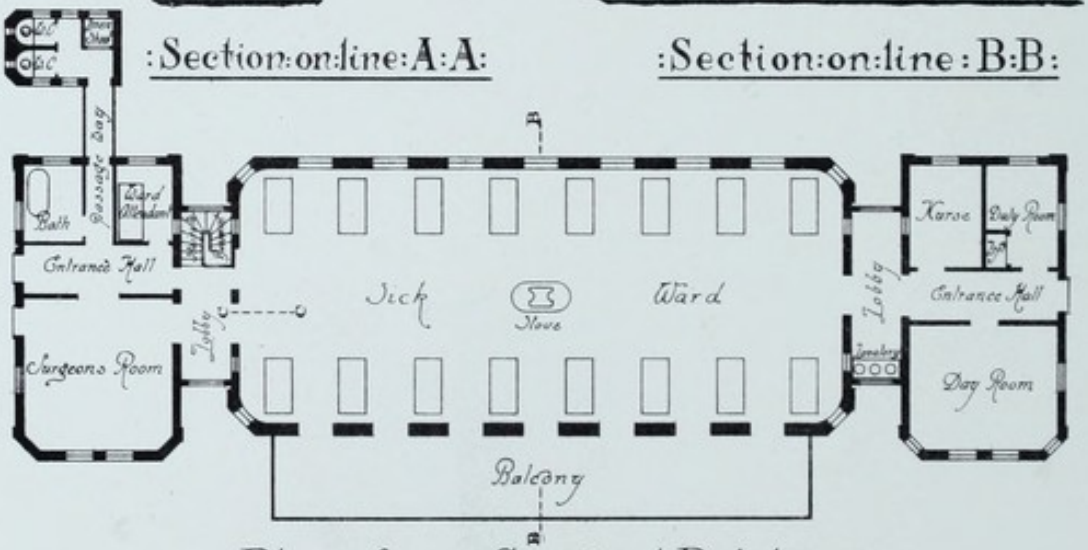
·Plan: of: Site·

Scale of Feet



:Section: on: line: A: A:

:Section: on: line: B: B:



:Plan: of: one: Surgical: Pavilion:

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

ST. DENIS HOSPITAL.

FRANCE.

The St. Denis, Bichât, Bourges and Montpellier Hospitals, now about to be described, are designed upon the principle introduced by M. Tollet, an engineer of great eminence, and who has devoted a considerable amount of time to the consideration of all questions concerning hospital construction. A large number of buildings, especially military barracks, schools and other like public institutions, have been, and are being, erected in France upon this principle by a company designated as the "Société Nouvelle de Constructions Systéme Tollet." It appeared to me desirable, therefore, to investigate with more than ordinary care how far the results, as they affected hospital construction, had realized the anticipations of the inventor. My enquiry has been materially assisted by the courtesy of M. Tollet, who personally conducted me through some of the buildings here described, and, inasmuch as I have been compelled to take exception to some of the details of his work, it was but right that I should submit the proof sheets to him for correction; this task he likewise most kindly undertook.

The St. Denis Hospital is remarkable as being one of the best of the executed types of M. Tollet's system of constructing sick wards. The principle consists of forming both the sides and the roofs of the wards with curved wrought-iron I-shaped ribs, placed about five feet from centre to centre, and filling in between, at the lower part, with brickwork, and the upper, or roof-portion, with tiling and brickwork, or concrete. In the buildings erected by M. Tollet, the outer surfaces of the roof are finished with a coating of cement or tiles, and the inner surfaces with plaster, upon which is laid three coats of oil paint. M. Tollet's claim for originality rests not only upon the novelty of this mode of construction but upon the formation of the finished interior faces of the walls and roofs in the shape of a pointed arch, "*de forme ogivale*," and it is claimed that buildings constructed in the manner described are not only incombustible, but that the absorption of disease germs, and other organic matter, is prevented; also that the free passage of air is not checked by sharp angles; and, lastly, it is pointed out that it is at all times possible, should it be requisite after an epidemic, to flush the whole of these inside surfaces either with flames of gas or streams of water.

Judging by the executed examples of this system of construction, it would seem that of necessity the sick wards must be of unusual height and of large cubic capacity. In France it is not unusual to see ordinary sick wards 18 to 20 feet in height, and containing from 2,000 to 2,500 cubic feet of space per bed, but in England the highest authorities on hospital construction would limit the height to 13 feet, and the cubic content to 1,200, or, at the most, 1,500 feet; and carefully conducted experiments have certainly appeared to shew that the above limits should not, upon hygeinic grounds, be exceeded. M. Tollet's principle could not, therefore, be introduced where these opinions prevail, but in France it is otherwise.

M. Laynaud, the architect of this building, has loyally carried out all the principles advocated by M. Tollet, and, in conjunction with him, has introduced many features that

are obviously improvements upon all other buildings of the kind hitherto erected. One important oversight in M. Tollet's ordinary mode of construction is that the end walls are upright, and that the angles formed by the intersections of the vault with the end walls are, if at all, very slightly rounded; but if the arched system is really to effect the object proposed it is clear that the end of the rooms should be curved similarly to the sides, and the angles forming the junctions of the two vaults should also be curved. M. Laynaud accordingly constructed his wards after this manner.* One of the great objections urged against M. Tollet's system of construction is that the thin crust of these vaults is insufficient to keep out the cold, but this is a fault for which a remedy should easily be found.†

M. Tollet has at all times strongly advocated our English plan of separating the w.c.'s from the wards by cross-ventilated lobbies, and it was really quite refreshing after visiting other French and German Hospitals to find in the building now being described that this principle is carried out in its entirety.

In Germany and some other countries, the system of erecting one-storied pavilions is being much brought into use, and it has been by every one strongly advocated that all such buildings should be raised from the ground by open basements; but, almost invariably, these basements (*see* "Heidelberg" and "Friedrichshain" Hospitals) are wholly, or almost wholly, enclosed. Here, however, the principle is fully carried out, and the wards are entirely raised above ground, and stand upon a series of brick piers without enclosures of any kind.

The foundation-stone of the building was laid by the Mayor and Town Council of St. Denis, June 1880; and the building was opened without ceremony on the 11th of October 1881.

Site.—The buildings stand upon a plot of ground of irregular pentagonal shape; they face the "Rue du Fort de l'Est," and are situated between the slope of the fort itself and the "Parc de la Legion d'Honneur." The extent of the site is 279,864 superficial feet, or 6 acres 1 rood and 7 perches, being 1,686 feet per bed.

Subsoil.—The buildings stand upon a subsoil of chalk, but the surface of the ground itself is of very irregular thickness.

General Arrangement.—The plate at page 175 shews by a block plan the general arrangement of the buildings upon the site, and a detailed plan and section of one of the surgical pavilions. The buildings are divided into the medical, surgical, aged, chronic and infirm patients' departments, and these include special wards for lying-in women and children. Infectious diseases are provided for in separate blocks. The establishment is entered by the central gates situated between the administrative blocks A and C on the plan of site.

Block A is three storeys in height above the basement, and contains, on the ground floor, the porter's office, and a sitting and dining room for the use of the officials of the

* One of the designs published by M. Tollet indicates this mode of constructing the ends of the wards, but he does not appear to advocate it, because, says he, "in this instance, for example, although more elegant in appearance it reducesthe cubic capacity of the whole ward by 1,040 cubic metres, or 65 metres (213 feet) per bed."

† M. Tollet considers that this remedy has been found by enlarging the space that intervenes between the outside of the vault and the inside of the roof covering.

e tablishment; on the first floor, the official apartments; and on the second floor, linen stores. Block B is one storey in height above the basement, and contains the kitchen and its offices. The basements of both blocks A and B are used as coal stores and other minor offices.

Block C, like blocks A and B, is used for administrative purposes; it is three storeys in height, and contains, on the ground floor, the steward's offices; and on the first and second floors, his residence. Block D, one storey in height above the basement, is the dispensary. The basement of blocks C and D is used for storage purposes.

Blocks E and F are pavilions, one storey only in height, for the accommodation of aged, chronic and infirm men and women respectively; each block contains two wards for 8 beds each, and two smaller rooms each for the reception of two incurable cases; these latter wards are used in block A for two lying-in women; there is a day room in the centre of each building, and the usual attached offices.

Blocks H H are pavilions, one storey only in height, for the accommodation respectively of male and female patients, each block contains two wards for 16 beds each, and two smaller wards each for the accommodation of two children; there is a day room in the centre of each pavilion with the usual attached offices.

Blocks I I I are pavilions one storey in height for the accommodation of surgical patients. The eastern block is occupied by women, and the central and western blocks by men. Each block contains a ward for 16 beds, with attached offices, and are more particularly described hereafter.

Blocks J J are pavilions one storey in height for the accommodation of male and female patients suffering from infectious diseases, and each consists of four wards containing one patient each with detached water-closets, kitchen, and a ward attendant's room.

Blocks K K are one storey in height, and each contains two ordinary baths, and one medicated bath, a vapour and douche bath, and two small dressing rooms.

Blocks L, M and N are all one storey in height above the ground level. L is a wash-house and engine house. M contains three chapels for Protestants, Roman Catholics and Jews respectively; the basement of the building is used as a laundry. N is a mortuary, post-mortem room, doctor's room, and coffin store.

Total Accommodation.—The total number of patients provided for is therefore 166, viz.:—

Aged, chronic, and infirm men in block E, in two wards of 8 beds each	16
Ditto in two wards of 2 beds each	4
Aged, chronic, and infirm women in block F, in two wards of 8 beds each...	16
Ditto in two wards with one parturient woman in each	2
Medical male and female patients in blocks H H, two wards in each block with 16 beds in each	64
Also in block F two wards in each block with two children in each	8
Surgical male and female patients in blocks I I I, one ward in each block with 16 beds in each	48
Male and female infectious cases in blocks J J, four wards in each block with 1 bed in each	8
Total	166

The blocks generally are connected together by a tramway for the conveyance of food, medicine, &c., to the various wards, and there is a complete system of electric bell communication throughout the establishment.

Connecting Corridor.—The blocks D B are connected together by an open covered way 9 feet wide in the clear, but all the other blocks are entirely detached.

Water Supply.—The water used in this institution is pumped up from an artesian well, sunk below the engine-house floor in block L, and it is raised into two large iron tanks, situated above the roof of this building, and from thence is distributed throughout the establishment.

Drainage.—The drainage from the various blocks of buildings is effected by means of Doulton's glazed earthenware pipes; all fœcal matter being caught in iron tanks and removed periodically in a manner similar to that described as being in use at the Lariboisière and other Parisian hospitals; no means of disinfection are employed, and the outlet from the drains is into the public sewers.

Area Covered.—The area covered by the building is 49,147 feet, or about one-sixth of the site, and 296 feet per bed.

Cost.—The architect informs me that the cost of the land was £8,000, being about £1,271 per acre, or £48 3*s.* 10*d.* per bed; and, according to the same authority, the cost of the building was £40,000, or £241 per bed nearly, so that the total cost of the land and buildings was about £289 per bed.

PRINCIPAL SICK WARDS.

The following description refers more particularly to the surgical wards, illustrated at page 175, each of which is self-contained in pavilions one storey only in height above the basement:—

Aspect.—The axes of all the pavilions run almost due E. and W., so that the windows of the wards face N. and S.

Size of Wards.—Each pavilion contains one large ward 65 feet 3 inches long by 27 feet 7 inches wide, and the total height to the apex of the pointed roof is 26 feet 4 inches, the average height throughout is, however, only 22 feet. The superficial floor space, after allowing for the rounded angles at the junctions of the side with the end walls, is 1,787 feet, or about 112 feet per bed, and the cubic contents are 39,314 feet, or 2,457 feet per bed.

Bed Space.—The average lineal wall space per bed is 8 feet 1 inch.

Windows.—In the south wall there are seven glazed doors which give access to the external balcony, and above these doors there are fanlights having glazed iron frames hung on the lower rails to open inwards. In the north wall are folding casement windows, with fanlights over, similar to those last described; as also at each of the four curved angles of the room smaller casement windows and fanlights to correspond. All the doors and sashes are glazed with ordinary sheet glass and the total effective glazed surface is 406 feet, or 25½ feet per bed. When all the windows and balcony doors are opened to their fullest extent the total area through which air can be admitted by them into the ward is 617 feet, or 38½ feet per bed.

Warming.—The warming of the wards is effected principally by two calorifers which stand in the open covered space beneath them, and hot air is taken from these calorifers along channels which run down either side wall at the level of the basement ceiling. These channels open at intervals into boxes (having perforated zinc sides) placed behind the heads of the beds at the level of the ward floor. In addition to this mode of heating

there is, in the centre of each ward, a stove having two open fireplaces. The day rooms are warmed with ordinary stoves.

Ventilation.—The ventilation of the wards is effected mainly by the windows and doors, but also to a large extent by a system of inlet and outlet apertures. Under each of the windows in the north side wall there is a large louvred opening closed by doors, through which air may be allowed to enter the wards; fresh warmed air is also, during winter, brought into the wards by the calorifers. There are three outlet openings; two of them situated at the junctions of the roof hips are formed with circular tubes 12 inches diameter, covered at the bottom next the ceiling with perforated zinc, and having their upper ends next the outer air finished as ornamental perforated finials. These outlets have valves for opening and closing when required by means of lines and pulleys. The other outlet opening is in the centre of the ceiling, and there is also a tube about 2 feet 3 inches diameter which surrounds the stove pipe, 9 inches diameter passing through it; this combined chimney and ventilator has its termination in a kind of zinc roof rider, and forms a conspicuous ornamental feature to each block of building. No means are provided for closing this outlet.

Lighting.—The ward is lighted at night by means of gas jets enclosed in glass globes placed over the entrance doorways at either end of the room. No special means are provided for carrying away the products of combustion.

Flooring.—The flooring is constructed with brick arches, springing from the lower flanges of wrought iron joists, and covered with concrete, on which is laid timber joisting; the finished surface is of diagonal-shaped oak frequently beeswaxed and polished.

Walls.—The outer walls are 15 inches thick, and are finished on the outside with red facings, without dressings of any kind. The inside faces are finished to a height of 5 feet 7 inches, with a plastering "stuc" composed of lime and powdered marble, and finished with a floated surface. The vaulted surface above this is finished with ordinary plastering and painted. There is a wood skirting 9 inches high at the level of the floor.

W.C.'s, Baths, &c.—The ward offices and the day-room are situated at either end of the large ward, and are separated from it by cross-ventilated corridors about 5 feet wide. At the end of one of these corridors there are three marbled earthenware "tip-up" lavatory basins, sunk in white marble slabs and supplied with cold water only; at the other end there is a winding staircase descending to the basement level.

There is an entrance-hall at each end of the building, and a passage-way leads off from one of them. This passage is continued by a covered bridge 8 feet in length with glazed sides, giving access to the water-closets. There are two water-closets each 3 feet 1 inch wide by 4 feet 6 inches extreme length, with white earthenware valve closets and oak seats. There is an arrangement by which a moveable funnel-shaped metal pan can be placed into the hole of the closet seat when emptying slops. In the lobby outside the water-closets there is a linen shoot. The soil pipes are formed by short lead branches about 4 inches diameter connected to longer branches of red unglazed earthenware 6 inches diameter, and these pass into a pipe of similar material 9 inches diameter which descends into a room in the basement and discharges itself into an iron receptacle that retains the solid and fœcal matter, and allows the liquid portion

to pass away through an overflow pipe into the drain, much in the same manner as that described for the Tenon Hospital, at page 173 ; it is, however, to be observed that in this instance the main soil pipe is carried up to above the level of the ridge of the roof, and so keeps the iron receptacle tolerably well ventilated; no such precaution is, I am informed, taken at Menilmontant. Adjoining one of the entrance halls there is a bath-room about 53 feet in area, fitted with a metal bath and supplied with hot and cold water. There is also a stove which, in addition to warming the room, heats the hot water and towels.

Day Room.—Adjacent to one of the entrance-halls, and entered from it, there is a day room for the use of convalescent patients, the area of which is 218 feet, or about 13½ superficial feet per patient occupying each pavilion.

Verandah.—The doors in the external southern wall of the ward give access to a balcony 9 feet in width and about 65 feet in length, and in suitable weather the patients in their beds may be wheeled out on to the balcony, and can be protected from the sun, when requisite, by a lean-to awning fixed against the outer wall in a manner similar to an ordinary shop blind.

Duty Room.—Adjoining one of the entrance-halls there is a duty-room having an area of about 57 feet; it is fitted with a sink and a gas warming apparatus, and there is also a lift worked by a rope for bringing up the food from the level of the tramway in the basement.

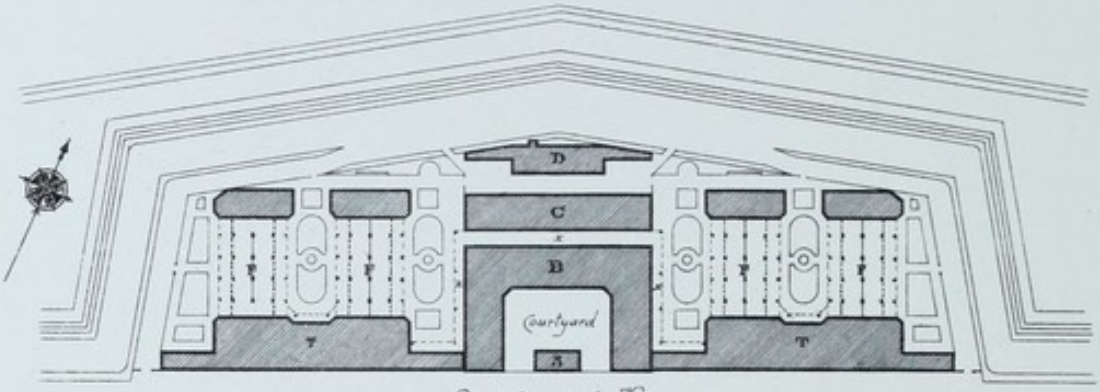
Nurses' Room.—At either end of the building there is a nurses' and a ward attendants' room having areas of 72 feet and 53 feet respectively, the ward attendants' ("infirmiers") room is fitted as a sleeping apartment, the nurses' as a sitting room.

Doctors' Room.—Leading off one of the entrance-halls there is a room used by the doctors for surgical operations; it is 266 feet in area.

Basements.—With the exception of a small chamber beneath the water-closets containing the iron receptacle for soil, the whole of the basements of these pavilions are entirely open at the side, the superstructure being supported on stone piers. The height from the ground to the underside of the ward floor is 8 feet 9 inches.

Total Area of Pavilion.—The total area covered by this pavilion, including its surrounding walls, is 3,572 feet, or about 223 feet per bed.

Bichat Hospital Paris



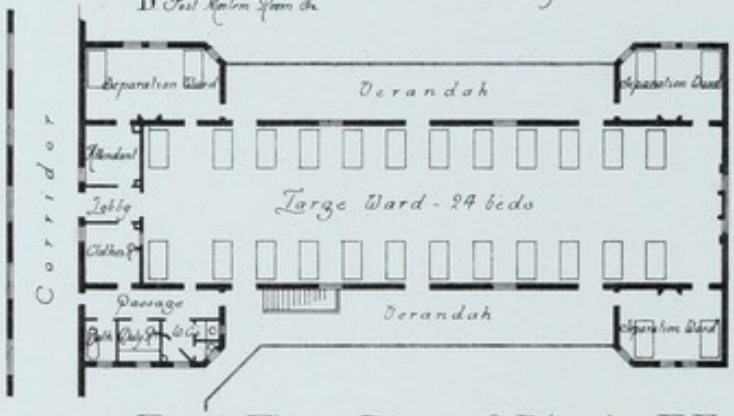
Boulevard Key

A Porters Lodge & Entrance
B Old Building containing Administration Offices Officers Apartments & small Wards
C Kitchen &c. Dispensary &c.
D Post Mortem Room &c.

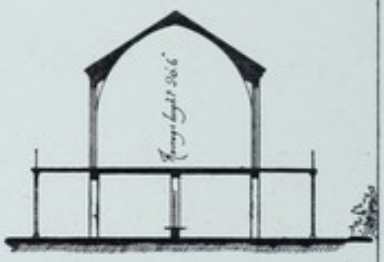
Plan of Site

Scale of Feet

F Pavilions containing Sick Wards on 1st floor
T Ground floor portion of Pavilions containing Outpatients Department & Baths

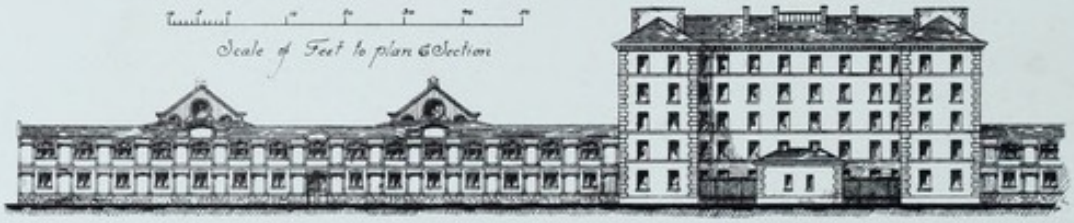


First Floor Plan of Blocks F.F



Section thro Ward

Scale of Feet to plan & Section



Front Elevation

Scale of Feet to Elevations



Elevation of Sick Ward



End Elevation

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del

BICHÂT HOSPITAL.

PARIS, FRANCE.

The projecting bastions of the fortifications surrounding the city of Paris form a series of large open spaces, and upon some of these there have been erected, in years gone by, huge buildings which, until lately, were used as military store houses, octroi stations, and for other like purposes. It has been for some time under the consideration of the municipality to cover these spaces, and, where possible, to adapt the structures standing upon them to hospital purposes; to this end the buildings now to be described have been erected as a first experiment on the bastion situated close to the Porte St. Ouen, on the northern quarter of Paris.

The new sick wards of this establishment, and the kitchen and other offices that surround the old building, have, like those of the municipal hospital of St. Denis, last described, been constructed upon M. Tollet's principles, but, in this instance, the design has been made and the works have been carried out under his direct superintendence.

At the latter part of the year 1881, when I was kindly conducted over the buildings by M. Tollet, they were not completed; but during the early part of 1882 they were opened, and although plans have been submitted to the municipal authorities by M. Tollet for like structures that it is suggested shall be erected at other bastions upon the same principles, no further step has, up to the time of writing this, been taken in the matter. It cannot, therefore, yet be said whether or no the experiment is considered by the Parisian municipal authorities to have proved a successful one.

The general principles laid down by M. Tollet for the design of hospital buildings in many respects entirely accord with those expressed by the best authorities. In the typical plans prepared and published by him, the entire separation of the sick wards, one from the other, is advocated; the w.c.'s are shewn to be separated from the wards by narrow ventilated lobbies, but more often by open covered ways, unenclosed at the sides; all the pavilions are one storey only in height, and raised upon basements many feet above the level of the outside ground, and it is suggested, in nearly all cases, that a balcony, nearly level with the floor of the wards, shall run longitudinally down one, and in some cases both, of the outside walls, so that the beds may, with their occupants, be wheeled on to them, whenever the weather will permit of such a course being adopted. The buildings actually erected by M. Tollet, although in the matter of planning superior to that of many other French hospitals, are evidently not in their details so perfect as he would desire they should be. This may arise from causes over which he has no control. It is seldom that an architect has full scope allowed him for carrying out in their entirety all the principles that he advocates, and M. Tollet is, therefore, not necessarily to blame if this and others of his actually executed buildings are not so perfect as his published types would shew him to desire they should be. His one great principle of constructing the walls and roofs of the sick wards, "*à forme ogivale*," is, nevertheless, preserved every-

where, but, as already pointed out, even this, and indeed most of M. Tollet's principles are best expressed in the wards designed by M. Laynaud for the municipality of St. Denis.*

The hospital at Bourges, hereafter to be described, and which was the first one erected by M. Tollet, more perfectly carries out, than any other of the buildings erected under his superintendence, the principles that he advocates, and it ranks, therefore, next to the St. Denis building.

In the Bichât Hospital, now to be described, the buildings are more closed in than is desirable, for although the distance of the walls of the large sick wards from each other may be such as to admit a sufficiency of direct sunlight to them during a great part of the day, the far projecting wings at either of the extremities of the buildings retard, to a great extent, the free circulation of the air around the walls of the wards, and this is intensified by the entire closing in of the end next the Boulevard Ney by a two-storied building. Excepting during certain hours of the day, the airing courts, especially the covered portions, will be found to be but dreary resting-places for the sick patients.

Site.—The establishment is situated, as before described, upon the site known as Bastion No. 38, Porte St. Ouen, 18e arrondissment, the entrance to it being from the Boulevard Ney, to which it faces. Already there was on the site a building seven storeys in height (including the basement and attics), around which M. Tollet's new buildings have been grouped. The formation of the ground is such that greater part of the site of this bastion is taken up with sloping banks, not included within the area of the hospital.

The extent of the site enclosed by the boundary walls is 83,635 superficial feet, being 1 acre 3 roods 27 perches, or 465 feet per bed nearly.

General Arrangement.—The general disposition of the buildings upon the site and plans, elevations and sections of the principal sick wards are shewn upon the plate at page 181.

The principal entrance to the establishment is through the Porter's Lodge adjoining the Boulevard Ney, and marked A on the block plan. This is an old building, and remains unaltered.

Block B is also an old building, the ground floor of which has been adapted for use as administrative offices. The upper floors contain officers' apartments; and 60 patients are also provided for in rooms containing one and two patients each.

Block C is a new building, and contains the kitchen, scullery, larder, stores, &c., and also the dispensary, laboratory, and drug store.

Block D is also a new building, and consists of a mortuary, post-mortem room, and medical officers' rooms in the centre, and disinfecting chambers in the narrow wings at either end.

Blocks F F F F are pavilions, each containing, on the first floor, sick wards, accommodating 30 patients, with attached offices, as described in detail hereafter. The ground storeys of these blocks, immediately underneath the centres of the large sick wards, are entirely open at the two sides, and form covered recreation grounds for the use of the patients. The two ends in a line with and beneath the separation wards, and w.c.'s are

* M. Tollet does not agree in this opinion.

utilised as linen and bedding stores and furnace rooms, and there are also dining rooms here for the patients and officers.

The ground floors of the connecting corridors T T are fitted up on the one side as an out-patients' department, and on the other as a bathing establishment for the use of the inmates and also for the outside public. The two extreme ends of these buildings are utilized, on both floors, as dormitories for male and female attendants respectively.

There is no laundry and wash-house at this establishment.

Total Accommodation.—Each of the four pavilions contains a large sick ward for 24 beds, and adjoining it three wards each for 2 beds; 60 patients are disposed about the old central building, so that the total accommodation provided is for 180 patients.

Connecting Corridors.—Each pair of pavilions is connected, on the first floor, by a corridor marked T on plan, running at right angles to the wards, and parallel to and adjoining the Boulevard Ney. These corridors are continued up to, and abut against, the old building, and they also extend to the cart entrance gates at either end of the ground, thus entirely shutting in the south-east ends of the recreation courts between the pavilions.

The space between the old building and the new kitchen department in the rear is roofed over, and forms a corridor 9 feet 10 inches wide, which is continued by open covered ways 6 feet wide (x x on plan) to the ground floors of the pavilion buildings.

Area Covered.—The area covered by buildings, including the covered ways and verandahs, is 42,537 superficial feet, being somewhat over half of the space enclosed by the boundary walls; but the adjoining sloping banks of the bastion, although outside the walls, are, it appears, available as a promenade for the patients.

Cost.—It is stated that the cost of the new buildings, and the conversion of the old ones, amounted, exclusive of furniture, to the sum of £35,722 (893,050 francs), or about £198 9s. 2d. per bed. The value of the land is estimated at £4,660 (116,500 francs), so that the land and buildings together cost at the rate of £224 6s. 10d. per bed. It should, however, be borne in mind, in comparing this cost with that of other hospitals, that the cubic capacity of the old buildings, upon the adaptation of which little was expended, bears a large proportion to that of the entire structure.

Principal Sick Wards.

The new main sick wards of the building are situated on the upper floors of blocks F F F F, and a detailed plan and section is shewn at page 181. There are some points in the construction of these wards that are opposed to the principles M. Tollet has himself stoutly advocated. Amongst others may be mentioned the non-separation of the water-closets by cross-ventilated lobbies, and the jutting out of the end wing buildings containing the separation wards, whereby it results that four of the beds in each ward have no windows at the sides of them, and, therefore, no cross ventilation.*

Aspect.—The axes of the pavilions all run from S.S.E. to N.N.W., so that the principal windows of the wards, and the verandahs outside of them, face E.N.E. and W.S.W.

* M. Tollet wishes it to be observed that this is compensated for by the proximity of the four beds in question to the window in the end wall.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the sick wards to the junctions of the upright lines of the outer front walls, with the sloping lines of the roofs, is 16 feet 6 inches, and the distance between the walls is 49 feet 10 inches, or about three times the above height. The distance apart of the pavilions at the ends formed by the jutting out of the separation wards is 25 feet 7 inches only, or about one and a-half times the height.

Size of Wards.—Each large ward is on plan of parallelogram shape, contains 24 beds, and is 98 feet 4 inches long, 26 feet 3 inches wide, and an average height of 20 feet 6 inches. The superficial floor space is 2,581 feet 3 inches, or about 107 feet 6 inches per bed; and the cubic contents, 52,974 feet, or 2,207 feet 3 inches per bed. Like all M. Tollet's buildings, the interior face of the walls and roofs of these wards are curved to the shape of a pointed arch, as shewn on the section at page 181.

Bed Space.—The average lineal wall space per bed is 7 feet 2½ inches. This does not include the spaces at the ends containing the doors leading into the separation wards.

Windows.—There are five windows in each side wall, and the total area of their effective glazed surface appears, from the drawings furnished me, to be 378 feet, or about 15¾ feet per bed. If, however, the window at the end of the ward be taken into consideration, the effective glazed area would be about 20½ feet per bed. Three of the windows in each side wall open down to the floor line as casements, so that the beds may be wheeled out through them into the verandah.

Warming.—Each ward is warmed by a calorifer placed in a room on the ground floor, immediately underneath one of the separation wards at the end next the connecting corridor. There is also an open fire stove in the end wall. The separation wards are also warmed by open fire stoves.

Baths, W.C.'s, &c.—The water-closets, baths, and other sanitary appliances are placed in a wing corresponding to those of the separation wards, and they are separated from the main wards by a passage-way about 5 feet wide. There are two water-closets to each ward fitted with ordinary pan apparatus. The bath-room is fitted with a metal bath, and is 6 feet 6 inches long, and 5 feet 3 inches wide.

Day Rooms.—No day rooms are provided on the sick ward floors, but the floor beneath one of the separation wards is fitted up as a dining room for the use of the patients. This room cannot, however, be reached by the patients without passing outside the building.

Verandahs.—Like all M. Tollet's buildings, there runs longitudinally down the outside of the wards a verandah. In this case there are two, one on either side, 8 feet wide, and both can be entered from the ward by casement windows, reaching to the floor line, and in such manner that the beds may, either with or without the patients in them, be wheeled on to these verandahs in fine weather. There is likewise an arrangement by which awnings can be drawn over the verandahs for protection from the direct rays of the sum. This is an important feature well worthy of notification.

Duty Rooms.—The duty room (the "tisanerie") is 7 feet 4 inches long, and 6 feet 6 inches wide; it is situated between the w.c. compartments and the bath-room.

Nurses' Room.—The attendants' or nurses' ("surveillants") room is situated to the right of the passage-way leading into the large ward, and it has an inspection window

overlooking the ward. The corresponding room to the left of the passage is designed for use as a clothes room ("vestiare").

Staircases.—At the ends of the covered ways marked x on the plan, and adjoining the pavilions nearest to the central buildings, there are staircases which give access to the first floors forming the corridors connecting each pair of pavilions. There is also an outside staircase to each pavilion, which leads from one of the verandahs down to the yards below.

Basements.—The central portion of the ground floor or basement of each pavilion (that portion of the length contained between the projecting separation wards), is intended for use as a covered recreation ground.

The corresponding space between these wings is planned as clothes, bedding, or ordinary store rooms. The spaces under the two end separation wards are intended to be used as dining rooms for the patients and officers, and under the separation ward next the connecting corridor there is a room for the heating apparatus. The spaces between each pair of pavilions marked S on plan, are intended to be used as linen stores.

The only objection that can be urged against this practice of stilting sick wards above the ground is the inducement offered for afterwards converting the lower space into sick wards, whenever the increase of population demands the erection of an additional hospital. There is a temptation, also, to utilise these open spaces as store and lumber rooms, or additional administration offices. I know of only one instance where this has not been done, and I have visited a large number of buildings in foreign countries where the plan of open basements has been adopted. When Dr. Mouat visited the building now under consideration in the early part of the year 1883—that is to say, within twelve months after it had been opened—these covered recreation grounds had already been partially closed in to form additional offices.

Area of Pavilions.—The total area occupied by the sick ward floor of each pavilion, including the surrounding walls, but exclusive of the verandahs, is 4,972 superficial feet, or 165½ feet per bed. If the verandah is included the space per bed is 270¼ feet.

BOURGES MILITARY HOSPITAL.

FRANCE.

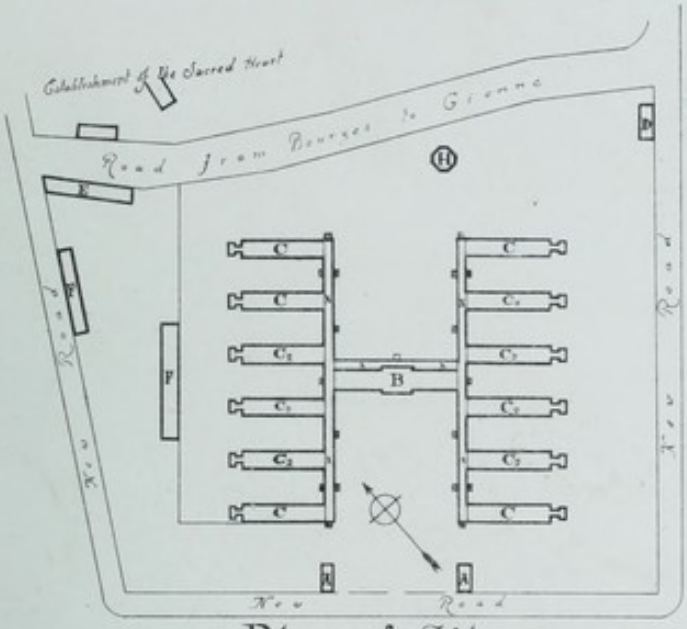
THIS was the first hospital erected on what is known as the "Système Tollet." The arrangement of the various buildings, especially the planning of the sick wards, is generally in accordance with the rules laid down by all the most eminent authorities upon hospital construction. The claim of M. Tollet to originality, it will be remembered, consists in his system of constructing the inside faces of the walls and roofs in the form of a pointed arch, and in the manner detailed more particularly in the description of the Civil Hospital of St. Denis.

M. le Dr. Ch. Sarazin, in an interesting account of the design and construction of this building, says—

"A laborious childbirth was that of the Military Hospital of Bourges. Its history would be an interesting and curious one to relate, for it is that of the struggle which new ideas always have to maintain in order to cut their way, even when they are founded on experience, on the scientific and positive side of health, and on common sense. One has seen repeated at Bourges that which has been gone through for the last thirty years whenever the question has arisen of building hospitals: the physicians recommending the improvement and application of modern hospital hygiene, the administrators and architects wishing to raise monuments. At Bourges, for the first time, it is the hygienic notion which has prevailed.

"On my arrival at Bourges the Commander-General of the Eighth Army Corps did me the honour to request that I would suggest a scheme for organising the hospital service. I was anxious that the system of small separate pavilions should prevail, the *block-system* of which the English and Americans have shown us such excellent models. The type recommended by M. Tollet for the barracks that had just been constructed at Bourges appeared to me to fulfil all the desirable conditions, and with the enlightened co-operation of the head engineer, Commander Gripois, we succeeded, after many struggles and vicissitudes, in getting a plan accepted which, with some slight modifications, has become that of the present hospital. Thanks to the firmness of the General, M. Ducrot, Bourges now possesses the first specimen in France of a hospital with independent pavilions without superimposed storeys, and having each a single large ward; a hospital as nearly as possible what both hygeists and physicians for a long time since, and with much unanimity, have called for."

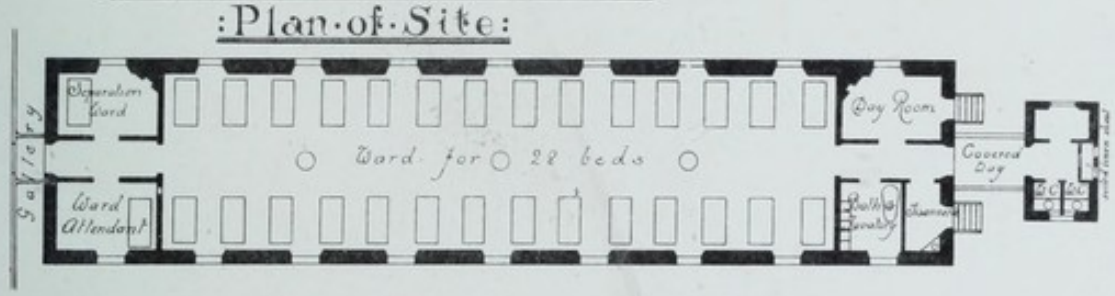
It will be seen that M. Sarazin, as is not unusual with some few members of his profession, takes credit for all that is hygienically good in the design of this building, and would have it understood that the sole aim of architects is the production of structures magnificent in appearance but in total disregard of all the laws of health. Yet it is singular that, almost in the same breath, he has to acknowledge that when requested to formulate a scheme for the hospital administration of this army corps he found a system already prepared for him by the architect, M. Tollet, and that he had the good sense to adopt it. These oft-recurring attempts to engender a feeling of rivalry between the two professions is much to be regretted, for it is quite apparent to those who have any knowledge of the design of hospital buildings that while it is always desirable that the joint experience of the medical man and architect should be brought to bear upon the consideration of all parts of hospital construction, yet the questions to be decided by each are of essentially different natures.



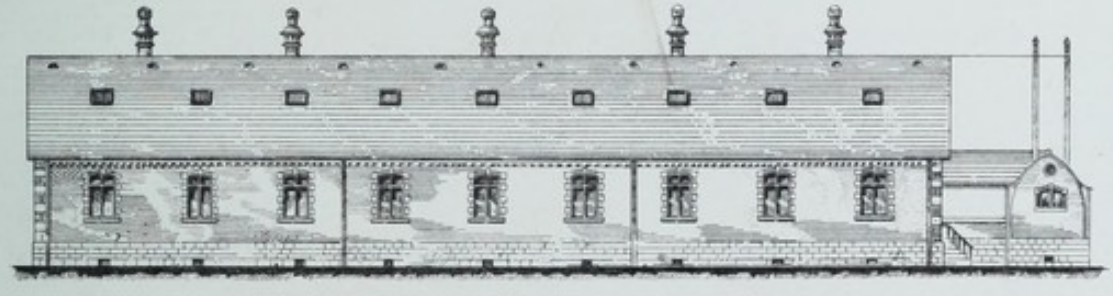
Military Hospital Bourges France

AA Porters Lodge & Guard House
B Kitchen, Baths, Dispensary
C Pavilions temporarily in use as Dormitories, Chapel, Stores, Officers' Quarters & other Administrative Offices
C_3 Pavilions containing Sick Wards
D Mortuary
E Coach House
F Sheds
H Water Tank & Riding House

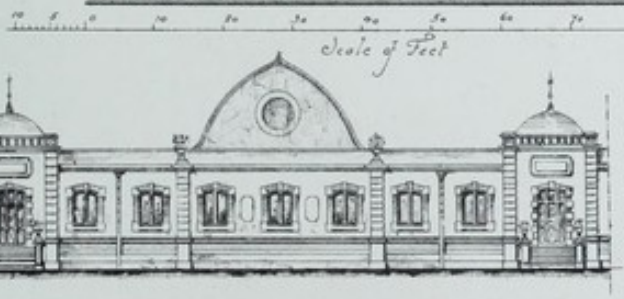
Plan of Site



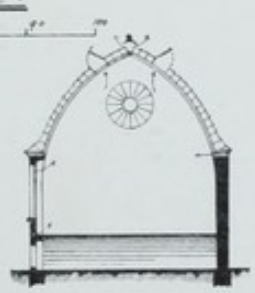
Plan of one Pavilion



Side Elevation of Pavilion



Part Elevation of Corridor



Section through Pavilion

Photo Lithographed & Printed by James Akerman, 6. Queen Square, W.C.

H. Saxon Snell del

I have before had occasion to remark that, although M. Tollet's expressed principles of hospital construction are all that could be wished for, no building hitherto erected by him properly represents the rules which he advocates, and that this is so probably arises from the occurrence of circumstances over which he has no control. The building about to be described was *in its conception*, no doubt, one of the best of hospitals, but the alterations made by the military authorities, ostensibly for purposes of economy, have had for their result the production of a building the *tout ensemble* of which is anything but satisfactory. That this has been so no one deplores more than M. Sazarin, the officer deputed in the first instance to organise the hospital service of this district. It was originally intended that the whole of the twelve pavilions should be devoted to the use of the sick patients, and that the officers', nurses' and hospital attendants' quarters should be located in the central court, the chapel being at the extremity of it. Now, however, five of the pavilions are utilised for these purposes, and the accommodation for the sick is correspondingly reduced. But this is not the only instance of false economy. The heating appliances are singularly insufficient, and generally the building in its details is not well finished.

Site.—The building is situated on a very elevated spot, and in the environs of Bourges. It is reached by the two roads, Dun-le-Roi and the new Boulevard of Sérancourt. The site forms an irregularly-shaped square, and is bounded on three sides by new roads, and on the back, or rear side, by the road leading from Bourges to Gionne. The extent of the site is 59,800 feet, being about 12 acres 1 rood 17 perches, or 277 feet per bed.

Subsoil.—The buildings stand upon a substratum of limestone, full of fissures, and, consequently, "so absolutely permeable to water that the natural drainage is perfect." A very thin crust of vegetable mould overlies the chalk.

General Arrangement.—The general arrangement of the buildings upon the site is shewn upon the plate at page 186, as also a detailed plan, section, and elevation of one of the principal pavilions.

The porter's lodge and the guard-house are situated on either side of the entrance gates, at the points marked A A upon the block-plan.

The central block, B, contains, on the basement floor, stores, larders, &c., and, on the ground floor, the dispensary, surgery, library, operation ward, with doctors' and dispsensers' rooms, the kitchen, with its offices, a furnace and boiler room, Turkish and other ordinary bath rooms. The upper floor of the central portion is occupied as living rooms by some of the officials, and as store rooms.

The twelve blocks marked C C 2 on plan are all erected as if for sick wards, and eventually, when the administrative offices are completed, they will be used as such, but at present only seven of them, C 2, are so occupied; the remaining five are used as dormitories and dining rooms for the hospital attendants, chapel, with chaplain's room and vestry, store rooms and other like administrative offices. One of these pavilions contains thirteen rooms for officers, with the usual offices attached. The seven pavilions, C 2, each contain a large ward for the reception of 28 patients, and an isolation ward for 1 patient. These pavilions will be more particularly described hereafter. Dr. Sazarin,

and others who take an interest in this building, have much deplored the false economy that induced the military authorities to postpone the completion of the building, seeing that in its present state it is quite inadequate to meet emergencies.

Block D is a mortuary; E, a coach house; F F, store and lumber sheds; H, the tank and riding house.

Total Accommodation.—The building, it will be seen, as at present arranged, can accommodate 216 patients in seven wards for 28 patients each, seven for 1 each, besides thirteen rooms for officers with 1 bed in each. When, however, the proper administrative blocks are erected the building will accommodate 332 patients.

Connecting Corridors.—The twelve pavilions and the central administrative block, B, are connected together by closed corridors, about 13 feet wide, having "ogival" shaped walls and ceilings; the extreme height is about 13 feet, and, being on a level with the floors of the sick wards, they are raised high up above the ground, consequently flights of steps are provided at intervals that the patients may reach the airing courts situated between the pavilions. These corridors are also available for the use of the patients in rainy weather, though, in consequence of the low height of the windows, they do not make very cheerful ambulatories. The flooring is of cement, and the walls are plastered. They are not, at present, heated, but arrangements have, it is understood, been made for doing so when "funds will permit."

Water Supply.—The height of the buildings above the town is so great that difficulty might have been experienced in obtaining a proper supply of water for the buildings, but this evil has been averted by the provision of a large storage tank.

Area Covered.—The area at present covered is about 83,173 superficial feet, or 385 feet per bed, but as the buildings are incomplete this estimate will hereafter have to be modified.

Cost.—Information as to the price paid for the land does not appear to be obtainable, and as respects the building it is difficult to arrive at what has been the exact cost. The information on this point given by M. Sazarin, so far as it can be understood, would, however, seem to shew that in its present unfinished state it has cost £31,920 (798,000 francs), as follows:—

The kitchen	£808 0 0
Dispensary	168 0 0
Baths	464 0 0
Furnaces, &c.	280 0 0
Pavilions and all other buildings	30,200 0 0
Total	£31,920 0 0

This does not, however, give any clue to what the cost of the building will be when it is completed. So far, it would appear to have cost, exclusive of the price of the land, about £148 per bed.*

* M. Tollet informs me that since this account was written a large two-storied building has been erected for the distinct accommodation of the hospital staff, thus setting free the whole of the pavilions for the purposes of sick wards and reducing the cost per bed of the building.

PRINCIPAL SICK WARDS.

The principal sick wards, like all those of M. Tollet's buildings, are one storey only in height above the basements, and the walls and ceilings of the interiors are shaped in the form of a gothic arch ("à forme ogivale"). A detailed plan, section, and elevation, of them are shewn at page 186.

Aspect.—The axes of the pavilions run from N.W. to S.E., so that the windows of the wards face N.E. and S.W. M. Sazarin says that "the pavilions being placed in a northerly and southerly direction, their long fronts are exposed to the east and west, and so receive the rays of the sun at its rising and setting, that is to say, at the times when it is nearest to the horizon and when, therefore, its rays can best penetrate into the wards of the pavilions. This is the orientation which best suits mild climates, and simple window blinds are always, under these conditions, a sufficient provision against the access of solar heat during the hottest days of the year. In warm countries, on the contrary, the east and west axis should be preferred, one of the fronts thereby being exposed to the north, and, in consequence, always cool, the other exposed to the south, but protected by a covered gallery-balcony, or verandah. These latter appendages do not appear necessary in our climate, and can be discarded in hospital plans as constituting a luxurious expenditure."

Relative Position of Pavilions.—The height of the buildings, as measured from the floors of the wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 16 feet 6 inches, and the distance between the buildings is 49 feet, or about three times the height.

Size of Wards.—Each ward is of parallelogram shape, contains 28 beds, and is 96 feet 5 inches long, 24 feet 7 inches wide, and 20 feet average height (the extreme height is about 25 feet). The total superficial floor space is therefore 2,370 feet, or about 89 feet per bed, and the cubic contents 47,678 feet, or 1,703 feet per bed.

Bed Space.—The average lineal wall space is 6 feet 11 inches per bed.

Windows.—The windows are placed between each pair of beds, and consist of double casements, with transom lights over. These windows are very low, and would be oppressive in appearance, but that they are supplemented by other dormer windows, about 24 inches square, situated about half-way up the roof.

Warming.—Each ward is heated by two cast-iron stoves, enclosed by casings, through the perforated sides of which fresh air escapes into the ward after it has been brought in through flues passing beneath the floors and heated by contact with the sides of the stoves. Arrangements are made by which the heated air may be moistened by passing over water. The flues from these stoves are so encased as to form extraction shafts for drawing away the vitiated air from the wards. In addition to these stoves there is in the centre of each of the wards a double grate with open fires. The apparatus is undoubtedly deficient in heating power during very cold weather, yet M. Sazarin tells us that the cost of it per pavilion reached the large sum of £240 (6,000 francs), or £8 (200 francs) per bed.

Ventilation.—Besides the ventilation afforded by the heating apparatus as last described, there are the upper and lower windows, and, in addition, sixteen ventilators on

either side of the ridge of the roof; these can be opened or closed by means of cords whenever the weather will permit.

Lighting.—The wards are lighted by large glass lanterns fixed against the side walls and closed tightly by glazed doors. Curved pipes are carried from the upper parts of them into flues in the walls, which rise upwards to the level of the roof and so assist the ventilation of the wards.

Floors.—The flooring is carried on arches, and the finished surface is of oak, which is stated to be laid in a bed of bitumen so as to ensure complete security from the rising of damp from the soil below.

Walls.—The basement walls are of stone, and so also are those of the ground floor to the height from which the arched vaulting commences. This vaulting, which continues to the ridge, is formed by T-shaped iron ribs bound together horizontally by iron cross ties and filled in between with hollow specially-made bricks; over this there is a space, and then iron battens are laid longitudinally for the support of the tiles which form the outer covering of the roof.

W.C.'s.—Almost for the first time in this history of modern hospital construction I am enabled to chronicle the fact of an existing Continental building having the w.c.'s entirely detached from the wards by means of cross-ventilated lobbies. Indeed, in these wards the connecting lobby is entirely open at the sides and should, perhaps, more properly be designated as a "covered way." This is somewhat to be regretted, for it is clearly impossible for delicate patients to make use of these conveniences excepting during the mildest weather. But for this objection, it might be hoped that the principle once introduced would rapidly extend to other like institutions hereafter to be erected in France. The bath and lavatories are situated to the right of the passage-way leading from the end of the ward, and they are placed in a room 9 feet 6 inches long and 9 feet wide.

Day Room.—To the left of the passage-way last described there is a day room, 14 feet 9 inches long and 9 feet 6 inches wide, and having, therefore, an area of about 140 feet, or 5 superficial feet for each patient in the large ward adjoining it.

Separation Ward.—This ward is situated to the left of the entrance passage-way, and is for the accommodation of one patient only. It is of the same size as the day room last described, and its cubic capacity is about 2,000 feet.

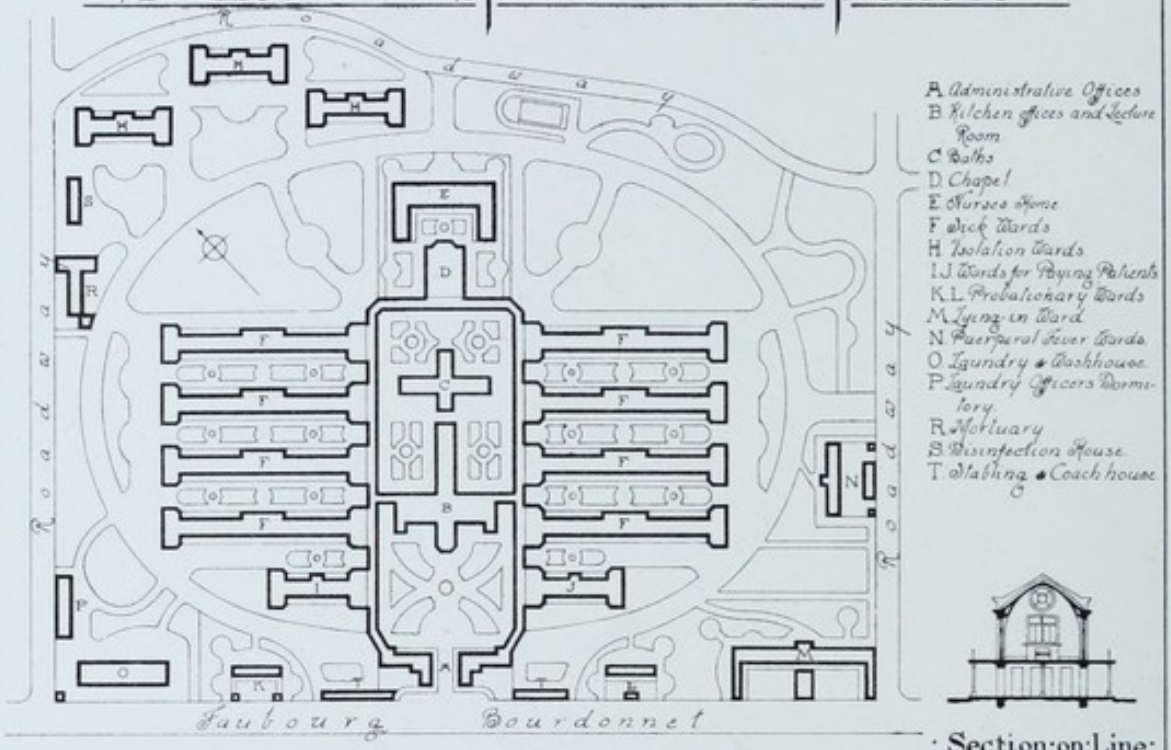
Nurses' Room.—A ward attendants' room is situated on the opposite side of the entrance passage, and is of the same size as the separation ward last described; it is fitted as a sleeping apartment.

Duty Room.—The duty room, or "tisanerie," is situated adjoining the bath room at the end of the large ward. It has a superficial content of about 50 feet, and is fitted with the usual warming apparatus and other domestic appliances.

Basement.—The whole of the structure is raised upon low vaulted basements, varying from 4 to 5 feet in height and cross ventilated by openings in the opposite walls.

Total Area of Pavilions.—The total area covered by each pavilion, exclusive of the connecting corridor, is 4,305 feet, or about 148 feet per bed.

· St Eloi · Hospital · Montpellier ·



· Plan · of · Site ·

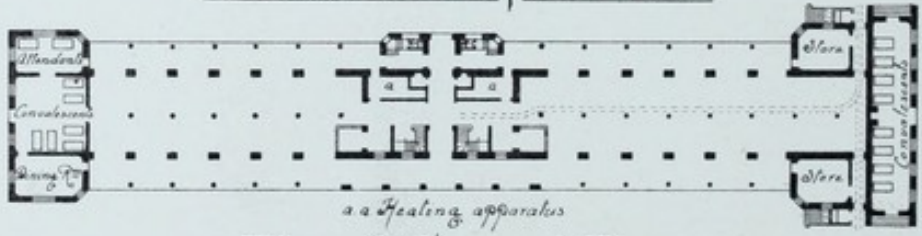
Scale of Feet



· Front · Elevation ·



· Plan · of · Principal · Floor ·



· Plan · of · Ground · Floor ·

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6. Queen Square, W.C.

H. Saxon Snell del

SAINT ÉLOI HOSPITAL.

MONTPELLIER, FRANCE.

THIS building is intended for the reception of both military and civil patients, and is one of the latest of M. Tollet's designs; indeed, it is not yet completed, and I am consequently unable to give any but a very general account of the details of its construction. A full description of what the building was intended to be was written by M. M. Bertin-Sans, Professor of the Faculty of Medicine, at Montpellier,* and a later, but shorter, account of it has been given by Messrs. H. Napias and A. J. Martin, secretaries of the Society of Public Medicine, at Paris†; but so many alterations have been made during the progress of the work that any really accurate description cannot be given at the time of writing this.

That the design of M. Tollet was not settled upon without considerable discussion is shewn by a very interesting pamphlet, written by M. J. Benoit, the honorary physician of the hospital,‡ in explanation of the various schemes laid before the Municipal Council, and of the considerations which ultimately led to their decision. It would appear that these preliminaries occupied nearly three years, from 1879 to 1882. The actual erection of the buildings commenced in 1883, and it is supposed that they will be completed by 1885; but an endeavour will be made to have the quarters devoted to the military patients ready by 1884.

Site.—The ground upon which the buildings stand is situated at the extremity of the Faubourg Boutonnet, N.N.W. of the town. It is about a mile and a quarter from the Hotel de Ville, from whence tramways run to within a short distance of the buildings. The extent of the site is 968,760 feet (9 hectares), or 22 acres 38 perches, and about 1,615 feet per bed.

General Arrangement.—The general disposition of the buildings upon the site and enlarged plans of the principal sick wards are shewn upon the accompanying plate (page 191). A perspective view of the building, as it was originally designed, is also shewn at page 46 of Section I, but during the course of erection various modifications have been made in the position of some of the blocks, as may be seen by comparison with the subjoined plan of the site.

The principal entrance will be through the centre of the block marked A on the plan of site. The ground floor of this building to the left of the central roadway contains the porter's lodge and the director's and general offices; also on the first floor the director's residence. The ground floor on the left hand side of this building is devoted to the out-patients' department, with physicians' and surgeons' rooms and library, and the first floor provides apartments for the principal officers of the establishment.

* L. Cristin et Cie. Montpellier, 1880. † Libraire de l' Académie de Médecine. Paris, 1882.
‡ Jeane Martel Aîné. Montpellier, 1880.

Block B contains, on the ground floor, the kitchen offices, from each side of which tramways run to the staircases situated centrally between each of the eight double pavilion blocks. Also on this floor are to be found the dispensary, laboratory, mess room, bedding stores, and other like offices. The first floor contains a theatre and operation rooms, with a library and other accommodation for the medical officers and students.

Block C, one storey only in height, is a very complete hydropathic department, containing thirty-two separate bath rooms, besides vapour and other medical baths.

Block D is the chapel.

Block E is two storeys in height, and contains, on the ground floor, a day room, dining room, oratory, kitchen, and other offices for the use of the sisters or nurses, and their dormitories are placed on the upper floor.

The eight blocks, F F, &c., are pavilions, each containing, on the principal floor, two sick wards, each for the accommodation of 28 patients, with attached offices, and four separation wards, having accommodation for 2 patients in each. Two of these double pavilions are used for surgical cases, and here one of the separation wards is divided into two rooms, and used for the purposes of operations, so that the number of beds is reduced by two in each of these pavilions. Six only of these double blocks are now erected. The remaining two will not be ordinarily occupied, but, when built, will serve to admit patients during the temporary evacuation of the others. Beneath the corridors, adjoining six of the blocks, accommodation is provided for 54 convalescent patients, in six dormitories of 9 each. The corresponding spaces in the two other blocks form the porters' and other officers' apartments.

Blocks I and J are respectively intended for the accommodation of male and female paying patients, and each contains two wards for 8 beds each, and two for 1 each.

The three blocks, H H H, are pavilions devoted to the exclusive accommodation of patients suffering from contagious disorders; each contains two wards for the accommodation of 10 patients each, and eight wards for 1 patient each.

Blocks K and L are male and female probationary wards, each having five separate rooms for the reception of patients suffering from complaints of a doubtful nature, and, therefore, requiring to be kept, for a time, under observation.

Block M, the lying-in wards, provides accommodation for 30 women, with their children, in rooms containing two in each.

Block N is a lying-in infirmary, consisting of six rooms, each for the accommodation of one woman and her child, and, like that at the Lariboisière Hospital, described at page 148; they are separated from each other, and from the attendants' rooms and offices by an open covered gallery.

Block O is the laundry and wash-house.

Block P is a building, one storey in height, containing one large room, fitted as a dormitory for 10 laundry women, and one room for the head laundress.

Block R is a mortuary and post-mortem room.

Block S is a house fitted with appliances for the disinfection of bedding, linen, and clothing.

Blocks T T are outhouses and sheds, fitted as stabling, coach-house, store and lumber rooms, workshops, &c.

Total Accommodation.—Provision will thus be made for 600 inmates, viz.:—

Twelve wards in blocks F, with 28 patients in each	...	...	...	...	336
Twenty-two ditto ditto 2 ditto	...	...	...	...	44
Six wards beneath the corridors, next blocks F, with 9 convalescents in each	...	...	...	...	54
Four wards in blocks I and J, with 8 patients in each	...	...	...	...	32
Four ditto ditto 1 ditto	...	...	...	...	4
Six wards in blocks H, with 10 patients in each	...	...	...	...	60
Twenty-four ditto ditto, 1 ditto	...	...	...	...	24
Ten ditto K L, 1 ditto	...	...	...	...	10
Fifteen ditto M, 2 ditto	...	...	...	...	30
Six ditto N, 1 ditto	...	...	...	...	6
Total	...	...	...	...	600

Area Covered.—The area covered by building is 222,898 superficial feet, or about 372 feet per bed.

Cost.—M. Tollet estimates that the total cost of the freehold and the buildings, exclusive of fittings and furniture, will not exceed £68,000 (1,700,000 francs) or about £114 per bed. The land cost £3,600 (90,000 francs), or about £6 per bed. If, therefore, M. Tollet's hopes are realised this will, indeed, be an example of cheap hospital construction.

Principal Sick Wards.

The construction of the principal sick wards is, generally, similar to that of the Bichât Hospital, described at page 181. There are the same kind of balconies running down either side of the wards, and at the ends of them; the separation wards projecting forward and obstructing the passage of light and air. The position of the w.c.'s and bath rooms is, however, much improved upon; nevertheless, they are by no means so well isolated as at the St. Denis Hospital. It will be interesting, when the building is completed, to note whether the open basements will not, as at most other institutions of the kind, become converted into store houses.

Aspect.—The axes of the principal pavilions run almost directly N.W. and S.E., so that the windows of the wards face N.E. and S.W. It is stated that this direction was given to the axes because the prevailing winds blow from N.W. to S.E.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 16 feet, and the distance between the walls is 57 feet 6 inches, or about $3\frac{5}{8}$ times the height. The distance apart of the pavilions at the ends formed by the jutting out of the separation wards is 27 feet 6 inches only, or about $1\frac{3}{4}$ times the height.

Size of Wards.—Each large ward is on plan of parallelogram shape, contains 28 beds, and is 115 feet 6 inches long, 26 feet 3 inches wide, and an average height of 21 feet 6 inches; the extreme height is 25 feet nearly. The superficial floor space is, therefore, 3,032, or about 108 feet per bed; and the cubic contents 65,118 feet, or 2,328 feet per bed. The interior faces of the side walls and ceilings are curved to the shape of a pointed arch, as are all sick wards built on M. Tollet's principle.

Bed Space.—The average lineal wall space per bed is 7 feet 2 inches. This does not include the spaces at the ends containing the doors leading into the separation wards.

Windows.—The windows are generally placed between each pair of beds, but like those of the Bichât Hospital the four near the separation wards have no windows at the sides of them, and, therefore, no cross-ventilation. There are but six windows in each side wall, and the total area of their effective glazed surfaces is stated* to be 464 feet, or about 16¼ feet per bed. If, however, the windows at the ends of the wards be taken into consideration, the effective glazed area would be 20¾ feet per bed.

Day Rooms.—No day rooms are provided on the sick ward floors, but the floor underneath one of the separation wards is fitted up as a dining room, for the use of those patients who are able to leave the wards.

Verandahs.—As at the Bichât Hospital, so here ; a verandah runs down the outside of each side wall ; they are 10 feet wide and can be entered from the ward by the casement windows, which open down to the floor line, and in such manner that the beds either with or without the patients in them may be wheeled on to these verandahs in fine weather. A contrivance is also provided by which awnings can be drawn over the verandahs for protection from the direct rays of the sun, a much better arrangement than the ordinary fixed slanting roofs, which, in dull weather, would render the rooms uncomfortably dark.

Duty Rooms.—The duty rooms ("tisaneries") are small apartments, 7 feet 6 inches long and 6 feet wide, situated away from the wards in an annexe, and adjoining the w.c.'s and bath rooms. They will be furnished with a well-arranged warming apparatus, and other usual fittings.

Nurses' Rooms.—The attendants' or nurses' ("surveillants") rooms, 9 feet 6 inches long and 9 feet 6 inches wide, are situated adjoining the large wards, which they overlook. They may be entered either from the passage-ways leading to the large wards, or from the verandahs.

Doctors' Rooms.—Opposite to the nurses' rooms, and adjoining the staircases, are two rooms, 9 feet 6 inches long, 8 feet wide, for the use of the doctors ("cabinet de medecine"); this is a luxury not often provided in hospitals.

Operation Room.—Where the pavilions are to be used for surgical cases a separation ward is divided into two parts, one of which is used as an operation room, and the other as a "salle de repos"; a resting place for the patient after the performance of an operation.

Baths, W.C.'s, &c.—The water-closets and other sanitary appliances are placed in an annexe that projects from the offices, forming the central block of each double pavilion, and they can be reached, from the ward only, by passing out on to the balcony, which, in this part, is covered by permanent roofing. The lavatories, "tisaneries," and urinals are also situated in this projecting block, but the bath room, although adjoining it, is placed in the central main block, and is entered from the corridor running down the centre of the double pavilion.

* *L'Etude et les Progrès de l'Hygiène en France de* 1878 *à* 1882. Libraire de l'Académie de Médecine. Paris.

Separation Wards.—There are, to each double pavilion, four separation wards, excepting in the surgical wards where there are only three, one being used as an operation room. Each provides accommodation for 2 patients; the areas of the larger ones are 281 feet, and their cubic contents 3,653 feet. Those situated at the ends next the corridors have a passage-way cut through them, and, therefore, the superficial contents are, in each of these cases, only 236 feet, and the cubic contents, 3,068 feet. It results that the patients in these wards have respectively 140 and 118 superficial feet, and 1,826 and 1,534 cubic feet of air space each.

Basements.—Those portions of the basement floor that are immediately under the large wards being open at the sides are intended as covered recreation grounds for the patients. The spaces under the main corridor adjoining one end of the pavilion is planned as a dormitory for convalescent patients, and the opposite end of the pavilion, between and underneath the separation wards, is fitted as a dormitory for the attendants, and a dining room. The basement underneath the centre of the pavilion will be used as store and furnace rooms.

Area of Pavilions.—The total area occupied by the sick ward floor of each pavilion, including the surrounding walls, but exclusive of the verandahs, is 10,127 superficial feet, or 163⅓ feet per bed. If the verandah is included the space per bed is 227 feet.

In concluding this account of M. Tollet's works it may be well to say that, although it must be admitted he has persistently advocated the ogival section of sick wards, and practically shewn how it may be constructed in a simple and effective manner, yet it is not altogether new, for some years before he introduced the principle into France a building, octagonal on plan but of ogival section, was erected and is now to be seen at the Augusta Hospital at Berlin. The construction of this building is, however, quite different to those of M. Tollet's, being of wood instead of iron.

The question as to whether or no this curved section of ward has any advantage over that with flat walls and ceilings and rounded angles is too large to discuss here, and it is doubtful if a decision could be arrived at without a series of practical tests, such as those undertaken by Drs. Cowles and Wood, and published in the Annual Report of the State Board of Massachusetts for 1879.

The extreme height of M. Tollet's wards is 25 feet, and the result of the experiments above referred to was to shew that above the height of 12 feet there is little or no movement in the air, except towards the outlet ventilators, and, therefore, that this higher space is of little value for the purposes of ventilation. Dr. De Chaumont, in commenting upon this report, says, "additional height adds also to the cost of construction; increases the expense of warming; makes cleaning more difficult; and, to some extent, hampers ventilation."* At page 50 of this section will be found further and more detailed remarks by Dr. De Chaumont upon this question of height and the dimensions generally of hospital wards.

Apart, however, from this question, the impression I have formed from a careful inspection of M. Tollet's executed buildings is that none of them represent in their

* *Encyclopædia Britannica*, Ninth Edition. Edinburgh, 1881.

entirety the very excellent principles enumerated in his writings and more particularly delineated by the typical plans of hospital construction that first brought his name into prominent notice; the nearest approach to his then ideal appears to me to be the St. Denis building. It will, however, be interesting to my readers to have M. Tollet's own opinion upon this matter as stated in the following extract (which he kindly allows me to publish) from his letters, written to me after an examination of the proof-sheets of the foregoing accounts of his works. From this it will be seen that, whatever were his previous opinions, the St. Eloi Hospital, just described, represents in every respect his present conception of what a good hospital building should be.

EXTRACT FROM A LETTER OF M. TOLLET.

"Vous dites 'qu'aucune des applications ne représente en entier les excellents principes posés dans mes ouvrages.'

"Cela est vrai pour l'Hôpital Bichât seulement, où j'ai été obligé d'utiliser un ancien bâtiment de caserne à étages multiplies et de placer 200 lits sur une surface de terrain de 60 mètres par lit inférieure à celle que j'ai indiquée en principe. Mais dans les bâtiments neufs les salles de malade ne sont pas superposées; elles sont très spacieuses et très largement ventilées; des praticiens les considèrent comme très favorables à la guérison des malades et des blessés.

"Tel qu'il est, ce petit hôpital, placé en dehors de la grande agglomération Parisienne, ne vaut-il pas encore mieux que les hôpitaux centraux à étages superposés, qui n'occupent des surfaces de terrain moitié moins étendues et qui sont enserrés au milieu des hautes constructions voisines? Dans l'impossibilité de pouvoir pour cet hôpital appliquer mon programme dans son entier, je n'ai pas cru devoir refuser de l'appliquer en partie. On a déjà constaté que les grandes opérations y réussissent bien. Un rapport officiel va être imprimé, et je vous l'enverrai.

"Les hôpitaux de Bourges et de St. Denis remplissent mieux les principales conditions de mon programme, savoir:—

"1. Emplacement en dehors des villes sur de larges surfaces de terrain convenablement choisies.

"2. Pas de superposition de salles de malades.

"3. Séparation des malades contagieux dans des bâtiments spéciaux.

"4. Grands espaces superficiels et cubiques offerts dans les salles (10 mètres de surface et 63 cubes d'air par lit).

"5. Ventilation naturelle puissante, obtenue de la façon la plus simple par la forme ogivale des bâtiments.

"La ventilation naturelle a été très justement préconisée par les médecins anglais, et les résultats l'ont justifiée Voir (pages 57, 58, 59, et 60 dans le mémoire de M. le Doyen de la Faculté de Médecine de Montpellier.) les statistiques encourageantes de l'Hôpital Militaire de Bourges—des pavillons de malades pour 32 lits ou plus. Dissémination de ces bâtiments sur une grande surface de terrain.

"Mais c'est surtout à l'hôpital de Montpellier qu'il m'a été permis d'appliquer *dans leur entier* les principes que vous approuvez, comme tous les hygiénistes. Il suffit de se reporter au plan général pour s'en convaincre.

"A. Emplacement en pleine campagne sur un excellent terrain.

"B. Surface de 150 mètres par lit.

"C. Eaux pures et abondantes.

"D. Chemin de ceinture extérieur pour isoler l'hôpital des autres constructions.

"E. Chemin de ceinture intérieur séparant les groupes de malades ordinaires, des contagieux et des autres quartiers.

"F. Pas de superposition de salles de malades.

"G. Espacement des pavillons d'une longueur égale à une fois et demie leur hauteur (17 metres 50, de longueur entre les façades, pour 11 mètres de hauteur au faitage).

"En plaçant les salles particulières à 2 lits sur les côtés, l'espacement de ces annexes n'est que de 10 mètres; mais leur hauteur le réduit à 7 mètres. Cette disposition protége les balcons contre les vents les plus violents, et elle démarque complètement les pignons, dans lesquels une large baie vitrée est ménagée,

et permet aux malades de jouir de la vue de la campagne. Cette large baie fait d'ailleurs compensation à la suppression des deux croisées en façades.

" L'espacement des pavillons mesuré de faîtage à faîtage est de 26 mètres 50, soit près de deux fois et demie la hauteur.

" H. Quartier spécial des malades contagieux placé au dehors de la direction des vents dominants, par rapport à d'autres quartiers de malades. Pavillons spéciaux pour chaque nature de maladie contagieuse avec services particuliers pour éviter le contact du personnel servant. Eloignement à 70 mètres des pavillons et ceux des malades ordinaires les plus rapprochés.

" J. Désinfection pour le linge et les objets de literie.

" K. Grands espaces superficiels et cubiques offerts aux malades dans les salles (10 mètres carrés et 65 mètres cubes par lit), et, comme il a été prévu en outre, des logements particuliers pour les convalescents à portée des préaux et des jardins ; en réalité les grandes salles ne logeront guère que 24 malades au lieu de 28, et les rations individuelles d'air se trouveront augmentées en proportion ; il en sera de même des surfaces occupées par lit.

" L. Le renouvellement de l'air aura lieu à raison de 150 mètres cubes par lit, lorsque toutes les croisées seront fermées lors du chauffage des salles.

" M. *Pavillon de réchange*, pour permettre de laisser reposer successivement tous les pavillons et de livrer les salles pendant plusieurs jours consécutifs à une large aëration continue après un nettoyage complet.

" N. Enveloppe interne en briques cuites et émaillées sur une partie de la hauteur, pouvant être assainie par le flambage ou même renouvelée à peu de frais sans déranger les autres parties de la construction. Cette enveloppe interne est maintenue par le fers de l'ossature ogivale."

UTRECHT HOSPITAL.

HOLLAND.

It is generally admitted that the towns of Holland furnish notably bad examples of hospital design, and certainly those, and they are the principal ones, visited by me at Amsterdam, Rotterdam, and Leyden, although costly in their construction, scrupulously clean and otherwise well managed, are undoubtedly badly planned and wanting in all the essentials of good sanitary arrangements. With respect to Amsterdam, there is every hope that if the efforts now being made by Dr. A. W. C. Berns of that town are successful, Holland will shortly have a town hospital that in its details will compare favourably with those of other European nations. This gentleman has published a full description, with numerous and elaborate plans of his proposed scheme, and there appears every likelihood that, with some slight modifications, it will be carried out.*

The first attempt to erect a hospital in this country, planned upon the pavilion principle, appears to have been made at Utrecht; but, as will be seen by the accompanying illustration, the idea has only partially been carrried out.

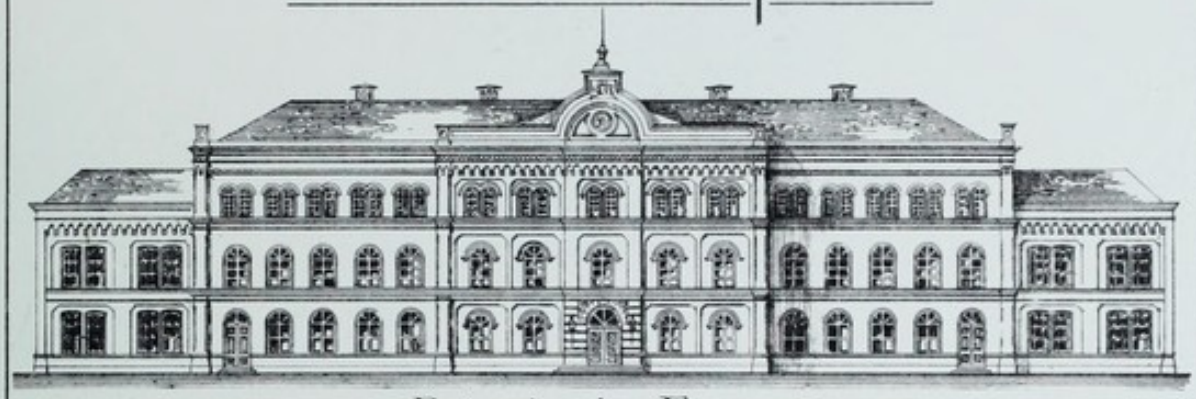
In the central portion of the front block the sick wards are enclosed on three sides and have windows only at one end, a plan typical of the mode of construction hitherto generally prevailing throughout most of the hospitals of Holland. The two end wings of this front block stand out as in the manner of pavilion wards, but they are not detached from the main building by corridors, and it is only on the upper floor that cross-ventilation has been secured by opposite windows, for the rear walls on the ground storey abuts against other buildings. At the back there are four pavilions separated from the main building on the first floor by corridors, but these corridors are partially enclosed on one side. The ground floor wards, like those of the front pavilions, abut on one side against other buildings, and have, therefore, no cross ventilation.

I am indebted to the courtesy of Professor Van Overbeek. de Meijer for having personally conducted me round the building and furnishing me with particulars for the following brief account of its principle features. I was much interested to find that in one of the wards fitted up as a lecture room this learned professor had collected together a most unique set of models for the instruction of his pupils in different branches of sanitary science, but especially that relating to the proper removal and disposal of sewage; indeed, it may safely be said that no such complete collection exists in any institution of our country, and certainly it would be difficult to find a more enthusiastic demonstrator than he of the evils of bad drainage, water supply, and ventilation.

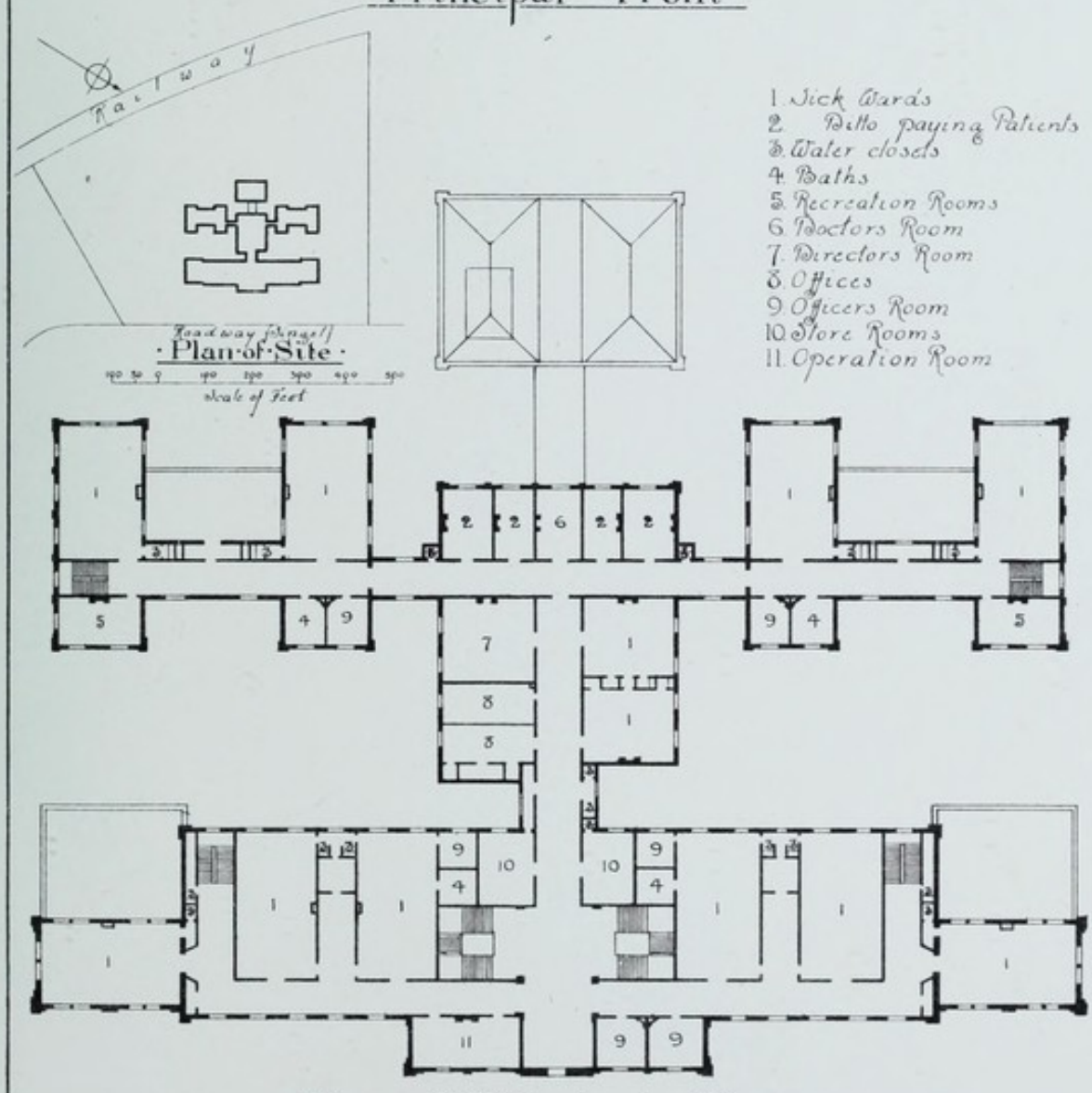
Site.—The building is situated at the southern extremity of the town, and faces the roadway running parallel with the canal "Stadts Buiten Gracht" that encircles it. The railway forms a boundary in the rear, whilst the ground at the two sides is occupied by

* J. H. and G. Van Heteren. Berlin, 1883.

· Utrecht · Hospital ·



· Principal · Front ·



· Plan of Principal Floor ·

Scale of Feet

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del

an orchard and other premises. The extent of the site is about 35,080 superficial feet, or 7 acres, 3 roods, 13 perches, being nearly 133 superficial feet per bed.

Subsoil.—The foundations of the buildings in many parts of Holland are difficult of construction owing to the loose sandy nature of the ground upon which they stand and the close proximity of water to the surface. This building was no exception to the general rule.

General Arrangement.—The accompanying plate shews the general disposition of the buildings upon the site, and a plan of the principal or first floor ; also an elevation of the entrance front.

The ground floor of the front block contains the administrative offices and residences, the laboratory, dispensary, instrument, lecture, waiting, and receiving rooms; also the out-patients' department and two sick wards, each accommodating 12 patients. The first floor contains six wards, each for the accommodation of 12 patients, together with the usual attached offices. There is also a small operation room on this floor. The floor above contains four wards, each for the accommodation of 12 patients, with the usual attached offices, besides store rooms and servants' dormitories.

The ground floor of the central block contains the kitchen, scullery, dining room, larder and store room. The first floor provides accommodation for the director and doctor, besides two wards, each for the accommodation of 8 patients, and four separation wards, each for 1 paying patient.

The two wings running right and left from the rear portion of the central block contain, on the ground floor, four wards, each for the accommodation of 12 patients, with the usual attached offices, a large recreation or day room, and two rooms, each for 2 lying-in women, besides bath rooms and other offices. On the first floor of these wings are four wards, each for the accommodation of 12 patients, with attached offices, two recreation or day rooms, and bath rooms as on the floor below.

The block of building at the rear is one storey only in height. It is connected with the main structure by an open covered way, and contains the engine house, furnace room, mortuary, &c., and in the rear, the pathological institute, with lecture room, laboratory, &c.

Total Accommodation.—It will be seen that provision is thus made for the reception of 264 inmates—viz., four wards for 1 bed each, two for 2 each, two for 8 each, and twenty for 12 each.

The planning and construction of the principal wards is undeserving of special notice.

AMERSFOORT MILITARY HOSPITAL.

HOLLAND.

Of all the buildings of Holland, erected for the occupation of the sick and wounded, this is the only one planned upon the general principles now universally recognized by the best authorities as those which should at all times govern the designs of hospital buildings. The structure is not, in every detail, perfect, but there are many points about it well worthy of notice, and especially so the combined heating and ventilating arrangements of the wards.

To Professor Van Overbeek de Meijer, of Utrecht University, all praise is due for having, by his advice, led the way to this great advance in the hospital construction of his country, and to him, and also to Dr. Wilson, chief military surgeon at Amersfoort, I have to offer my especial thanks for the facilities afforded me for obtaining the following information as to the details of the structure. The plans and working drawings of the various buildings were prepared and their erection superintended by Captain G. J. de Jongh.

The erection of the buildings was commenced in the year 1875 and completed by 1877.

Site.—The buildings are situated in one of the outlying districts of the town of Amersfoort. The principal front faces the high road leading from Amersfoort to Hoevelaken, and the other three sides of the building are surrounded by open fields and gardens.

The extent of the site is 230,349 superficial feet, being about 5 acres, 1 rood and 6 perches, or nearly 2,953 feet per bed, but the surrounding land being for some distance uncovered by buildings, the site may, from an hygienic point of view, be considered almost unlimited.

Subsoil.—The subsoil is a light sandy loam of great depth, and much difficulty was experienced in securing proper foundations; the normal level of the land water being, as is mostly the case in Holland, within a few feet of the surface.

General Arrangement.—The general arrangement of the buildings upon the site is shewn upon the plate at page 200, also there are detailed plans and sections of one of the principal sick wards, and of the contagious or isolation wards.

The grounds are entered by a gate indicated at H on the plan of site, and the main entrance-hall of the building is in the centre of the administrative block A. The basement of this block, which is brick vaulted throughout, is devoted principally to storage purposes, one room, however, originally intended for, but never used as, a disinfecting chamber, is shortly to be converted into a ward for insane patients, or prisoners, as may be required. The ground floor of this block contains an entrance-hall, with three rooms on the left of it for the occupation of the porter, and two on the right that are made use of as offices. In the rear, and immediately opposite to the entrance-hall, is the main staircase, on the right of which is the kitchen and scullery, and on the left the dispensary

·Amersfoort : Military : Hospital·

Front Elevation.

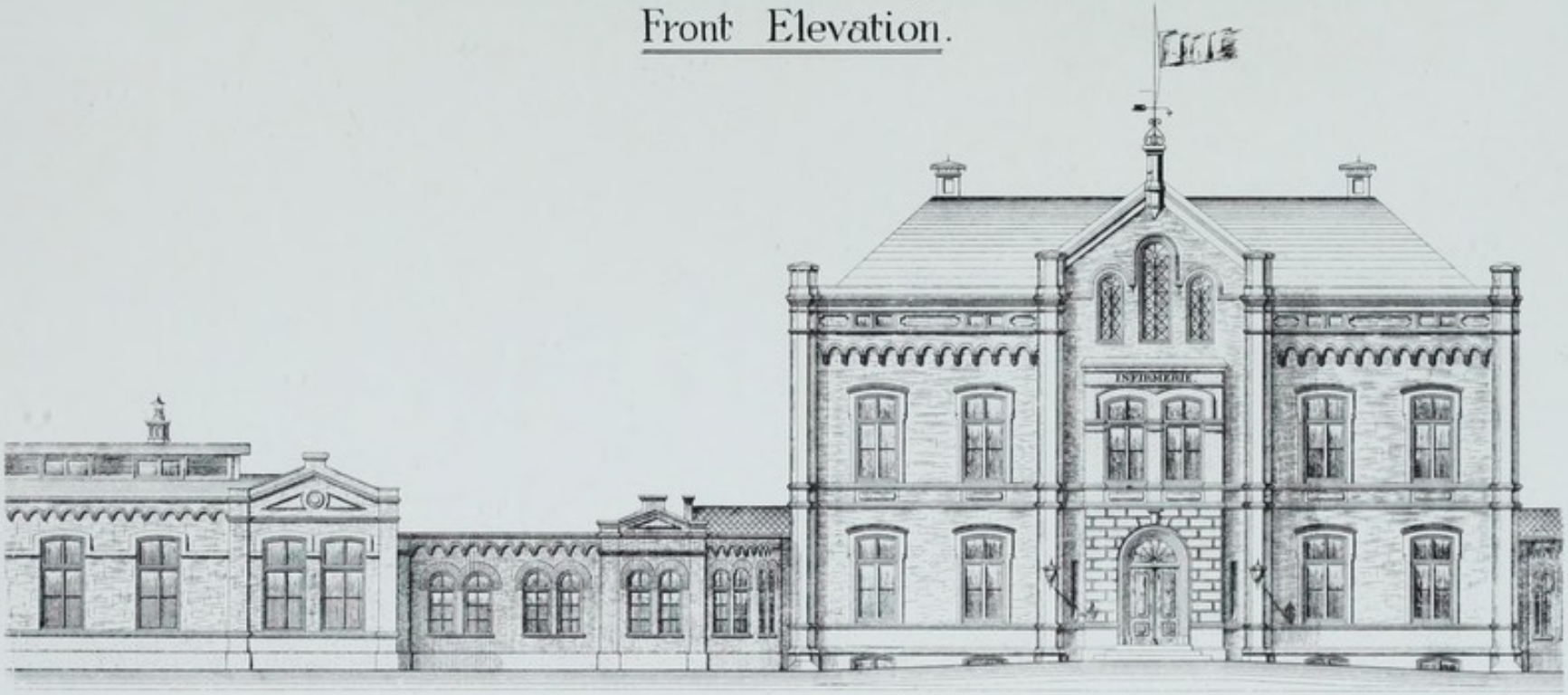


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and a "tisanerie." The first floor contains the apartments of the "Administrateur." There are likewise on this floor two rooms for the use of sick officers, and a bath room. The office "bureau" and a store room are also placed on this floor. The third floor is entirely contained in the roof, and is used as a linen and clothes store. The water cisterns, for the general supply of the establishment, are also placed on this attic floor.

Blocks B B are pavilions, one storey only in height, for the reception of patients. Each block has a large ward containing 12 beds, and two smaller wards with 2 beds each. They are seldom in use during any but the summer months, the ventilating arrangements being such that it is found extremely difficult to keep them properly warmed during the winter. These and the other pavilions will be more particularly described hereafter.

Blocks C C are similar to blocks B B, but the roofs are differently constructed and in such wise that the buildings may be used during the winter months. They are, when it is possible, closed during the summer time.

Block D is a pavilion, one storey in height, used for the reception of patients suffering from diseases of a contagious or infectious character. There is one room for 8, one for 4, and two for 1 patient each.

Block E is a mortuary.

Block F is a pump house, and at the side of it a well for the supply of water to the establishment.

No laundry is provided as all the clothes are washed in the town of Amersfoort.

Total Accommodation.—Accommodation is thus provided for 78 beds, viz. :—

Patients in blocks B B, in two wards with 12 beds in each, and four wards with 2 in each	32
Ditto in blocks C C, ditto ditto	32
Ditto in block D, with one ward for 8 beds, one ward for 4 beds, and two for 1 bed each	14
Total	78

Connecting Corridors.—The four ordinary sick pavilions are each connected at one end to the central administrative building by circular enclosed corridors, 8 feet 3 inches wide and 11 feet high. These corridors are used by the patients in the daytime as ambulatories.

Water Supply.—All the water used in the establishment is raised by a hand pump to two large tanks situated in the highest portion of the central administrative offices, from whence it descends to the various sinks, baths, &c.

Drainage.—The rain and the bath and sink water are carried away from the building in earthenware pipes. No drainage is provided from the water-closets, the contents of which are carried away daily in iron tanks.

Area Covered.—The area covered by buildings is about 18,881 superficial feet, or nearly one-twelfth of the whole site, and 242 superficial feet per bed.

Cost.—The cost of this building is stated to have been about £15,000, or £192 6s. 3d. per bed. No particulars are obtainable as to the value of the land.

Summer Sick Pavilions.

The pavilions marked B B on the block plan of the site (*see* page 200) are, like all the others, one storey only in height, and, as before explained, they are not inhabited during

the winter months unless, it is absolutely necessary, it being found that the loss of heat through the open roofs and lanterns is too great for it to be possible to keep the apartments properly warmed without an unusually large expenditure of fuel. The actual number of sick at any one time in this establishment is, however, seldom during peace greater than one half the total accommodation provided.

Aspect.—The axes of the buildings throughout run from W. by S. to E. by N., so that the windows of the wards face N. by W. and S. by E.

Relative Positions of Pavilions.—The height of the buildings, as measured from the floors of the wards to junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 17 feet 6 inches, and the distance between the pavilions running parallel to one another is 77 feet 6 inches, or nearly four and a half times the height.

Size of Wards.—The large ward of each pavilion is of parallelogram shape, and contains 12 beds. It is 38 feet long, 26 feet 3 inches wide, and 18 feet 6 inches average height, exclusive of the ventilating roof lantern, 5 feet wide and 3 feet high, which runs the whole length of the ward. The total superficial space, therefore, in each large ward is 997 feet 6 inches, or about 83 feet per bed, and the cubic contents 19,024 feet, or about 1,585 feet per bed.

Bed Space.—The average lineal wall space per bed is 6 feet 4 inches.

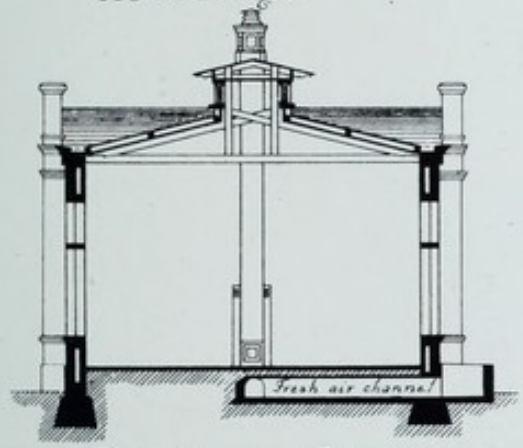
Windows.—There are three windows in each side wall, and the effective glazed surface in each ward is 183 feet, or 15 feet 3 inches per bed. The glazed sides of the lantern light are not taken into consideration as they are obscured when the louvred ventilators, as they mostly are, are opened. The sashes are constructed somewhat peculiarly; the top portion of each one for about one-third of the total height of the window opening is hung by pivots on its bottom rail, and can be made to fall forward into the ward by means of lines and pulleys; the lower two-thirds of the height is in one piece and hung as an ordinary sliding sash with lines and weights, and it will be seen that as this lower portion is opened it more or less prevents air entering through the upper part. The windows are not, as they should have been, placed mid-way between each two pair of beds.

Warming.—The warming of the large wards is effected by two stoves, standing centrally between the feet of the beds; and these stoves are so constructed that air brought from the outside and beneath them passes round the heated iron surfaces next the fire and flue pipes and escapes into the room through the upper part of the casings which surround the whole apparatus. Iron-moulded rims, forming cornices round these casings, are so constructed as to contain water, which, as it evaporates, moistens the air of the ward.

Ventilation.—The ventilation of these summer wards is effected mainly by the windows and lanterns. The latter run down the centre of the roof and the full length of the wards; each side is divided into seven panels, or divisions, and these divisions are alternatively formed as glazed, sashed and louvred openings. The sashes cannot be opened, but panelled sliding shutters cover the louvres, and are so contrived that they can be drawn horizontally away and across the sashes when the weather will so permit,

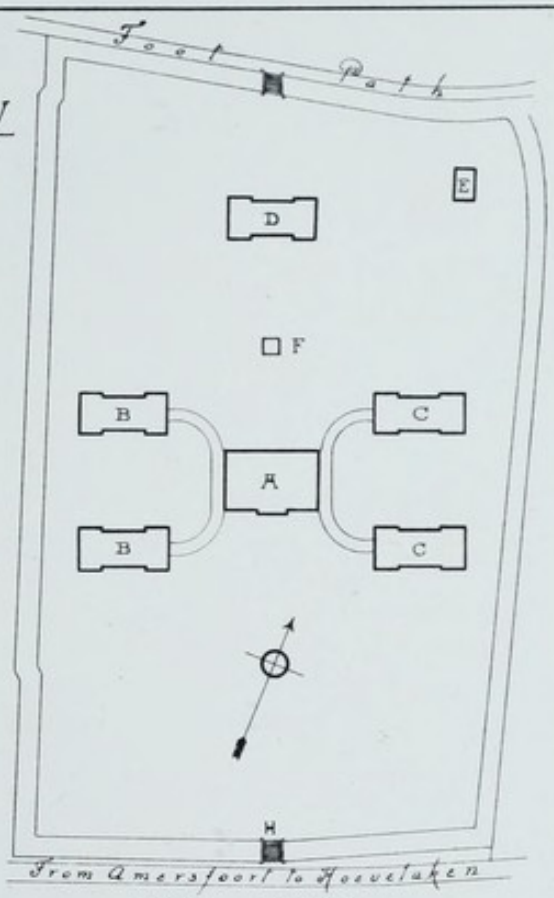
Amersfoort Military Hospital

A. Administrative Building
B. Summer Sick Pavilions
C. Winter Sick Pavilions
D. Isolation Wards
E. Mortuary
F. Pump House
H. Entrance gate



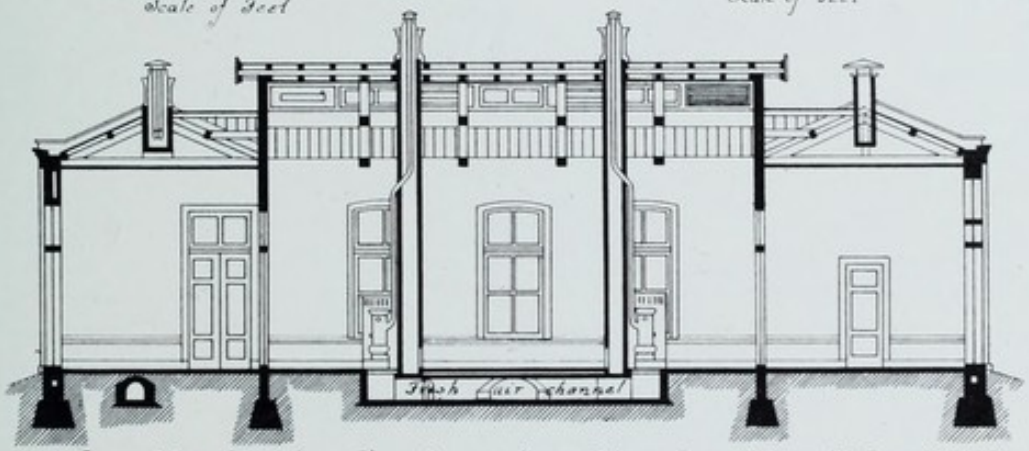
Transverse Section

Scale of Feet

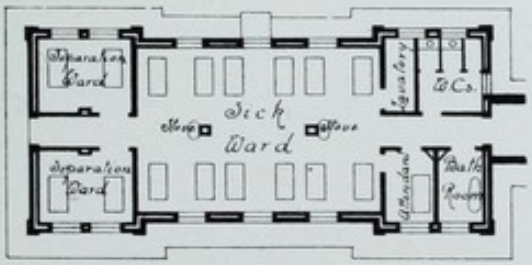


Plan of Site

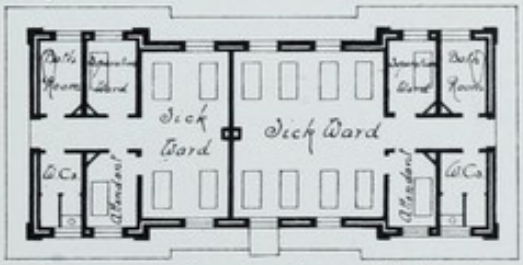
Scale of Feet



Longitudinal Section through Summer Wards



Plan of Wards B & C



Plan of Isolation Wards

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Air is also admitted into the ward by means of a brick channel, about 3 feet 4 inches wide and 1 foot 8 inches high, which runs beneath the floor from the outside wall to the centre of the room, from whence it branches right and left, and passing through channels, 1 foot 8 inches wide, opens into the room beneath the stoves in the manner described in the last paragraph. Provision is also made in each ward for the exit of foul air by two brick shafts, 1 foot 4 inches square inside, which run from the level of the floor to the ridge of the lantern, where they are capped by ornamental iron wind guards. The iron flues from the adjoining stoves pass into these brick shafts at the level of 14 feet 3 inches above the floor line, and, rising upwards, they find their exit above the top of the wind guard, and thus add warmth to, and induce an upward current in, the ventilating shafts. The foul air passes out of the ward into these flues through doors placed next the floor and on the sides opposite to that on which the stoves are placed.

Floors.—The floors of the wards are formed of deal boarding, about 6 inches wide and 3 feet 6 inches long, laid diagonally on timber joisting. The surface appears to have been stained, beeswaxed, and polished.

Walls.—The walls are all constructed hollow and in two thicknesses of brickwork. The external finishings are of cement, with the exception of the sills, copings, and other weatherings; these are of stone. The inside faces are plastered, and so are those of the roof.

W.C.'s, Baths, &c.—The w.c.'s and urinals are contained in a room, 11 feet 6 inches long, and 10 feet 2 inches wide, adjoining the entrance corridort. The w.c. compartments are 5 feet long, and 3 feet wide. The apparatus is a simple eartherware pan dipping into an iron syphon trap, and this discharges itself directly into an iron tank, situated in the basement, beneath each w.c. compartment. Three years ago, however, a sewer was constructed, discharging itself into the watercourse close to the hospital. These tanks are removed daily, and emptied on land far away from the hospital; but, under such an arrangement, it is obviously necessary to curtail the use of the water, for, otherwise, the iron receptacles would too soon become overcharged, and, therefore, the pipe conveying water to the pan is furnished with a cock that can only be turned by a key that is kept by a non-commissioned officer in charge; the consequence is, as might be expected, that the apparatus does not always get properly cleaned, and, seeing that the rooms in which they are placed are not separated from the building by cross-ventilated lobbies, the result cannot but be harmful to the patients. It is stated that the water-level being so close to the surface of the site, it is found impossible to convey this sewage away from the building in the ordinary way through pipes; but, if this is so, it might have been better to employ the dry earth system than to continue the present unsatisfactory arrangement. The rain and other clear water discharges itself by means of drains into the watercourses running near to the hospital grounds.

The baths are of plain metal, and unenclosed. They are supplied with hot water from small portable coppers, which, with their furnaces, stand in the corners of the rooms, and at the feet of the baths. These coppers are very compact in form, and are said to act effectively. They are manufactured by Corneau Frères, of Charleville, in France.

Adjoining, and entered from each of the large wards, there is a lavatory room, 11 feet 5 inches long, and 4 feet 7 inches wide, furnished with three tiny white earthenware basins, and supplied with cold water only.

Separation Wards.—At the further end of each ward, and entered off either side of the corridor leading to the recreation grounds, there are two separation wards, each of which is intended for the occupation of two patients; they are 15 feet 5 inches long, 11 feet 5 inches wide, and 16 feet high, and so the floor space allowed to each patient is, consequently, 88 superficial feet, and the corresponding cubical contents, 1,408 feet. It is seldom, however, that more than one patient is placed in these rooms.

Duty Rooms.—Duty rooms are not attached to each block of wards, but in the central administrative block there is a "tisanerie," and this partially answers the purpose of a duty room for all four blocks.

Nurses' Room.—The nurses are, as is usual in military hospitals, all men, and their rooms adjoin and can be entered from the large wards. They are each 11 feet 5 inches long and 7 feet 10 inches wide.

Area of Pavilions.—The total area, including the outer walls, covered by each pavilion is 2,241 feet, or 140 feet per bed.

Winter Sick Wards.

These buildings are in every respect similar to those of the summer wards, excepting that there are no roof lanterns, and the ceilings, therefore, instead of following the sloping lines of the rafters are made flat and on a level with the tie beams, and consequently the cubic space per bed is only 1,330 feet instead of 1,585 feet as in the summer pavilions.

The Moabite Hospital Berlin



Plan of Site

Scale of Feet

A. Porters Lodge
B. Administrative Offices
C. Kitchen
D. Engine House
E. Disinfecting Chamber
F. Laundry
H. Cart & Stores sheds
J. Ice house
K. Sick Wards
L. Isolation Wards
M. Disused Pavilions
O. Mortuary
P. Foul clothes house



Plan of one Pavilion

Scale of Feet



Part Elevation of Pavilion



Section on Line A-B



Ground Plan of Kitchen Building



Elevation of Kitchen Building



First Floor Plan of Kitchen Building

Scale of Feet

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H. Saxon Snell del.

THE MOABITE BARRACK HOSPITAL.

BERLIN, GERMANY.

SINCE the first part of this work was published Dr. Mouat and myself have had an opportunity of again visiting Germany together, and on this occasion we were personally conducted through most of the principal hospitals of Berlin by the illustrious Professor Dr. Virchow, whom it is perhaps needless to say is one of the greatest authorities in his country upon the question of hospital construction. It has not been attempted in this portion of our work to deal with any but general hospitals, and the one, therefore, now about to be described was at first omitted because it is ostensibly the Infectious Hospital of the city. It appears, however, that practically it is a general hospital, and is used exclusively for special purposes only in cases of epidemics; as a rule, the number of patients suffering from ordinary complaints very largely exceeds those suffering from diseases of an infectious or contagious character,* and for this reason, and because it is in many respects a remarkable building, it has been thought advisable that a description of it should not be omitted from these types of hospital construction.

The erection of the buildings was commenced on 2nd January 1872, and it is stated that in the short space of three months afterwards the administrative offices and sixteen pavilions were ready for the reception of patients. The materials employed were those taken from a temporary hospital that had been erected on the field of Templehof during the Franco-German war. In the year 1873 eight more pavilions were erected, further additions have since been made at various times, and it may be some years before the whole of the contemplated wards will be finally completed. The buildings generally are erected of inexpensive materials, and being of a temporary character its statistics might

* During the year 1880 the number of patients admitted to this establishment was 2,780, and the following tabulated statement of the classes of cases treated will shew how small a proportion were of an infectious character:—

Acute infectious cases	697
Chronic constitutional diseases	70
Cases of poisoning	52
Diseases of the nervous system	134
Do. circulatory do.	92
Do. respiratory do.	774
Do. digestive do.	250
Syphilitic diseases	133
Diseases of the bones and joints	188
Diseases of the cutaneous system	156
Do. intellect	8
Injuries caused by accidents	147
Miscellaneous and unclassed diseases	73
Total	2,780

Berl. Klin. Wochenschr., 1882, No. 27.

well form the groundwork of comparison with other permanent hospitals in considering the advantages that have been claimed in favour of temporary hospital structures. These buildings, which have now been erected for upwards of ten years, and appear likely to last, with partial renewals, for twenty years longer, have cost about one-third of the amount ordinarily expended upon permanent buildings of a like character. Looking at the question from a monetary point of view, it would be very interesting in the future to learn what have been the respective sums paid for repairing, upholding, maintaining and heating this and, say, the Friedrichshain Hospital, then, taking into consideration the difference in the number of patients, the capitalization of interest, and the probable life of the two buildings at the time the comparison was made, it might probably be shewn that the temporary structure was the cheaper of the two. If this were so, then it would appear that the principle might well attain of erecting temporary hospitals, the more so as it is asserted that the walls, roofs and floors of all sick wards sooner or later become permeated with the germs of various diseases, and therefore the oftener they could be renewed the better. Moreover, it has been suggested by high authorities that during the course of twenty or thirty years advances made in the science of medicine and surgery may result in the treatment of patients under altered conditions, and therefore that it is not unreasonable to anticipate in the future as great a difference of opinion existing as to what should be the construction of a hospital as has been found to be the case in the past. Much is, undoubtedly, to be said on both sides of this question.

Site.—The Moabite Hospital is situated in one of the outlying districts of Berlin, the principal, or southern, front being in the Thurm Strasse; it is bounded on the west by Maurermeister Strauss, on the north by Birken Strasse, and on the east by private grounds. The site is of rectangular shape, 524 feet wide, 1,528 average depth, and contains 800,670 superficial feet, or 8 acres 1 rood and 10 perches nearly, the area per bed being about 1,144 feet.

Subsoil.—The ground upon which the buildings stand is of a very dry, sandy nature, and is well drained.

General Arrangement.—The general disposition of the buildings upon the site, and detailed plans, elevations, and sections of one of the wards and of the kitchen building, is shewn upon the accompanying plate, page 205.

The principal entrance is by a gateway adjoining the porter's lodge, marked A on the block-plan of the site. The building to the right of the entrance (marked B) contains the administrative offices and residences.

Block C is an exceedingly well arranged kitchen building, having, on the basement, cellarage for keeping milk, butter, and other perishable stores, and, on the ground floor, a scullery, larder, ice cellar and stores, and the kitchen, fitted up with a well appointed cooking apparatus; the walls of this building have from time to time been very tastefully decorated in colors by the inmates.

Block D is an engine-house, and contains the furnaces and the boilers, from which steam pipes are conveyed round the whole of the buildings for the purposes of heating and for the supply of hot water to the baths and sinks, situated in various parts of the

establishment. At the rear the block E contains a very excellently-contrived disinfecting chamber and accessories.

Block F is the wash-house and laundry, a two-storied building, having drying rooms and apartments for the attendants upon the upper floors.

Blocks H H are cart and other sheds; I is a fire-engine station; and J is an additional ice cellar.

The twenty-four blocks marked K are pavilions, each containing one large ward capable of accommodating 29 patients; but in some of the wards a part is partitioned off to form a day room, thus reducing the number of beds to 28. These pavilion blocks are more particularly described hereafter.

Block L is a building that was in course of erection at the time of my visit, and consists of three rooms each for the accommodation of three patients suffering from acute contagious diseases.

The five blocks marked M are temporary pavilions, roughly put together, and originally erected to meet the exigencies of an outbreak of cholera, but they are now dilapidated and used only as storehouses and coal sheds. The northernmost of these blocks has lately been burned down, and will probably not be rebuilt at present.

Blocks N, O, and P are respectively a mortuary, a waiting-hall, and a shed for burning clothing and other infected matter.

Total Accommodation.—It may thus be estimated that provision is made for 700 inmates, in twenty-four pavilion wards with from 28 to 29 beds in each, and three wards with 3 beds in each.

Water Supply.—The water is supplied partly by the town authorities and partly by an artesian well situated near the engine-house.

Area Covered.—The area covered by buildings is 116,456 superficial feet, or about one-seventh of the site, and 166 feet per bed.

Cost.—The entire cost of buildings to the present time is stated to have been £57,805 (1,156,114 marks), or about £83 per bed.

Principal Sick Wards.

Each of the main sick pavilions are of similar design, and consist of one large ward, with attached offices, as shewn in detail upon the plate at page 205.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 11 feet, and the least distance between any two pavilions is 56 feet, or five times the height.

Size of Wards.—The sick wards are of parallelogram shape, and each generally contain 28 beds. They are 86 feet long, 22 feet 6 inches wide, and 12 feet 6 inches average height. The total superficial floor space being, therefore, 1,935 feet, or about 69 feet per bed, and the cubic contents 24,187 feet, or 864 feet per bed. In some of the pavilions the day room is omitted, and, in these cases, the space being thrown into the ward, another bed is obtained.

Bed Space.—The average lineal wall space per bed is 6 feet 2 inches.

Windows.—There are fourteen windows in each side wall, but they are not of the same size in all the pavilions; the effective glazed surface of those in the ward measured was 313 feet, or about 11 feet per bed; when these windows are opened to their fullest extent the total area through which air can be admitted by them into the wards is 427 feet, or 15¼ feet per bed. The external doorway at the end of the ward, when open, affords additional ventilation to the extent of about 2 feet per bed. The windows generally are divided into two heights by a wooden transom. The upper part consists of a sash hung upon its lower rail and opening inwards to its full extent; the lower part is an ordinary folding casement sash.

Warming.—The arrangements for heating the various buildings were entirely remodelled in the year 1879, under the direction of the engineer, Herr Voight. All the pavilions are heated from the central steam apparatus, situated in block D, from whence steam pipes are carried in brick channels round the grounds, and branches extend to the various pavilions and pass round the walls of the wards and offices. It is stated that no difficulty is experienced in maintaining a temperature of 68° in the wards in the depth of winter and when the ventilation is perfect.

Ventilation.—The ventilation of each ward is effected principally by the external door and the windows, but there are, in addition, in each side wall, next the floor, seven inlet ventilators, having an area of about 60 inches each, and covered with perforated zinc; also, in the ridge of the roof, nine outlet ventilators, each 2 feet 9 inches long and 1 foot 9 inches wide, fitted with wooden flaps for closing when necessary.

Floors.—The flooring is formed by dry brick rubbish, about 18 inches thick, laid upon the natural surface of the ground, which is of a very dry and sandy nature. The upper part is floated with cement and is about 18 inches above the ground level outside.

Walls and Roof.—The main body of the walling is constructed similarly to English brick nogging, the joints being pointed on the outside, but the inside is covered with narrow deal boarding jointed with moulded fillets, and forming a wall in all about 6½ inches in thickness.

The roof, which is of very simple construction, is covered with tarred and sanded felt, laid on deal boarding; no gutters are provided, but the eaves overhang the outer side walls by rather more than 3 feet and the end walls by 5 feet.

W.C.'s, Baths, &c.—The w.c.'s, baths, and other sanitary appliances are situated at the end of the ward adjoining the entrance corridor; they are not separated by ventilated lobbies, but lead directly out of the ward. The two w.c.'s, which are placed in one room, without a division between them, are fitted with ordinary pan-closet apparatus, the end nearest the ward is partitioned off and fitted with a small cast-iron sink and a tap for drawing water. The adjoining bath room, 10 feet long and 6 feet wide, is fitted with an uncased metal bath and supplied with hot and cold water.

Duty Room.—A duty room, 12 feet long and 10 feet wide, is situated to the right of the entrance corridor and adjoining the large ward, which it overlooks; it is not, as is usual, fitted with cooking or warming apparatus.

Nurses' Room.—The room adjoining is of the same size as that last described, and is fitted as a sleeping room for nurses.

Lumber Room.—On the opposite side of the passage a room of similar dimensions as the last is used as a lumber or store room, a not unusual addendum to the offices of foreign hospital sick wards. It is termed an "abstellraum," or "putting-away room," and is supposed to be useful as a store room for surplus ward furniture and appliances, but in nearly all cases it will be found that these rooms are receptacles for hospital rubbish of all kinds, and consequently they would be better done without.

Total Area of Pavilions.—The total area covered by each pavilion, including the walls surrounding it, is 2,868 feet, or about 103 feet per bed.

HALLE UNIVERSITY HOSPITAL.

GERMANY.

On again visiting Germany, after the publication of the first part of this work, I was made aware that the building about to be described was nearly completed, and partially occupied. Little, however, appeared to be known as to it, and I was therefore quite unprepared, when the visit was determined upon, to find the building to be undoubtedly the finest establishment of its kind in the country.

The following description is taken from the original working drawings and from personal inspection of the buildings, but considerable difficulty and expense has been incurred in obtaining this information in consequence of the architect not feeling himself justified in assisting my inquiry, inasmuch as he had promised similar information to the publishers, Messrs. Ernst and Korn, of Berlin, who, nevertheless, I have much pleasure in stating, are engaged in the preparation of an elaborate work descriptive of the building, and containing large detailed engravings of the various blocks.

The architect, Von Tiedemann, commenced the preparation of the plans May 1874. The erection of the building began June 1876, and, although the greater part was completed and in occupation, some of the blocks were, at the time of my visit (June 1883), yet in course of construction.

Site.—The buildings are situated in a very elevated position, near to the eastern borders of the town, and upon the "Marienbreite," Magdeberger Strasse bounding it on the west, Schlemmel Strasse on the east, and Stein Strasse on the north-east.

Subsoil.—The upper scil is stated to be of a loamy nature, but, at no great depth, a hard sandstone rock is met with, the material of which has been used in the construction of the basement walls.

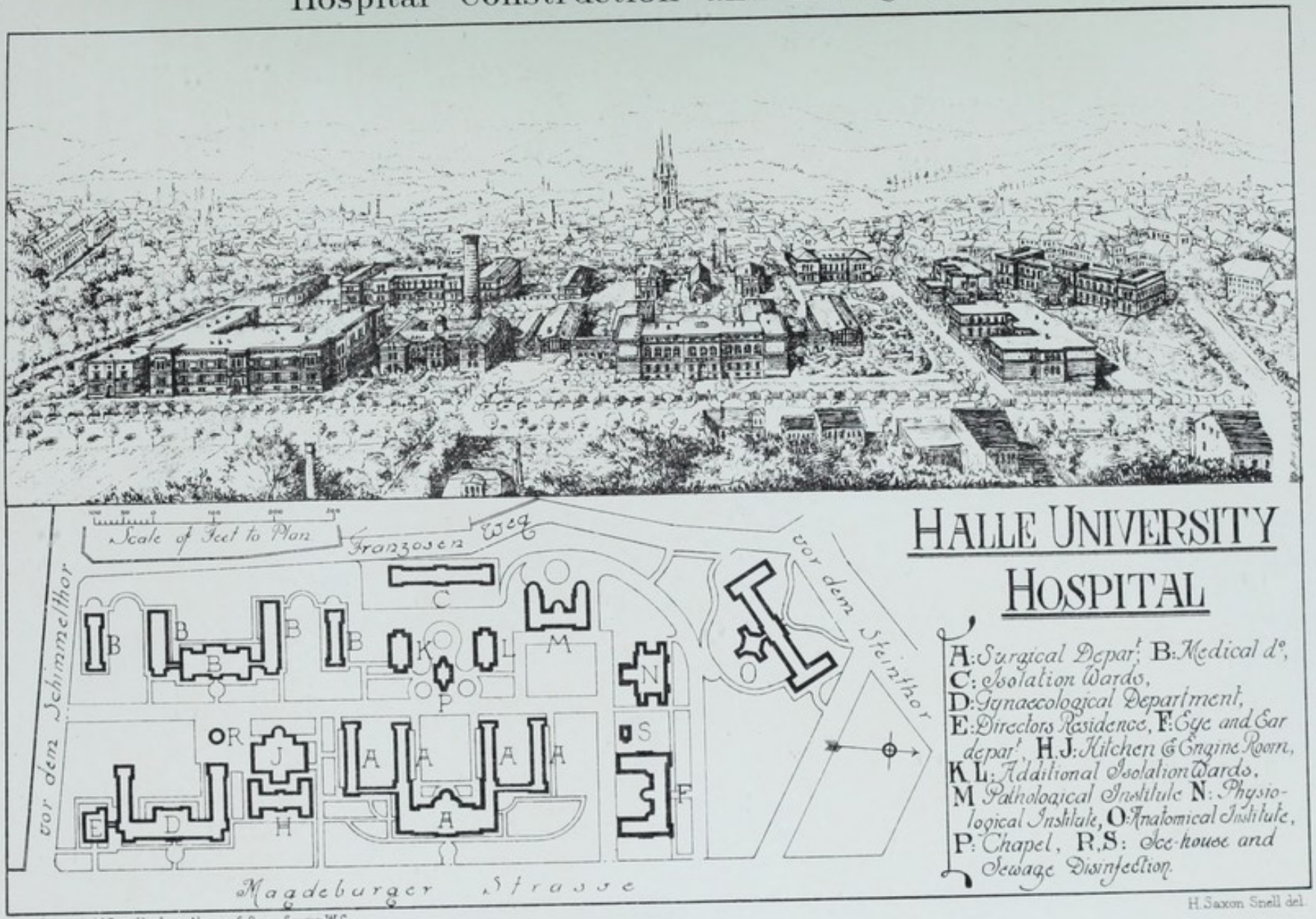
General Arrangement.—The general disposition of the buildings upon the site is shewn upon the accompanying plate; and at page 216 will be found detailed plans and sections of the principal pavilions.

There are several entrance gates, by which access can be obtained to the various departments, but the main entrance to the establishment is by the gate opposite to the blocks marked A.

These blocks, A, constitute the surgical department of the establishment, and consist of a central building, two storeys in height above the basement floor, and four one-storied pavilions, to be more particularly described hereafter, jutting out in the rear, and connected together by means of spacious corridors.

The basement of the central block, about half of which is sunk below the level of the ground, contains the porters' and male attendants' rooms, and there is cellarage beneath the operation theatre.

On the ground floor there is a well arranged and lighted operation theatre and various dormitories for the occupation of patients immediately after or prior to operations. Here also is the out-patients' department, the instrument and bandage



HALLE UNIVERSITY HOSPITAL

A: Surgical Depart; B: Medical d°,
C: Isolation Wards,
D: Gynaecological Department,
E: Directors Residence, F: Eye and Ear depart, H.J: Kitchen & Engine Room,
K.L: Additional Isolation Wards,
M Pathological Institute N: Physiological Institute, O: Anatomical Institute,
P: Chapel, R.S: Ice-house and Sewage Disinfection.

H. Saxon Snell del.

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

rooms, bath rooms, and the director's and assistant doctor's rooms. The first floor also contains doctor's rooms, one large ward, 89 feet 2 inches long and 26 feet 8 inches wide, and several other smaller wards, each for one or more patients. The accommodation provided in this surgical department is as follows, viz.:—

Two pavilion wards, containing 20 beds each	40
Two do. do. 24 do.	48
One ward in central building, containing 24 beds	24
One do. do. do. 4 do.	4
One do. do. do. 3 do.	3
Two do. do do. 2 do.	4
Total	123

Blocks marked B indicate the principal medical department, and consist of a central building, with two wings, all two storeys in height above the basement, and two detached pavilions, each one storey only in height. The general plan of this central portion is not unlike the Strasburg University Hospital, illustrated at page 137 of this section. The basement floor is sunk about half its height below the general ground level, and contains rooms for the use of the porter and other male attendants. In the two wings there are, on this floor, four rooms, two on either side, and each for the accommodation of 6 syphilitic patients, with the usual attached offices; likewise, on each side, a room for the reception of 3 lunatic patients, with a padded room attached. The ground floor contains the out-patients' department, with lecture hall, rooms for the conduct of therapeutic, electric, laryngoscopic, and microscopic investigations; also the director's, assistant doctor's, and porters' rooms. In each of the two wings on this floor there is a ward, with the usual attached offices, for the accommodation of 12 patients, and also three smaller rooms, one being for the accommodation of 3 ordinary patients, and two for 1 private patient each. On the first floor there is another lecture hall, a library, the matron's apartments, and additional assistant doctor's rooms; likewise, in each wing, a ward for the accommodation of 12 patients, with the usual attached offices, another for 3 ordinary patients, and two for 1 private patient each. In the central portion there is a ward for the accommodation of 6 children, with an isolation ward for 2. The outer pavilions will be more particularly described hereafter; they each contain accommodation for 16 patients in one large ward, and a separation ward for 1 patient. The accommodation provided in this department is as follows:—

Two wards for 16 patients each	32
Four do. 12 do.	48
Five do. 6 do.	30
Six do. 3 do.	18
One do. 2 do.	2
Twelve do. 1 do.	12
Total	142

Block C is a building for the isolation of patients suffering from diseases of an infectious or contagious nature, and will be more particularly described hereafter. It contains two wards, each for the accommodation of 12 patients, and two for 1 patient each, or a total of 26 beds.

Block D is gynaecological department, and, as the name implies, is devoted to the treatment of the diseases of women. It is a building two storeys in height above the basement floor, and contains, on the basement, cellarage, storage, and attendants' rooms; also dining and reading rooms for the general use of the students of all departments. The ground floor contains the entrance-hall, the director's and assistant doctor's rooms, and various small wards for the patients; also a lecture room. The first floor provides accommodation in small wards for patients of various classes, with lying-in and delivery rooms, waiting room for students, examination, lecture and operation rooms, and apartments for the midwife. The accommodation provided in this department consists of

One ward for 6 patients each	6
Seventeen wards for 4 patients each	68
Two do. 2 do.	4
Two do. 1 do.	2
Total	80

Block E is the residence of the director of the establishment.

Block F is a building, two storeys in height above the basement, for the treatment of patients suffering from diseases of the eye and ear. The departments are nearly separated from each other, being united only by the lecture hall and operation theatre, which are placed on each floor of the centre of the building. The basement, half of which is sunk below the general ground level, contains various rooms for the use of the officers; also stores and cellarage. The ground floor of the building is entered through two large vestibules by doorways situated on either side of the apsidal-shaped staircase that projects from the front wall of the central portion of the building. The door on the right gives access to the ear, and that on the left to the eye department. The director's office, the assistant doctor's apartments, and a room for anatomical collections are placed on the right hand side of the central building, and the adjoining wing contains three wards, with the usual attached nurses' rooms and offices. Each ward is planned for the accommodation of 6 patients suffering from aural complaints. A waiting and three examination rooms (one darkened) are situated on the left hand side of the building, and the adjoining projecting wing contains two wards, with the usual attached nurses' rooms and other offices; each ward is planned for the accommodation of 6 patients suffering from eye diseases, and also a separation ward for 1 patient. A lecture room and staircase occupies the centre of the building on this floor. The first floor has an operation theatre and staircase in the centre, and, on the right hand side of them, the apartments of the assistant doctor and a separation ward for 1 patient. The adjoining wing contains, on this floor, three wards, each for the accommodation of 6 patients suffering from aural complaints, and the usual attached nurses' rooms and offices. The accommodation on this floor, to the left of the centre, consists of a room for the use of the director and apartments for an assistant doctor; also a separation ward for 1 patient, and three wards, each for 6 patients suffering from diseases of the eye, together with the usual attached nurses' rooms and offices. Indoor accommodation is thus provided in this department for 69 patients, in eleven rooms containing 6 beds in each, and three with 1 bed each.

Block H is a building four storeys in height above the basement floor, and contains the kitchen, with its larders, store rooms, and other usual offices, the wash-house and laundry, with a summer drying room (occupying the whole of the upper, or attic, floor of the building), the servants', hospital attendants', and officers' day and bed rooms, and, generally, the whole of the principal administrative offices of the building. The kitchen department is situated to the right, and the laundry wash-house, from which it is separated by a division wall, on the left.

Block J is the boiler and engine house.

Blocks K and L are additional isolation wards for the use respectively of the medical and surgical departments. They appear to be erected for the reception of a lower class of persons than those forming the general body of the hospital inmates. The director's report describes them as "vagabonds, beggars, persons suffering from venereal diseases, and others totally without means of support." The buildings, which are two storeys in height, each have, on each floor, a large ward for the accommodation of 12 patients, and one separation ward for 2 patients, and, in addition to the ordinary ward offices, there are apartments for the assistant doctors delegated to the charge of these departments. The total number of patients accommodated in the two pavilions is 56; viz., four wards for 12 patients each, and four for 2 each.

Block M is the pathological institute. The basement storey, owing to a fall of the ground, can be entered from one side on the level, and in it are placed the rooms for the dead, the chapel, the mourners' and visitors' room, and apartments fitted with kennels, hutches, stalls, and tanks for the preservation of animals, reptiles, &c.; also, on this floor, are apartments for the department attendant. On the ground floor, to the right of the centre, are placed the director's and students' rooms, and various apartments devoted to the purposes of chemical, microscopic, and other special investigations. The post-mortem room occupies the rear portion of the right hand wing. The rooms on this floor, to the left of the centre, consist of a porter's office, preparation, vivisection, and class rooms, also a lecture hall. The rooms on the first floor, to the right of the centre, are principally devoted to the study of microscopy, and the central and left-hand rooms are fitted as laboratories and for the exhibition of pathological collections.

Block N, the physiological institute, like the department last described, is fitted with various apartments for the study of microscopy, chemistry, optics, vivisection, &c.; also a library and museum. On the basement floor accommodation is provided for animals, reptiles, and other objects of study; also mechanical workshops, fitted with an "Otto" gas engine, rotary fans, dynamo-electric, and other machinery. Apartments are provided here for the use of the director of the department.

Block O is the anatomical institute; the left wing contains the professor's and students' rooms, but the right hand side is principally occupied as a museum. In the rear of the centre is a large lecture hall. The basement contains kennels, hutches, tanks, and such like accommodation for objects of anatomical investigation. Apartments are also provided for the custodian and for other officers employed in this department.

Block P is a chapel; block R an ice cellar; and block S a building for intercepting and disinfecting the whole of the sewage of the establishment.

Total Accommodation.—According to the foregoing description of the various departments it will be found that accommodation is provided for 494 inmates, viz.:—

The Surgical department (block A)	123
„ Medical do. (block B)	142
„ Isolation wards (block C)	26
„ Gynaecological department (block D)	80
„ Eye and ear department (block F)	69
„ Supplementary isolation wards (blocks K and L)	56
Total	496

Water Supply.—The establishment is supplied from the town mains, and, as there is a constant service, it has been deemed unnecessary to provide cisterns in the various buildings.

Drainage.—All the sewage of the establishment is conveyed by pipes to a building, marked S on the block-plan of the site. After undergoing the process of disinfection the solid matter is deposited in tanks and carted away at intervals, whereas the liquid portion is conveyed by pipes into the town sewers. At the time of my visit carts were being filled with this disinfected matter, and no objectionable effluvia was perceptible.

Area Covered.—The area covered by building is 162,227 superficial feet, or nearly one-fifth of the site, and 327 feet per bed.

Cost.—The buildings were not at the time of my visit completed, and, although a greater part of them were occupied, the accounts had not been finally adjusted, nor have they been to this date; therefore, the following estimate of the cost, given by the architect, Herr von Tiedemann, can only be considered as partially approximate.

Medical department (block A)	£26,075
Surgical do (block B)	24,370
Isolation pavilion (block C)	2,710
Gynaecological department and the director's residence (blocks D and E)	22,750
Eye and ear department (block F)	13,550
Administrative building and boiler and engine house (blocks H and J)	10,100
Chapel (block P)	875
Anatomical institute (block O)	19,000
Physiological do. (block N)	9,000
Pathological do. (block M)	9,000
Additional isolation wards (blocks K and L)	6,300
Sewage disinfection building (block S)	850
Total	£144,580

The above sum does not include professional charges, and salary of clerk of works, laying out roads, boundary walls and fences, and pumps and boilers in engine-house. If, therefore, we add for these items as follows:—

Boundary walls, laying out grounds, &c.	4,000
Boilers and pumps	1,000
Five per cent. for superintendence	7,479
Five per cent. on all the preceding items for extra and contingent work not included in the architect's original estimate	7,853
Total	£20,332

It may, therefore, be taken that the cost of the building and fittings will probably amount to about £165,000, or £334 per bed. The land cost £20,250, or about £44 per bed, so that the total outlay will have been at the rate of £378 per bed.

Medical One-Storied Pavilions.

These buildings consist of a pair of detached pavilions belonging to the medical department, but they are isolated from the main, or central, building, as shewn upon the block-plan of the site. A plan of the principal floor and a section are shewn upon the plate at page 216.

Aspect.—The axes of these and all other pavilions (excepting the isolation wards) run nearly directly east and west (E. by N. and W. by S.), so that the windows of the wards face nearly north and south (N. by W. and S. by E.).

Relative Position of Pavilions.—The height of the pavilions, as measured from the ward floors to the junctions of the upright lines of the outer front walls with the sloping lines of the roof, is 15 feet, and their distance from the adjacent main building is 90 feet 3 inches, or about six times the height.

Size of Wards.—The principal ward of each pavilion is of parallelogram shape, contains 16 beds, and is 73 feet 6 inches long, 29 feet 6 inches wide, and 15 feet average height. The total superficial floor space is, therefore, 2,168 feet, or 135 feet 6 inches per bed, and the cubic contents 32,524 feet, or 2,033 feet per bed.

Bed Space.—The average lineal wall space per bed is 9 feet 2 inches.

Windows.—The sashes in the lower portion of the windows of the side walls are hung as folding casements, and the sashes of the upper portion are made to open by lines and pulleys; they are all glazed with sheet glass. When all the windows are opened to their fullest extent the total area through which air can be admitted by them into the wards would be 304 feet, or about 19 feet per bed; the total area of their effective glazed surface is 264 feet, or 16½ feet per bed.

Warming.—The system adopted for warming the buildings generally is that by which steam is conveyed in pipes underground to the various blocks from the engine-house, marked J on the block-plan. In the ward now being described these steam pipes are connected with coils placed next the walls, as shewn upon the plans. The condensed water from these coils is taken by a separate pipe back to the large tank situated in the furnace-house, and is then again pumped up into the boilers.

Ventilation.—The ventilation of the wards is effected during the summer time by purely natural means, that is to say, by the opening of the windows and roof ventilators. When, however, the coldness of the weather necessitates the closing or partial closing of these openings the foul air is drawn off from the ward by means of an underground flue, which communicates with the furnace-shaft of the boiler-house at the point marked J on plan. This furnace-shaft, which is circular on plan, has a clear diameter of 16 feet 4 inches, and is 131 feet high. The two vertical smoke flues, each 4 feet 11 inches diameter, are made of cast-iron, and pass up the centre of the brick shaft, thus heating the space surrounding it, causing a strong upward current, and drawing, with great force, the foul air through the underground flues that converge towards it from the medical, surgical, and gynaecological departments. It is stated that when three boilers only are

in use the heat of the iron casing rises to from 356° to 456° Fah., and that it is found to be capable of drawing air through a pipe 12 inches diameter at the rate of 22,600 to 32,500 cubic feet per hour. The sectional area of the underground ventilating flues, as they enter the chimney, are 6 feet 6 inches square, but they reduce in size towards the ends to about 20 inches wide and 4 feet high, and so can be crawled through for the purpose of cleaning.

The admission of fresh air into the wards is likewise provided for by means of openings in the side walls, next to and below the hot water coils.

Lighting.—The buildings generally are lighted by gas. No special provision is made in the wards for conveying away the products of combustion.

Flooring.—The floors are laid with deal boarding, secured to the timber joists resting upon the vaulting beneath. These boards, in many of the wards, are painted a brown color, and varnished.

Walls.—The outer walls are of brick, about 14 inches thick, faced on the outside with banded courses of various colors. They are plastered on the inside, and, where they have been completed, are painted very tastefully.

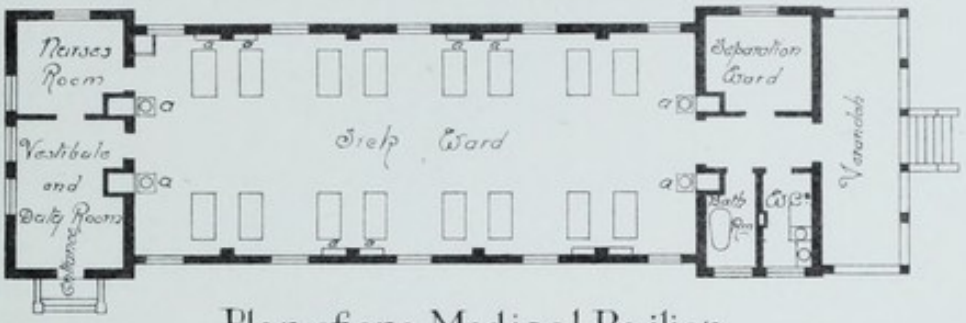
W.C.'s, Baths, &c.—The water-closets are, as is usual in Germany, planned without any attempt to cut them off from the main building. They are situated in compartments leading from the corridor joining the large ward to the verandah, and each division is about 5 feet 6 inches long and 3 feet 3 inches wide. The apparatus employed in many of the buildings is a kind of cast-iron latrine, and, therefore, is kept constantly full of water; when the contents is emptied a contrivance exists by which the incoming water is mixed with disinfectants: disinfectants being, apparently, in this, as in all other cases, the panacea for all continental unsanitary arrangements. The urinals are the ordinary white glazed earthenware apparatus. The adjoining bath room is 6 feet 6 inches wide and 10 feet 9 inches average length, and is fitted with a moveable metal bath. The pipes supplying hot and cold water to these baths are joined together, and have one outlet, so that the turning of the stop-cocks attached to each pipe enables the assistant to exactly regulate the requisite temperature of the outcoming water.

Duty Room.—The principal entrance to each block is through a large ante room, 20 feet long and 14 feet wide, and in it there is placed a warming apparatus, a sink, shelving, and the usual fittings of a duty room. To enter through what is really the scullery of the building appears, at first sight, wrong, but the duty rooms of sick wards are too often kept very uncleanly, and are made receptacles for much dirt, whereas when, as in this instance, they are made entrance-halls, it is argued that the greatest attention must necessarily be paid to keeping them scrupulously neat and clean—an advantage certainly not to be lost sight of in considering the question of the planning of hospital wards and their offices.

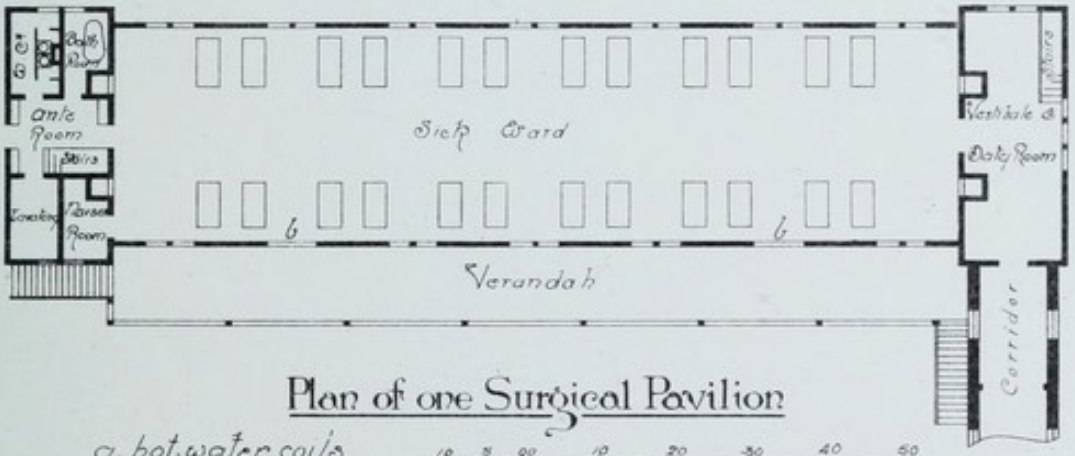
Separation Ward.—Entered from the corridor which leads from the rear end of the large ward to the verandah, and opposite to the bath room and w.c.'s, a separation ward is provided for the accommodation of one patient. It is 13 feet 11 inches long and 12 feet 7 inches wide, and contains, therefore, 175 superficial and 2,626 cubic feet.

Verandah.—No day room is provided, but at the extreme rear end of each pavilion an open verandah, 33 feet long and 9 feet 10 inches wide, is provided (similar to that at the

Halle University Hospital

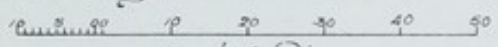


Plan of one Medical Pavilion

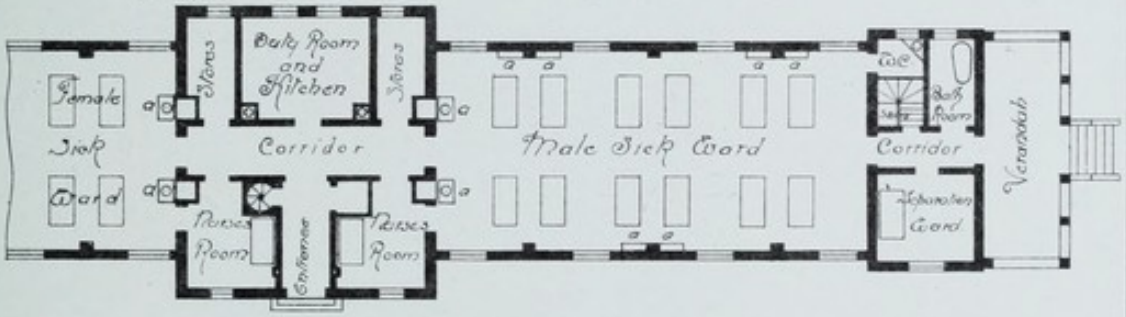


Plan of one Surgical Pavilion

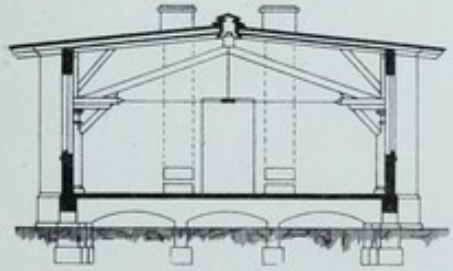
a. hot-water coils
b. glazed doors



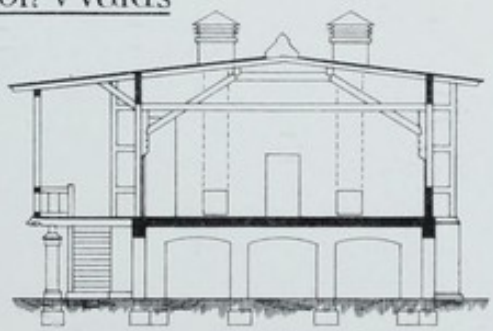
Scale to Plans



Plan of Isolation Wards



Section thro' Medical & Isolation Wards



Section thro' Surgical Wards

Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Friedrichshain Hospital in Berlin), and on to this the beds, either with or without the patients in them, can be wheeled when the weather permits.

Nurses' Room.—The nurses' room leads out of the entrance vestibule, and it also has a door communicating with the large ward. It is 13 feet 11 inches long and 12 feet 7 inches wide; the area of it is, therefore, 175 feet.

Basement.—The ground floors of these pavilions are raised about 3 feet 3 inches above the surface of the outside ground upon low open arches, and there is, therefore, a free space for the passage of air beneath. The whole of the site is covered with brick vaulting. Although the practice is now very common on the Continent of raising pavilion wards high above the ground upon open arches, yet I have had before to remark that in nearly all cases it will be found that these arched basements become filled up and are used as store rooms, or for other hospital purposes. In the building now being described the height of the crown of the vaulting above the ground line is only 2 feet 4 inches, and there is no inducement, therefore, to convert them from the purpose for which they were intended. Shall we find, however, in years to come that these supposed fresh air spaces are receptacles for dust and dirt that would otherwise have been removed from the building?

Total Area of Pavilions.—The total area covered by each pavilion, including its offices, but exclusive of the verandah, is 3,544 feet, or about 208 feet per bed. If the verandah be added the area is 3,939 feet, or about 232 feet per bed.

Surgical One-Storied Pavilions.

These buildings consist of two pairs of pavilions connected by corridors to the main entrance block, or surgical department, as shewn upon the block-plan of the site. A plan of the principal floor and a section through one of the buildings are shewn upon the accompanying plate.

Aspect.—The axes of these buildings run nearly directly east and west (E. by N. and W. by S.), so that the windows of the wards face east and west (N. by W. and S. by E.)

Relative Position of Pavilions.—The height of the buildings, as measured from the ward floors to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 24 feet 3 inches, and the least distance between any two of the blocks is 55 feet, or about $2\frac{1}{4}$ times the height.

Size of Wards.—The large wards are of parallelogram shape, and those furthest from the main block each contain 24 beds. They are each 114 feet long, 29 feet 6 inches wide, and an average height of 15 feet 9 inches. The total superficial floor space is, therefore, 3,368 feet, or 142 feet per bed, and the cubic contents 53,046 feet, or 2,210 feet per bed. The wards of the pavilions nearest to the main block are somewhat shorter than the above, and contain 20 beds only, but otherwise they are similarly planned.

Bed Space.—The average lineal wall space per bed is 9 feet 6 inches.

Windows.—The sashes in the lower portions of the windows of the side walls are hung as folding casements, and the sashes of the upper portion are made to open by lines and pulleys; they are all glazed with sheet glass, and the total area of their effective glazed surface is 624 feet, or 26 feet per bed. When all the windows are opened to their fullest extent the total area through which air can be admitted by them into the wards would be 768 feet, or 32 feet per bed.

Warming and Ventilation.—The arrangements for the warming and ventilation of these pavilions are generally similar to those of the medical department, described at page 215, but instead of the steam passing through coils it is carried round the walls next the floors and at the backs of the beds by means of cast-iron pipes, every alternate length of which has a series of gills for the purpose of more quickly radiating heat.

Flooring.—The floors of the large wards are formed by brick vaulting covered with concrete, the surface being finished with "terrazzo," a material formed of marble chippings bedded in concrete, then ground to an even surface, and, when dried, polished.

Walls.—The finished thickness of the walls of these buildings is about 10 inches, and they are formed of timber framing, 5 inches in thickness, wrought and stopt chamfered on the outside, and filled in with brickwork, finished internally with wall boarding, and tastefully decorated by painting.

W.C.'s, Bath, &c.—The water-closets are each 3 feet 9 inches long and 3 feet 4 inches wide, and are contained in a compartment leading out of the ante room at the end of the ward. The apparatus is similar to those described at page 216 for the medical pavilions.

The bath room averages 9 feet 9 inches long, 6 feet 4 inches wide, and is fitted with a moveable metal bath. The lavatory is a room 11 feet 5 inches long, 6 feet 4 inches wide, and is fitted with five wash basins ranged down one side.

Duty Room.—This room, like those of the medical pavilions, forms the entrance-hall of the building. It is 33 feet 6 inches long and 13 feet wide, and is fitted with warming apparatus, sink, shelving, and other usual appurtenances.

Verandah.—On the southern side of each pavilion there runs the full length of the ward an outside covered verandah, and from it at either end are flights of steps leading to the airing yards below. These verandahs are about 10 feet wide, and can be entered from the wards by means of two folding casement doors.

Nurses' Room.—At the further end of each large ward is a nurses' room, 11 feet 5 inches long and 6 feet 4 inches wide, and it has an area, therefore, of 72 feet 4 inches.

Ante Room.—This room, which is 13 feet long and 9 feet 9 inches wide, forms the means of communication between the ward and the bath, lavatories, and w.c.'s; it also contains a small staircase, which gives access to store rooms situated in the basement.

Basement.—The floors of the wards are raised about 8 feet high above the outside ground on an open vaulted basement; the ends are covered in and made use of as store rooms; the central portion is left open.

Total Area of Pavilions.—The total area covered by each of the pavilions furthest from the main block, including its offices, but exclusive of the verandah, is 4,571 feet, or 190 feet per bed. If the verandah be added the area is 5,800 feet, or about 242 feet per bed, whilst for the pavilions nearest to the main block, the area covered, exclusive of verandah, is 3,960 feet, or 198 per bed, or, with the verandah, 4,994 feet, or 249 feet per bed.

Isolation Pavilion.

This building consists of a double pavilion, one half of which is devoted to the use of male and the other half to female patients. A plan of the principal floor and a section through the central portion is shewn upon the plate at page 216. The construction and

details of the building generally are similar to those of the medical pavilions, and it will, therefore, only be necessary to describe the points of difference in the planning.

Aspect.—The axes of the pavilions exceptionally run nearly directly north and south (N. by W. and S. by E.), so that the windows of the wards face the east and west nearly (E. by N. and W. by S.)

Size of Wards.—The principal sick wards are of parallelogram shape, and each contains 12 beds; they are 57 feet long, 27 feet wide, and an average height of 15 feet. The total superficial space, therefore, is 1,540 feet, or 128 feet per bed, and the cubic contents 23,100 feet, or 1,925 feet per bed.

Bed Space.—The average lineal wall space per bed is 8 feet 2 inches.

Windows.—The total area of the effective glazed surface is about 292 superficial feet, or 24⅓ feet per bed, and when all the windows are opened to their fullest extent the area through which air can be admitted by them into the wards is 326 feet, or 27⅛ feet per bed.

W.C.'s, Baths, &c.—The compartments containing the w.c. apparatus lead directly out of the large wards, and are 6 feet long and 4 feet 10 inches wide. The bath rooms are 11 feet 10 inches long and 6 feet wide, and are fitted with metal moveable baths.

Duty Room.—The duty room consists of a large kitchen, 17 feet 2 inches long and 14 feet 4 inches wide, situated in the centre of the building and opposite to the main entrance. All the cooking for the inmates is done here in order to avoid the communication, which otherwise would be unavoidable, with other parts of the establishment. The two rooms placed on either side of the kitchen are each 14 feet 4 inches long and 6 feet 6 inches wide; they are used as a larder and store room for kitchen purposes.

Separation Wards.—At the rear of each of the large wards, and leading off the corridors that give access to the verandahs, are separation wards, each of which is intended for the accommodation of one patient; they are each 13 feet long and 11 feet 10 inches wide, and contain, therefore, 154 superficial feet.

Verandahs.—No day rooms are provided, but there are at the ends of the buildings open covered verandahs, similar to those described for the medical wards at page 218.

Nurses' Rooms.—The nurses' rooms are situated on either side of the entrance vestibule and have direct communication with the large wards. They are each 14 feet 4 inches long and 11 feet 10 inches wide, but contain an area, owing to projections into the rooms, of only 152 feet.

Basement.—Those portions of the basement situated immediately under the large sick wards are raised about 3 feet above the surface of the outside ground open arches and vaulting, and there is, therefore, a free space for the passage of air beneath. The portions beneath the central and end offices are, however, sunk lower, and are utilised generally as store rooms, and also for the purposes of washing and disinfecting the linen used in this part of the establishment.

Total Area of Pavilions.—The total area covered by this double pavilion, including the ward offices, but exclusive of the verandah, is 5,970 feet, or about 230 feet per bed. If the verandah be added the area covered is at the rate of 258 feet per bed.

ST. GEORGE'S UNION INFIRMARY.

FULHAM ROAD, LONDON.

It was not intended these types should illustrate more than one example of a workhouse hospital, but since the publication of the first part of the work I have been requested to give an account of the above building, erected from my designs some few years since for the Guardians of the Poor of the Parish of St. George's, Hanover Square, inasmuch as it contains a larger number of inmates than any other hospital in the Metropolis, and is by many considered to be equally as good a building as the one erected for the St. Marylebone Guardians, and illustrated at pages 58 and 60. So far as concerns the wards and offices I believe this is so, but experience has shewn that one or two details, pointed out further on, are capable of improvement. On the other hand, there are details, such as the construction of the ward windows, more particularly referred to at pages 62 and 223, that are far better than those at St. Marylebone, and will be found well worthy the attention of those interested in the constructive details of hospital design.

The great defect of the building is the smallness of the site, resulting in the too close proximity of the various blocks of buildings to one another, but this is a fault common to nearly all metropolitan buildings, where, as in this case, the cost of ground is unusually high.

The foundation stone was laid July 26th 1876 by Hugh Horatio Seymour, Esq., J.P., Chairman of the Board of Guardians of St. George's Union, and, on February 20th 1878, it was formally opened by the Right Honorable G. Sclater Booth, M.P., then President of the Local Government Board.

Site.—The building is situated at the western end of the Fulham Road, in the parish of Chelsea. The entrance and main front face the road, but the other sides are bounded by the open gardens of small semi-detached villas and the grounds of the adjoining workhouse. The extent of the site is about 123,192 superficial feet, or 2 acres 3 roods 12 poles, being nearly 153 feet per bed.

Subsoil.—The ground immediately below the surface soil consists of loamy sand and gravel overlying the London blue clay.

General Arrangement.—The accompanying plate shews the ground floor plan of the establishment and a detailed plan and section of one of the principal pavilion blocks.* It will be seen that the building is entered from the Fulham Road by a porch, which forms part of the ground floor storey of the first of the seven pavilions throughout which the patients are distributed. The remaining portion of the ground floor of this pavilion is occupied by the porter's lodge, steward's office, medical superintendent's consulting room, and the assistant medical officer's living rooms. On each of the three

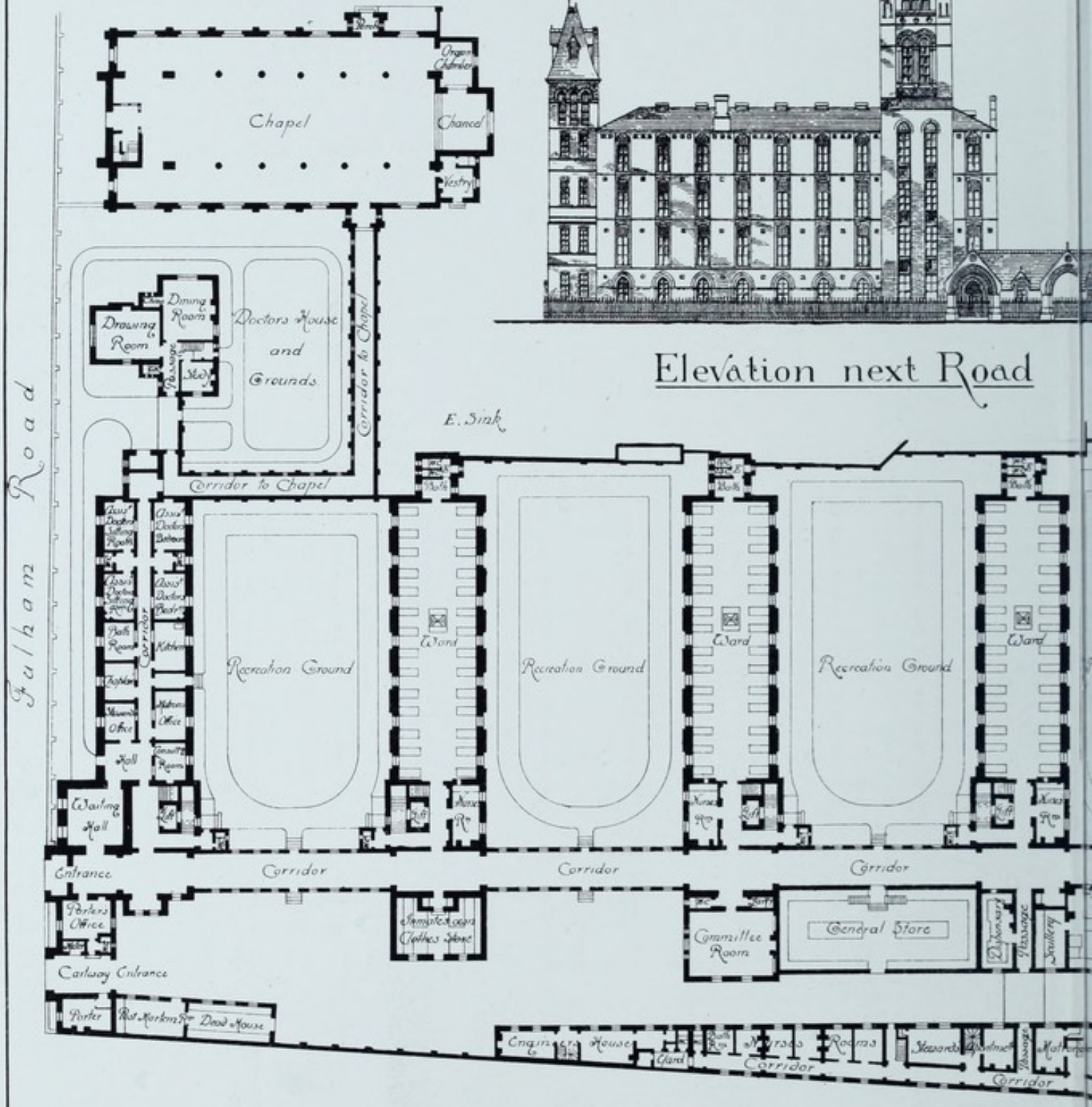
* Enlarged detailed drawings of this building, and also those of St. Marylebone Infirmary, are published in *Charitable and Parochial Establishments.* Batsford, London. 1881.

St. George's Union Infirmary

Fulham Road, London. S.W.



Elevation next Road



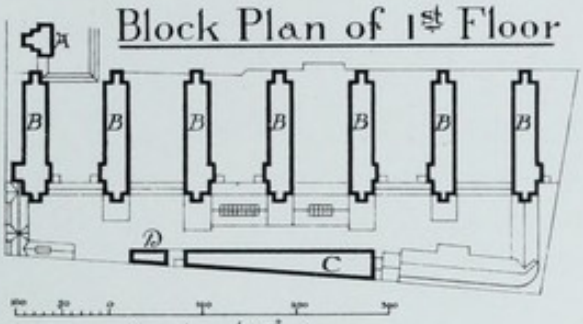
Scale of Feet.

Plan of Groun

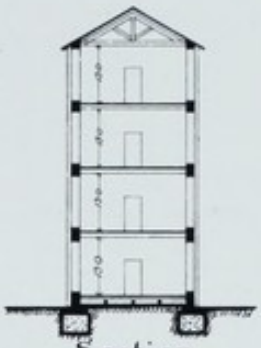
Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

A · Doctors House
B · Sick Wards
C · Nurses Dormitories
D · Engineers House

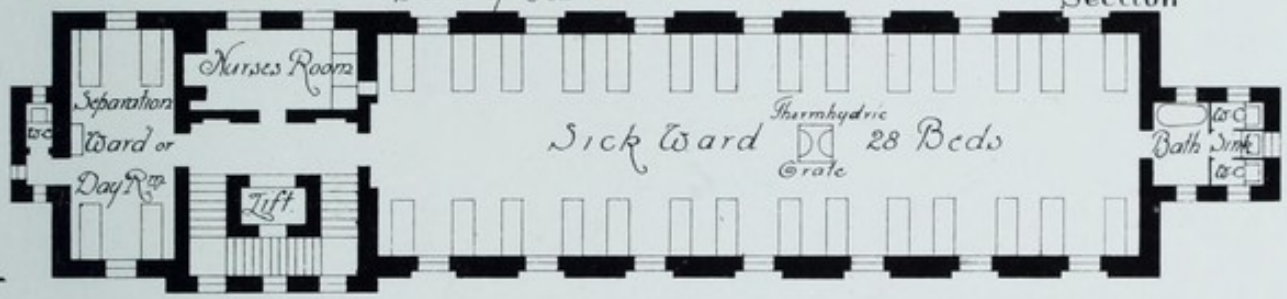
Block Plan of 1st Floor



Scale of Feet

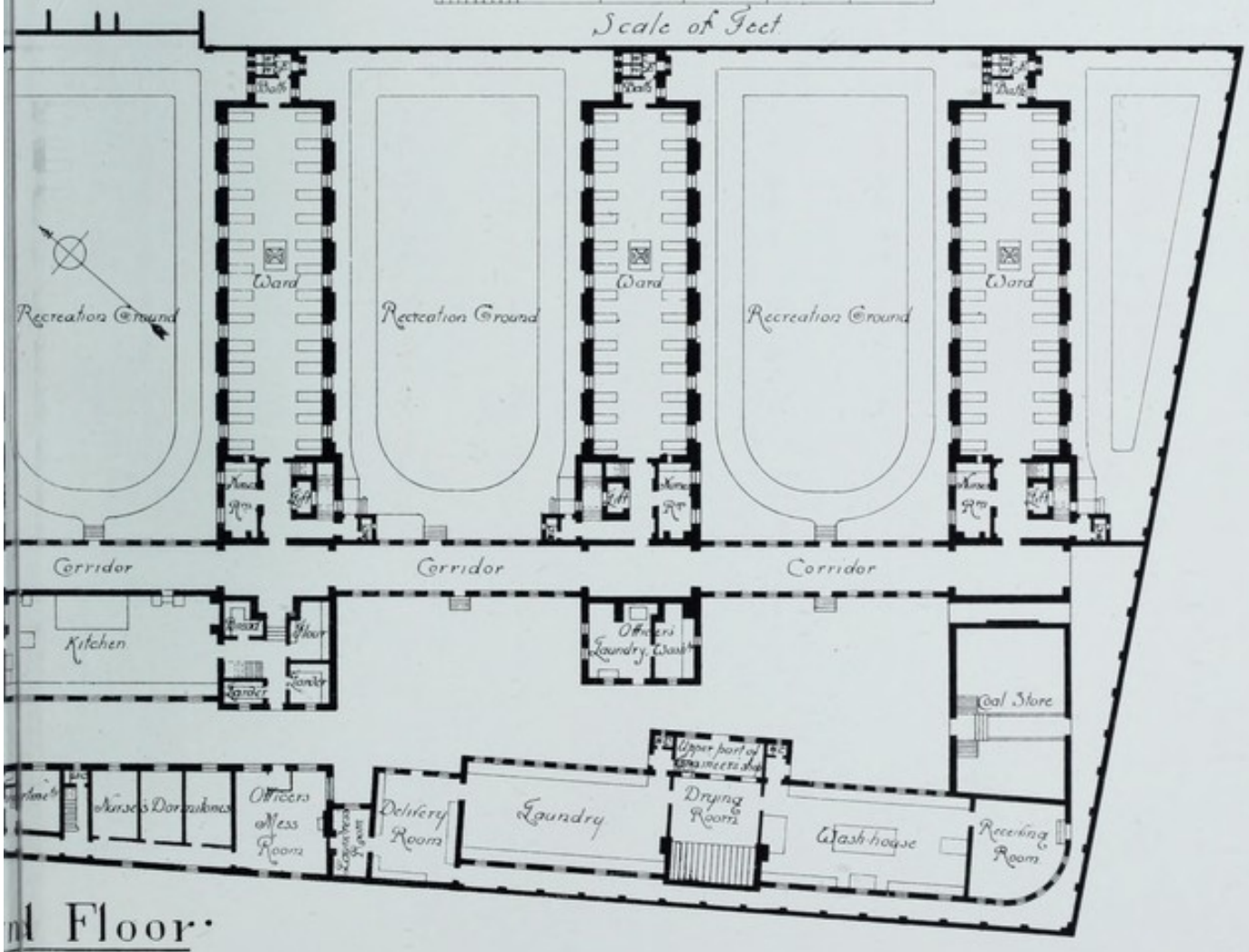


Section



First Floor Plan of Pavilions

Scale of Feet



nd Floor·

H Saxon Snell del.

upper floors there are two wards, one for 28 patients and one for 4 patients, with the usual attached offices, and thus accommodation is provided in this pavilion for 96 patients.

The remaining six pavilions are each three storeys in height above the ground floor, and, on each floor, similar accommodation is provided to that described for the upper floors of the first pavilion, excepting that the smaller wards are omitted on the ground floors, and that the top floors of one of the pavilions are divided by partitions into small rooms for the use of nurses. Of these six blocks, therefore, five contain accommodation for 124 and one for 92 inmates.

The medical officer's residence is situated between the chapel and the end of the first pavilion, and it faces the Fulham Road.

The chapel, shewn upon the plan, does not really form part of the infirmary buildings, although it is available for the use of the patients. This building belongs to the adjoining workhouse establishment.

On the right of the principal entrance there is a mortuary and post-mortem room.

On the opposite side of the corridor, adjoining the second pavilion, is the inmates' own clothing store. Then, opposite to, and between the ends of, and adjoining the third, fourth, and fifth pavilions, a building, one storey in height, provides kitchen and stores accommodation. The guardians' committee room and the dispensary are also located in this block. The basement is used as cellarage. The low building adjoining the end of the sixth pavilion was constructed for use as an officers' wash-house, but under the present management it is made use of as a carpenter's shop.

The steward's and matron's apartments, the principal nurses', and the domestics' dormitories, also the engineer's house, are placed against the boundary wall and opposite to the kitchens and stores buildings, from which they are separated by a road, 20 feet wide.

The laundry, wash-house, and coal stores form a continuation of the last-mentioned block of buildings, and are as far removed from the occupied portions as the small extent and peculiar form of the ground would permit.

Total Accommodation.—Provision is thus made for the reception of 808 patients, in twenty-six wards of 28 beds each and twenty wards of 4 beds each. The following is a detailed account of the space allotted to each of the various offices of this institution:—

PAVILIONS GENERALLY.

	Area in feet.
Twenty-six wards, each for 28 beds, and each	2,016
Each pavilion has, on the ground floor, a w.c. for the use of the officers.	
Each pavilion is provided with a direct-acting hydraulic lift; and, in the basements, there are furnace rooms containing boilers for heating purposes.	
Twenty day rooms, to be used, when required, as separation wards, for 4 beds each, and each	306
Twenty-three nurses duty rooms, each ...	144
Three do. do. do. ...	289
Each sick ward floor has 3 w.c.'s, 1 sink, 2 linen closets, 2 lavatories, and a moveable bath.	
The staircases surrounding the lifts, as also the corridors, are all of York stone, supported upon brick vaulting, so that these portions of the buildings are fireproof.	

ADMINISTRATIVE OFFICES.

	Area in feet.
Entrance-hall	166
General waiting room	298
Porter's office	180
Committee room	517
Do. lavatory and w.c., &c.	49
Dispensary	226
Chaplain's room	104
Matron's office	133
Steward's office	104
Medical officers' consulting room	104
Do. drawing room	298
Do. dining room	283
Do. study	92
Do. kitchen	172
Do. scullery	71
Do. coal cellar, larder, beer cellar, &c.	
Do. bed room	201
Do. do.	112
Do. two bed rooms, each	139
Do. bath room	56
Do. w.c., china closet, &c.	
Two assistant medical officers' sitting rooms, each	136
Two do. do. bed rooms, each	136
One do. do. bath room	104
One do. do. kitchen	133
Assistant medical officers' w.c., &c.	
Matron's sitting room	256
Do. bed room	336
Do. do.	195
Do. kitchen	126
Do. w.c., larder, linen closet, &c.	
Steward's sitting room	208
Do. bed room	284
Do. do.	190
Do. kitchen	117
Do. w.c., larder, linen closet, &c.	
Porter's bed room	146

	Area in feet.
Engineer's living room	144
Do. kitchen	176
Do. scullery	49
Do. bed room	144
Do. do.	176
Do. larder, coal cellar, dust, w.c.'s, &c.	
Eleven nurses' rooms, average each	93
Six do. do.	200
Two do. do.	210
Fourteen do. (on top floor of one pavilion) average each	120
One do. do.	306
Three do. bath rooms, average each	90
Nurses' w.c.'s, lavatories, linen room, &c.	
General kitchen	1,422
Do. scullery	182
Officers' mess room	575
Buttery, larders, and kitchen stores	893
General store	1,422
General coal store, w.c.'s, dustholes, &c., &c.	1,060
Two store rooms in upper part of tower, each	131
LAUNDRY, &c.	
Receiving room	506
Wash-house	1,182
Drying room, with horses	538
Ironing and folding room	1,182
Clean linen store and delivery room	497
Wash-house for officers' clothing	145
Ironing room	275
Laundress' room	128
Disinfecting chamber	77
Engineers' shop and furnace room	519
Boiler and engine room	315
Coal cellar for furnace coals	120
Inmates' own clothing store	455
Dead house	261
Post-mortem room	220

Connecting Corridors.—The main corridor connecting together the various blocks of buildings is 11 feet wide; it runs through the ends of the pavilions and occupies the space used as day rooms or separation wards on the upper floors.

Water Supply.—The water used in the establishment is supplied by the Chelsea Waterworks Company, and is delivered into a large cistern in the large tower, from whence it is distributed to cisterns situated in various parts of the building. There is also a large brick tank under portion of the main corridor for the collection of rain water from the various roofs, and this water is pumped up into a tank situated over the laundry, for the use of which it is principally required.

Drainage.—The drainage is effected by means of glazed earthenware pipes, varying from 6 to 9 inches diameter, leading respectively from the various soil pipes, baths,

lavatories and sinks to a main drain, 12 inches diameter, running down the centre of the road into the parish sewer. The rain water is conveyed to the storage tanks before referred to in similar pipes, 6 inches in diameter, but it first passes through settling and filtering chambers.

Area Covered.—The area covered by buildings is 51,902 feet, being about three-sevenths of the site, and 64 superficial feet per bed.

Cost.—The cost of the land was £20,467, or about £25 6*s.* 7*d.* per bed, and £7,244 19*s.* 1*d.* per acre. The buildings and their appurtenances, including engineering works and fixtures of every description, also professional fees and clerk of works' salary, cost £78,177, or about £96 15*s.* per bed, so that the total cost of both land and buildings was at the rate of £122 1*s.* 7*d.* per bed. It should be borne in mind that this building being erected under the rules of the Local Government Board the cubic contents per patient is 936 feet only, instead of 1,200 feet as prescribed for general hospitals; but it has already been pointed out, at page 58, that this reduction in the size of the wards does not make a corresponding difference in the price per bed, because the extent of the ward offices and of the administration departments of the building generally remain the same in both cases. The cost, for example, of erecting this building, with ward accommodation at the rate of 1,200 cubic feet per patient, would have been increased by only £14 14*s.* per bed—that is to say, it would have cost about £111 instead of £96 15*s.* per bed.

Principal Sick Wards.

The sick wards throughout this building are all of one size and are similarly arranged, so that, with the exception of one or two slight modifications previously pointed out, the following account may be considered as descriptive of them all.

Aspect.—The axes of the pavilions run nearly directly N.E. and S.W., so that the windows of the wards may be said to face N.W. and S.E.

Relative Position of Pavilions.—The height of the pavilions, as measured from the lower floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 56 feet, and the least distance between any two pavilions is 60 feet, or $1\frac{1}{14}$ times the height.

Size of Wards.—Each ward is of parallelogram shape, contains 28 beds, and is 84 feet long, 24 feet wide, and 13 feet high. The total superficial floor space is, therefore, 2,016 feet, or 72 feet per bed, and the cubic contents 26,208 feet, or 936 feet per bed.

Bed Space.—The average lineal wall space is 6 feet per bed.

Windows.—There are seven windows in each side wall, and the total area of their effective glazed surface is $437\frac{1}{2}$ feet, or $15\frac{5}{8}$ feet per bed. When all the windows are opened to their fullest extent the total area through which air could be admitted by them into the wards is 177 feet, or about $12\frac{3}{8}$ feet per bed. All the windows are glazed with 21 oz. sheet glass.

In nearly all modern hospitals for the acute sick the beds are ranged down the outer walls, and between them are the windows. The object of this arrangement is obviously to insure a free draught of air passing between the beds and through the wards from one window to another, whenever they are opened. It is, however, found practically impossible, in consequence of down draughts, to at all times have the windows (if of

ordinary construction) so opened whilst the patients are lying in bed, excepting only when there is little wind or the external and internal temperatures are about equal. This evil has been successfully combatted in this and other hospitals for which I have acted as architect by the introduction of a combined casement and lifting sash, so designed that the lower sashes, when opened, form a protection to the heads of the patients from any draught that may be passing through the windows while they are lying in bed, and, therefore, cross ventilation is possible at all times, without annoyance or danger to the patients. The construction of these casements is such as to render them more nearly air-tight than ordinary lifting sashes, and they are in other respects free from many of the objections appertaining to casements of ordinary construction. In order, however, to meet the prejudice of those who have been accustomed to, and still believe in, the ordinary lifting sash, it is contrived that the upper parts of the window shall open in this fashion, and be used, therefore, for additional ventilation whenever the weather will so permit. The outer part forms a balcony, upon which the patients may stand in the summer weather. A very cheap and effective iron espagniolette bolt fastening, suitable for these casements, may be purchased at a cost of about 6*s*. each.*

Warming.—Each ward is provided with one patent double open fire hot-water apparatus (a " Thermhydric grate "), illustrated and described at page 62 of this section. Had there been two of these apparatus, it would have been unnecessary to supplement this means of warmth by hot-water pipes round the walls. The success of the invention had not, however, been proved at the time of erecting this building, and it was, therefore, thought desirable to provide against failure.

Ventilation and Lighting.—The system of ventilation and lighting is similar to that at St. Marylebone Infirmary, described at pages 65 and 66, with the exception that the inlets for fresh air are formed by parged flues in the outer brick walls, instead of by iron piping.

Floors and Walls.—The construction of the floors and walls is similar to that at St. Marylebone Infirmary, described at page 66.

W.C.'s, Baths, &c.—The main ward water-closets, baths and other sanitary appliances are situated at the extreme end of each pavilion. The buildings containing them are carried up above the ordinary level of the adjoining pavilion, and form towers, the upper parts of which contain hot and cold water cisterns for the supply of the various baths, water-closets, &c., beneath them. There are on each floor two water-closets, generally 2 feet 7 inches wide and 6 feet long, each fitted with ordinary blue earthenware hopper pans and traps, and with Underhay's regulating water valves.

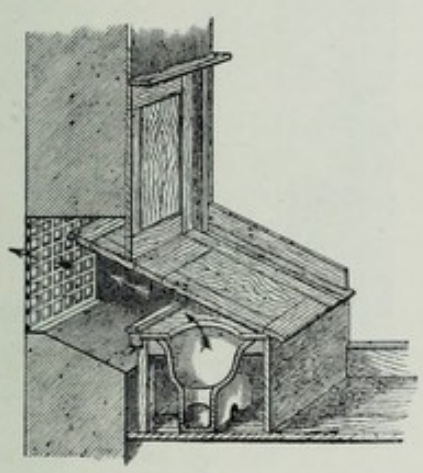
As it is always desirable that water-closets, baths, and lavatories should be placed in contiguity to all wards occupied by the acute sick, too much care cannot be bestowed upon the endeavour so to construct these offices that the chance of any foul air entering from them into the wards shall be reduced to a minimum; and to this end it has in all modern buildings been deemed advisable to separate the two by a lobby, having opposite

* For detailed drawings of these windows, *see Charitable and Parochial Establishments.* Batsford, London, 1881.

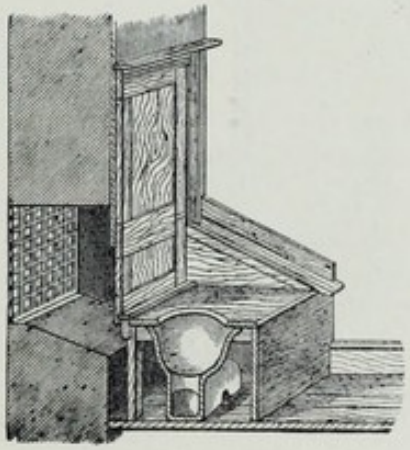
windows for cross ventilation. If these windows properly perform the functions allotted to them, it is clearly desirable that they should be as far distant as possible from any of the ward windows, otherwise the fouled air would, when the wind sets in certain directions, be blown into the wards through these adjoining windows, when open; and, to avoid this, it is, therefore, always better to place these offices directly at the ends of the wards, as has been done in this and the St. Marylebone Infirmary, rather than, as is usual, at the sides.

Arrangements are seldom made for the warming of these lobbies and water-closets, and, in consequence, air is drawn through them into the wards, whereas, when they are heated to a higher temperature than the wards, the passage of the air is, as it should be, in an opposite direction. Moreover, it is clearly often prejudicial to the recovery of the patients that they should periodically be compelled to remain, in a more or less nude state, in an atmosphere often very many degrees colder than that of the adjoining wards. The lobbies, water-closets and bath rooms of this building are all heated by hot-water pipes passing round the walls.

The construction of the lid coverings of the water-closets and sinks of this building is shewn upon the accompanying wood-cuts, *Figs.* 20 and 21, from which it will be seen



Lid Closed. *Fig.* 20.

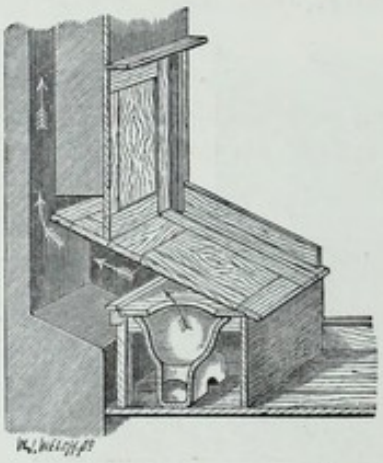


Lid Opened. *Fig.* 21.

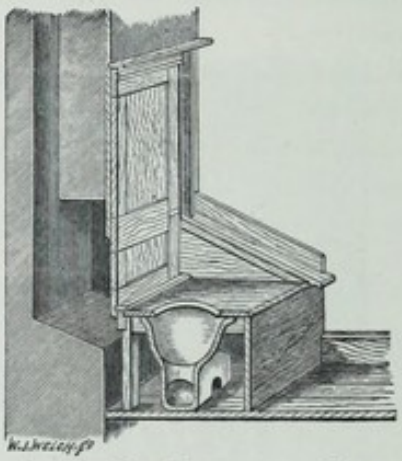
that when the lids are closed the apparatus stands practically in the outer air, and any offensive gases rising through the soil and waste pipes would not, therefore, be so likely to find their way into the building as with the ordinary mode of construction. When the lids are raised, the outer air is, of course, shut off. Theoretically, this invention is all that could be desired for solving the problem of how to prevent sewage gas entering a dwelling, but practically it is found to fail because the patients cannot be induced in all cases to close the lids, and I have not, therefore, excepting in this instance, adopted the invention in hospital wards. Previously, however, to abandoning the idea, I made a contrivance by which the shutting down of the lids caused the water-closet basins to be flushed and emptied similarly to the action resulting from pulling up the handle in the ordinary manner; but the patients still neglected to shut down the lids, and so the evil was only intensified. The contrivance would, however, be found useful in hospitals erected for a better class of patients, and many such have been put up by the maker.

Experience has, however, shewn that the position of the gratings immediately at the backs of the water-closet apparatus or sinks is objectionable, because when the wind sets directly towards the building the air is forced inwards rather than outwards. It was also found that in very cold weather the water pipes were liable to get frozen, and they are now so constructed that when the lids are closed the apparatus are opened to flues built in the adjoining walls, and running upwards like ordinary chimney flues, as shewn at *Figs.* 22 and 23. It is better that a gas burner should be inserted into and that an extraction cowl should be placed upon the tops of these flues. The invention was patented by myself, but I have no pecuniary interest in it. The maker, Mr. Edward Howard, of 34 Upper Gloucester Place, London, W., has, I believe, erected a large number, and will, no doubt, be only too glad to afford any information as to them.

The slop sink, which is placed in a recess next the water-closets, is formed of lead, 1 foot 10 inches long, 1 foot 6 inches wide, and 10 inches deep. The lobby separating the ward from the w.c. compartments is 9 feet long and 6 feet wide, and it contains a metal moveable bath, which, when required, can be wheeled to the bedside of a patient.



LID CLOSED. *Fig.* 22.



LID OPENED. *Fig.* 23.

It would have been a great improvement if these offices had been planned in a similar manner to those of St. Marylebone Infirmary, *see* page 60,* but a prejudice existed in the minds of some competent authorities against the provision of bath rooms, they deeming it desirable that the bath, when required to be used, should, in all cases, be wheeled to the bedside of the patient.

The soil and waste pipes are formed of cast-iron hot-water socketted tubes, caulked with gaskin and read lead. They are carried down on the outside walls, and are so arranged as to render it almost an impossibility that any foul air contained in them could enter the building.

Separation Wards.—On each of the upper floors there is a small ward for the accommodation of 4 patients, containing 306 superficial and 3,978 cubic feet; therefore,

* Fully detailed plans of these offices are published at page 17 of *Charitable and Parochial Establishments.* Batsford, London. 1881.

each patient is here provided with 76 superficial and 994 cubic feet of air space. A cross ventilated lobby, leading to a w.c., is attached to each of these small wards.

Day Rooms.—The separation wards last described, when not otherwise urgently required, are made use of as day rooms; indeed, it is seldom that they are used in this building for the purpose they were originally designed for.

Duty Rooms.—Attached to and overlooking the large and small wards there is a nurses' duty room, having an area of 144 feet. It is fitted with a range and sink, and racks and shelves for ward crockery, &c. The nurses' dormitories are situated, as previously described, in other parts of the establishment.

Lifts.—Adjoining the main corridor, and forming a centre, round which each pavilion staircase winds, there is a lift, 8 feet long and 4 feet 3 inches wide, for conveying patients, coals, and food from the lower to the upper storeys. These lifts are each worked by an hydraulic ram, which descends into a brick well a depth corresponding to the extreme height, through which the cage has to be lifted.

Staircases.—The pavilion staircases, including the lifts, occupy an area of 323 feet, and they and the corridors adjoining them are all fireproof, being formed of Yorkshire stone resting upon brickwork vaulting. The steps are each 4 feet 3 inches long, with a tread of 11 inches and a rise of 6¼ inches.

Total Area of Pavilions.—The total area covered by each floor of the pavilions, including the surrounding walls, is 3,665 feet, or about 114 feet per bed.

HOSPITAL OF ST. ANDREW THE APOSTLE.

GENOA, ITALY.

A CALCULATION was made in 1875 that there were about 800 hospitals in the Kingdom of Italy, and, although in the southern provinces extensive districts are entirely unprovided with them, hospitals are to be found in almost all the chief towns of provinces and districts, and also in many places of minor importance.

The following account of hospitals in Rome is extracted from an able and interesting report upon the relief of the poor of that country, drawn up, in the year 1875, by Mr. Herries, then H.M. Secretary of Legation at Rome.

"1. The oldest and most extensive of the Roman hospitals is that of *S. Spirito in Sassia*, founded at the beginning of the thirteenth century by Innocent III. It was first called *S. Maria in Sassia*, or *Saxia*, from the name of an ancient church built, together with a house, for the resort of Anglo-Saxon pilgrims by Ina, King of the West Saxons, who, about the year 728, after his retirement to Rome, established the *Schola Saxonum* in a part of the Borgo, which thence obtained the popular appellation of *Sassia*. The place having become deserted was chosen by Pope Innocent for the great charitable institution soon afterwards called S. Spirito, from the religious Order of that designation, to which he entrusted its management.

"It was originally intended not only for the cure of the sick and the relief of the poor in various ways, but also for the reception and education of foundlings. In 1608, Paul V. incorporated with it a bank of deposit for the profit of the institution; and, in 1726, Benedict XIII. transferred to S. Spirito the lunatic asylum existing elsewhere in Rome.

"The hospital, properly so called, which, like the other branches of the institution, is devoted to the assistance of poor persons, without distinction of class or nationality, is principally for the medical treatment of acute cases of disease. It has room for 730 beds.

"Its medico-surgical staff consists of 10 chief physicians and 4 chief surgeons, 10 assistants, 4 substitutes, 10 sub-assistants, 8 under-substitutes, 1 chief and 1 under apothecary, with 13 assistants. There are, besides, 39 sisters of charity, and 126 other hospital attendants, porters, &c., &c.

"The daily average number of persons treated from 1855 to 1870 was the following:—

1855	...	...	573	1859	...	...	434	1863	...	...	399	1867	...	...	376
1856	...	...	646	1860	...	...	510	1864	...	...	385	1868	...	...	390
1857	...	...	732	1861	...	...	494	1865	...	...	352	1869	...	...	344
1858	...	...	617	1862	...	...	443	1866	...	...	345	1870	...	...	380

"The total number of persons admitted during the ten months ended October 31, 1870, and during the corresponding period of 1871, was respectively 8,204 and 10,799. The increase in the latter period was, therefore, 2,595.

"A military hospital, where soldiers of the garrison are treated by contract with the government, is annexed to the general civil hospital, and placed under the same direction.

"The second branch of the institution of S. Spirito is that which is devoted to the care of foundlings. A portion of the hospital building, specially constructed for that purpose in the pontificate of Sixtus IV., and restored a few years ago, is large enough to contain about 100 infants and from — to 50 nurses, with all requirements. The total number of foundlings received during the twenty years ended December 31, 1870 was 23,191, of whom 11,437 are males, and 11,754 females. For the ten years 1860-69, the annual average was 1,141 infants admitted, of whom 382 were ascertained to be of illegitimate birth, 300 of legitimate birth, 459 being of uncertain origin. The average annual number of foundlings supported by the establishment was 3,268, and that of the deaths among those of all ages 981. By far the greater number of the infants received are given out to nurse in the country. According to calculations made for a period of twenty-seven years, from 1844 to 1870, the average rate of mortality among foundlings in their first year was 88·78 per cent. for those in the hospital (annual average, 651), and 12·80 per cent. for those in the country (annual average, 2,285), the general average for the whole being 29·64 per cent.

Hospital of St Andrew the Apostle : Genoa :

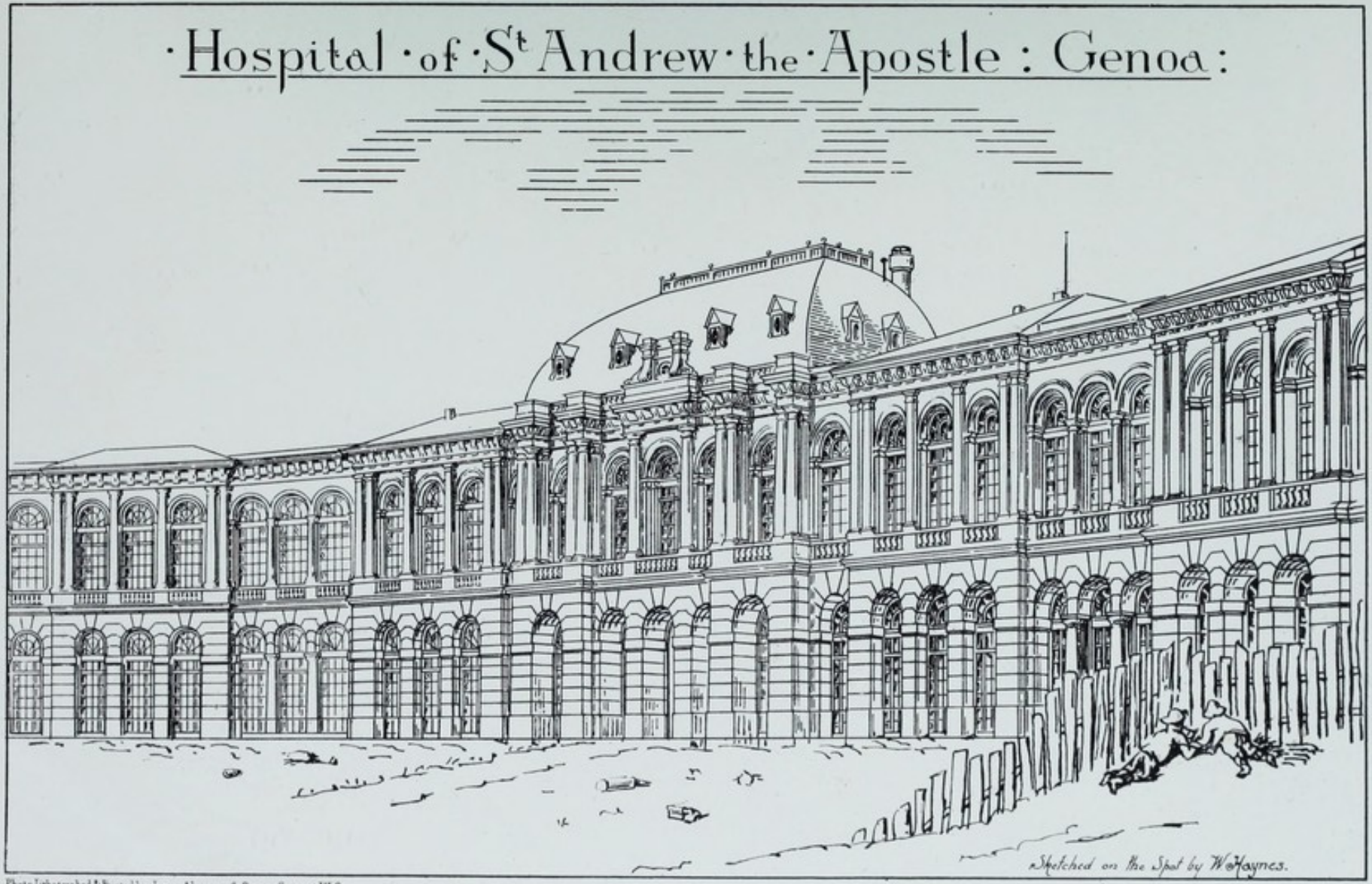


Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

"In connection with the foundling establishment there is what is called a *conservatory* open, where those girls who are not disposed of in marriage, or otherwise, are maintained at the expense of the institution of S. Spirito. To those who marry portions are given at the rate of about 530 francs. Boys, when not adopted, as is frequently the case, by the persons who undertake their care until the age of ten years, are brought up or apprenticed in one way or another, remaining, however, eventually at the charge of the hospital until the age of twenty-one.

"The average annual expenditure incurred on account of foundlings is 305,603 francs.

"The lunatic asylum of S. Spirito contains 669 patients, under the care of a directing physician, a vice-director, 3 medical assistants, and 68 keepers, nurses, &c.

"As already observed, there is a bank annexed to the institution. It was formerly, but has now ceased to be, a source of considerable profit.*

"2. The hospital of the "*SS. Mo Salvatore ad Sancta Sanctorium*," founded by Cardinal John Colonna, in the year 1216, is now reserved for women only. Patients are admitted without distinction of age, condition, nationality, or religion. Their average number is little more than 250, though the hospital would be capable of containing 561 beds. The gross income of the institution amounts to 252,000 francs, and, after deduction of the charges on the property and cost of administration, there remains a net income of 165,000 francs. The daily cost of each patient in 1870 was calculated at 1·80 francs, and that of every attendant at 2·60 francs.

"3. The hospital of *St. James in Augusta*, founded in 1339, in pursuance of the testamentary dispositions of Cardinals James and Peter Colonna. It is principally for ulcers, tumors, and similar affections. Incurable cases are also admitted. It could give accommodation to about 450 patients, but the ordinary number of those treated is about 250. No conditions of nationality, religion, or class are required for admission. The income of the hospital amounts to 228,437 francs.

"4. The united hospitals of *S. Maria in Portico*, founded by Pope Celestin III., towards the end of the twelfth century; *S. Maria delle Granzie*, established by Gregory VI., in 1045; and *S. Maria della Consolazione*, for wounds and other injuries requiring immediate surgical treatment. There is room for 180 beds. The total income is 97,000 francs.

"5. The hospital of *S. Maria and S. Gallicano*, for cutaneous diseases, established by Benedict XIII., in 1726, contains 238 beds. It has a yearly income of 13,975 francs, besides 53,750 francs received from the State (this was under the Pontifical government) as compensation for property confiscated. The cost of every patient is about 2·04 francs a day. The average number of patients is nearly 100.

"6. The convalescent hospital of the Holy Trinity. The average number of persons in it is reckoned at about 95; the maximum being, for men, 120; for women, 60; and the minimum for both men and women, 10.

"The primary object of this foundation, which dates from 1550, was the reception of pilgrims to Rome in years of jubilee under the care of the arch-confraternity of the Holy Trinity. The house destined for that purpose has dormitories capable of accommodating about 500 persons, and refectories where nearly 1,000 can be fed at once.

"Pilgrims seeking the hospitality of the institution were required to prove that they had come from a distance exceeding 60 miles, and for the purpose of visiting the holy places.

"The following statistics of the numbers received in the years of jubilee, from 1575 to 1825, are given by Cardinal Morichini.

Years of Jubilee.	Number of Pilgrims who received Hospitality.	Years of Jubilee.	Number of Pilgrims who received Hospitality.
1575	116,848	1700	300,000
1600	324,600	1725	382,140
1625	852,760	1750	136,513
1650	308,533	1775	99,667
1675	311,777	1825	263,592

"The arch-confraternity of the Holy Trinity, when first approved by Pope Pius IV., had only 15 ducats a year of its own, and made up what was wanted by collecting alms. It now has an income of 174,976 francs, and the annual expenditure of the whole institution is reckoned at 172,300 francs.

* "The above account of S. Spirito is principally taken from an interesting report on the management of the institution, by its director, Dr. Pantaleoni. The statements which follow, concerning other hospitals and charitable institutions generally at Rome, are extracted from Cardinal Morichini's work, already noticed."

"7. The lying-in hospital of S. Rocco has an income of 23,377 francs. The principle of the institution is the observance of absolute secrecy. Any pregnant women are admitted without inquiring as to name or condition. Those who are not considered as poor pay a small sum monthly, when, as is frequently the case, they come into the hospital for the purpose of concealment a long time before delivery.

"8. The hospital of St. John Calibita, commonly called "*dei Benfratelli*," for acute cases of disease, was founded in 1581 by the monks of the Order of *S. Giovanni di Dio*, popularly designated as the "*Fate bene fratelli*." This Order has the entire management of the hospital, and, with the exception of the principal physician and surgeon, all the persons employed are members of it. As a rule, patients are admitted only on the recommendation of a benefactor of the institution. The average number under treatment is about 40.

"In 1867 the receipts, a considerable proportion of which was derived from the sale of medicines prepared in the pharmacy of the establishment, amounted to 75,000 francs, and the expenditure for the hospital, and the maintenance of the brethren attached to it, amounted to 53,750 francs, the remainder being applied to repairs, charges of administration, &c. At the beginning of that year there were 50 patients in hospital; 919 were admitted in the course of the year, 59 died, and 865 went out. The daily cost of every patient was 1·50 francs.

"9. A special hospital for poor priests, founded in the seventeenth century by a certain Giovanni Antonio Vestri.

"10. The hospital of *S. Francesca Romana*, for chronic affections, founded by the will of the late Cavaliere Carlo Doria Pamphily, was opened in 1860. To be qualified for admission patients must be Romans domiciled in the city, who are incapacitated for work by chronic maladies, and who cannot be received into other hospitals. Persons suffering from cutaneous diseases are excluded.

"11. A room for the treatment of eye diseases, established by Prince Torlonia.

"12. Of the great number of special hospitals for particular guilds and nations, or provinces, which formerly existed in Rome there remain only two of the former category—a hospital for apothecaries or druggists, and a hospital for bakers; and one of the second category—the Spanish hospital, founded in 1350 by two ladies of Barcelona, and the endowment of which was augmented by Charles V."

Little addition has been made to the number of hospitals in Rome since the above account was written, but it may be expected that before long a building will be erected outvying anything of the kind yet attempted in Italy. Plans are now being considered for the erection of an establishment to contain from 450 to 500 patients, at a cost of £320,000 (eight million lire), or from £640 to £711 per bed. The site chosen lies between Via le Manzoni and Porta Maggiore, and will extend from Via le Principessa Margherita on the north-east to Via Conte Verde on the south-west. A large project is likewise on foot for the erection of a combined workhouse and hospital, "Ospizio di Carita," at Turin, which, if carried out, will contain accommodation for 1,600 inmates, with hospital accommodation for 400. Designs for this establishment have been prepared by the architect, Signor P. Carrera. The hospital wards appear by the plans to be disposed in six T-shaped blocks, each two storeys in height, the wards being placed in the extremities of each of the three arms, and the offices at the junctions of them. The arrangement is very compact, and, although by no means perfect, might, with slight modifications, be made to conform with modern principles. A full description of the details of the proposed building, together with plans, are contained in a memoir presented by Signors L. Pagliani and P. Carrera to the Royal Italian Society of Hygiene, and published in its journal.*

The only hospital in Italy known to have been planned in accordance with modern principles is the one now to be described. The architect, Signor Cesare Parodi, before

* *Giornale della Reale Societa Italiana D'Igiene*. Milan. 1883.

preparing his design, tells us that he made an especial study of the plans of the following hospitals: Lariboisière, Hôtel Dieu, St. Louis and Bourges in France; The Woolwich Military, Royal Free, King's College, Blackburn and Netley Hospitals in England; Boston Hospital in America; and the Grand Hospital of Milan.*

Signor Parodi has been so good as to give me much valuable information as to the general characteristics of this building and also a block-plan of it, but, as he declined on any consideration whatever to let me have a detailed plan and section of one of the pavilions, it has been necessary for me to send over and have the accompanying sketch of the principal front taken upon the spot, and the detailed plan and section at page 233 measured.

The building has been erected by the order and at the expense of the Duchessa de Galliera, and it was intended to have been completed by the year 1884, but the Duchessa's agent is said to have robbed her of a very large sum of money, and the progress of the building was, therefore, delayed. The carcase and much of the internal finishing were complete at the time it was visited.

Signor Parodi is, so far, much contented with the result of his labours, and he assures me that the building even now attracts a continuous stream of visitors, students of hygiene, architects, engineers, and artists, to say nothing of tourists, who are drawn from all quarters by eulogistic descriptions in the guide books.†

Architectural and artistic effect appears to have been studied in the design of all parts of the building. The entrance hall, Signor Parodi tells me, is to be embellished "with frescoes from the skilful hand of Giuseppi Isola," and the frescoes on the inside of the arched ceiling of the chapel are being "executed by another highly distinguished artist, the Chevalier Niccolo Barabino, a name famous for the magnificent works of art executed by him in that pure and classical style which calls to mind the days of Raphael," whilst "the architectural decoration, designed in the classic style, breathes the spirit of Galeazzo Alessi, the architect of the Basilica of Carignano and so many other of the ancient palaces that enrich Genoa."

Site.—The ground upon which the buildings stand was presented by the city authorities. It is in the district of Carignano, the highest part of the town, and just within the south-east angle of the city walls. The extent of the site is about 538,750 superficial feet, being 12 acres 1 rood 18 perches, or nearly 1,259 superficial feet per bed.

Subsoil.—The foundations of the building are carried down to a bed of solid rock.

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* Politecnico. Giorn. dell' Ing. Arch. Civ. ed Industr. Anno, 28.

† "Oramai quest' opera attira a se continuamente innumerevoli visitatori, studenti, sanitarii, architetti, ingegneri, artisti. Achne la schiera dei turristi vi accorre perchè trovasi gia consegnata nelle guide. Sotto il punto di vista artistico il *Courier de l'Art* che si stampa a Parigi, nel suo numero del 4 Ottobre 1883, si esprimeva in questi termini. 'Les travaux extérieurs de l'immense hôpital monumental dont l'inépuisable charité de Mme. la Duchessa de Galliera a doté la ville de Gènes sont entièrement terminés. Cette énorme construction, élevée dans la situation la plus salubre sur les hauteurs de Carignano qui dominent presque toute la ville, fait le plus grand honneur à l'architecte, M. Parodi, qui n'a pas moins intelligemment combiné les dispositions intérieures auxquelles on travaille sans relâche; aussi compte-t-on que l'inauguration pourra avoir lieu au commencement de l'année 1885.'"—*Extract from letter of Signor Cesare Parodi.*

General Arrangement.—The pavilions containing the principal sick wards are seven in number, and on plan they radiate from a front connecting corridor, which, on plan, forms the segment of a circle.

The principal entrance to the establishment is placed in the centre of block A on the plan of site. This building is four storeys in height, and contains the principal administrative offices, including a large and handsome hall and staircase, a council chamber, and apartments for the use of the manager, sub-manager, house-surgeon, and others of the principal officers. In the rear there is an annexe, two storeys in height, for use as receiving wards, with three rooms on each floor for 6 patients each, and examination and bath rooms and other offices adjoining.

The central pavilion, block B, contains, on the basement floor, the kitchen and general dining hall, also the boiler and engine room, and machinery for ventilating and heating. The ground floor contains sick wards for 24 patients, but these are only to be used on emergencies and when the ordinary wards are full. On the first floor is a chapel, with a library and residence for the chaplain, also apartments for the sisterhood in the rear, for whose use a gallery is provided at the back of the altar, and screened from it by iron grills.

The principal sick wards are situated in the six pavilions, C, D, E, F, H, J, to the right and left of the central building last described. They are each two storeys in height above the basement and contain, on each floor, a large ward for 20 patients and four separate wards for 1 patient each. The attics of these buildings will be available as apartments for the domestics and other officers of the establishment not provided for elsewhere. The basements, which are partially above the ground level, are variously occupied—that of block C is devoted to the out-patients' department; block D contains the dispensary, laboratory and drug stores; block E is fitted up as a general store room; block F is a linen and clothing store room; block H is the general bathing department of the establishment, for use by both sexes, but approached by separate corridors and entrances; block J is similarly arranged, but with all the usual appliances for the hydropathic treatment of patients.

Block K forms a corresponding wing to the entrance; block A contains operation rooms and a lecture theatre, also apartments for students and other usual arrangements for academical purposes.

Block L, one storey in height, is the mortuary, post-mortem room, and anatomical museum.

Block M is the wash-house and laundry, which it is intended shall be fitted with washing and wringing machinery worked by steam, and with the latest improvements.

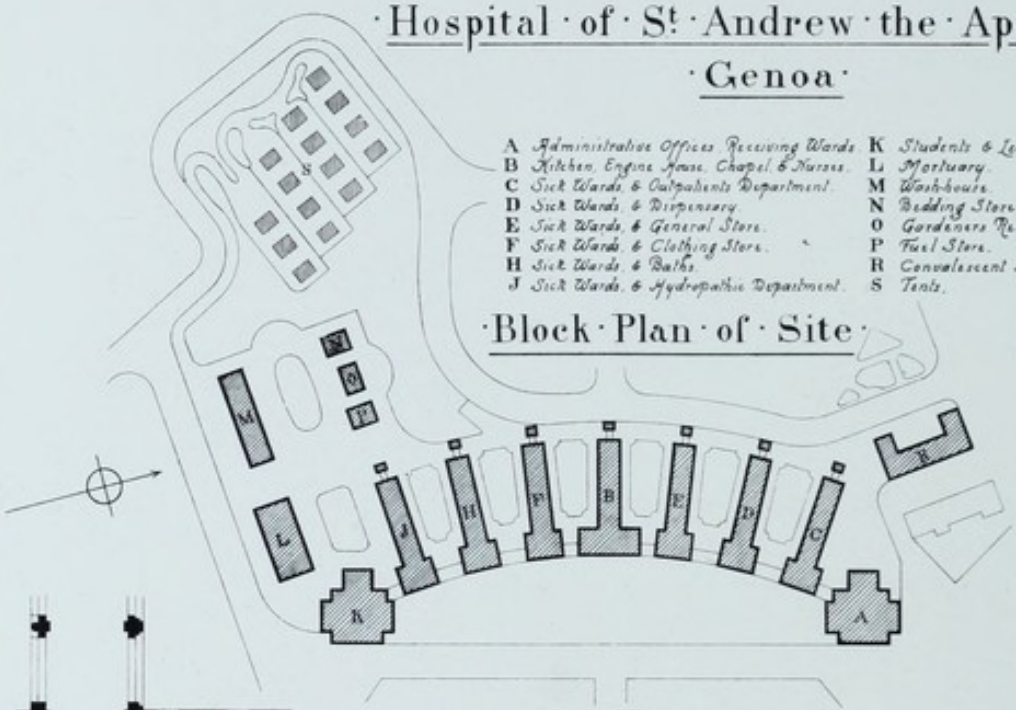
Block N is the mattress department; block O is the gardener's residence; block P a fuel store; and block R a convalescent home, five storeys in height, for the accommodation of 80 paying patients.

The space marked S is intended for the erection of tents for the occupation of patients during warm weather.

Hospital of St. Andrew the Apostle Genoa

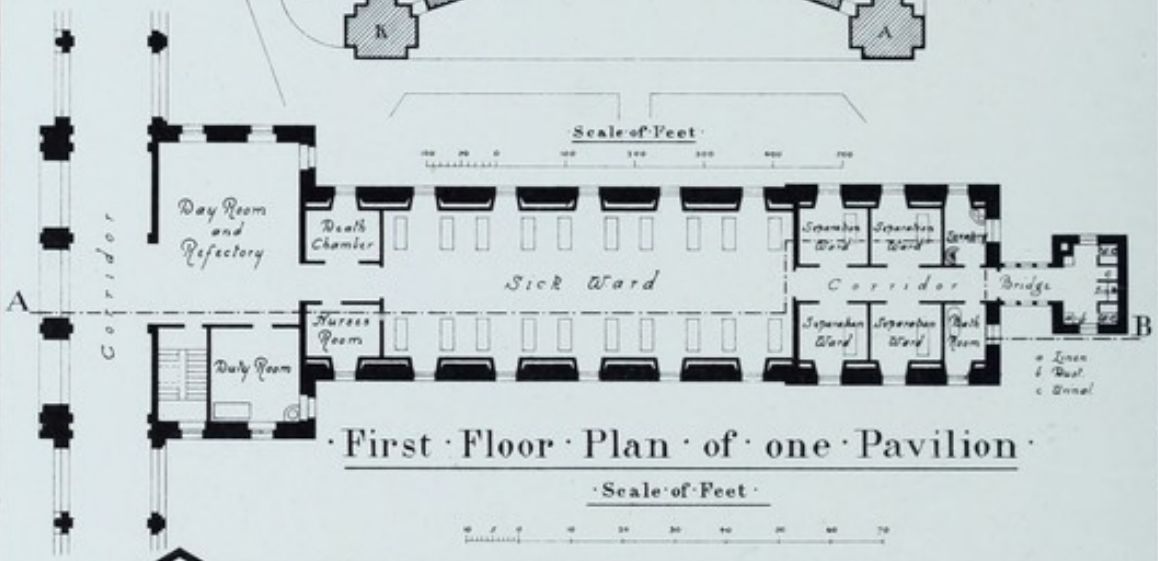
A Administrative Offices, Receiving Wards.
B Kitchen, Engine House, Chapel & Nurses.
C Sick Wards, & Outpatients Department.
D Sick Wards, & Dispensary.
E Sick Wards, & General Store.
F Sick Wards, & Clothing Store.
H Sick Wards, & Baths.
J Sick Wards, & Hydropathic Department.
K Students & Lecture Theatre.
L Mortuary.
M Wash-house.
N Bedding Store.
O Gardeners Residence.
P Fuel Store.
R Convalescent Home.
S Tents.

Block Plan of Site



First Floor Plan of one Pavilion

Scale of Feet



Longitudinal Section A.B

Scale of Feet

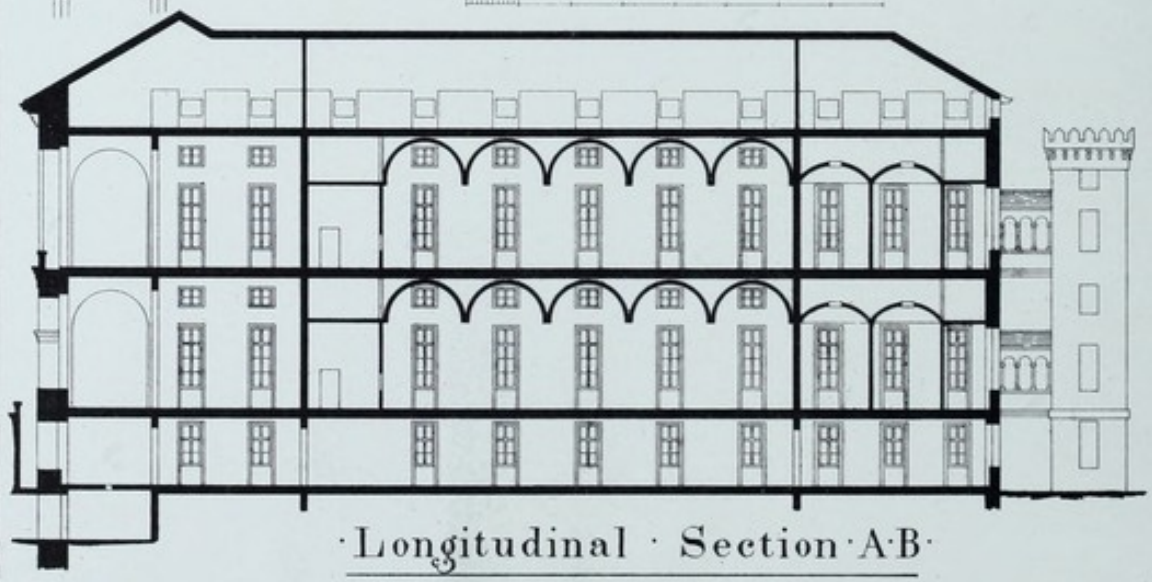


Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

Total Accommodation.—Provision is thus shewn to have been made for the accommodation of 428 patients, viz. :—

Twelve wards, in blocks C, D, E, F, H, J, for 20 patients each			20
Forty-eight	do.	do. do.	48
Six	do.	A, for 6 patients each...	3
Reserve	do.	B	24
Convalescents	do.	R	80
		Total	428

Connecting Corridors.—The main corridors, connecting together the seven pavilion blocks, are two storeys in height, and they each are 16 feet wide and 25 feet high. They are lighted on either side by French casement windows, and are intended to be used as ambulatories by the patients.

Water Supply.—The generous founder of this establishment, the Duchessa de Galleria, has likewise with equal liberality had a water conduit constructed at her expense for the benefit of the town, and this will also supply the hospital building. A well has likewise been sunk, the water from which will be used for certain purposes.

Drainage.—It is stated that the drains are formed of stone cemented upon the inside, and that they are carried away from the building on the western side and into the sea.

Area Covered.—The area covered by buildings is about 112,553 feet, being rather more than one-fifth of the site, or 263 superficial feet per bed.

Cost.—It is estimated that the value of the land is £60,000 (1½ million lire), or £140 per bed, and £4,853 7*s.* 9*d.* per acre. The cost of the buildings, Signor Cesare Parodi informs me, will not exceed £280,000 (7 million lire), or £654 per bed; so that the total cost of both land and building will be £794 per bed.

Principal Sick Wards.

The principal sick wards of this building are shewn in detail on the accompanying plate.

Aspect.—The axis of the central pavilion runs W. by N. to E. by S., so that the windows of the wards face S. by W. and N. by E.; the axes of the other pavilions change until at the two extreme ends they run respectively from W. by S. to E. by N. and N.W. to S.E.

Relative Position of Pavilions.—The height of the pavilions, as measured from the lower floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is about 61 feet, and the average distance between each pavilion is 76 feet or about 1¼ times the height.

Size of Wards.—Each of the large sick wards is of parallelogram shape, will accommodate 20 beds, and is 79 feet long and 28 feet wide. The total superficial floor space is, therefore, 2,212 feet, or 110 feet per bed, and the cubical contents 50,876 feet, or 2,544 feet per bed. The window recesses are, however, unusually deep, and if this were taken into account the contents as above stated would be somewhat increased.

Bed Space.—The average lineal wall space per bed is $7\frac{8}{10}$ feet per bed.

Windows.—Each side wall has five large folding casements and above each one is another smaller window hung on centres; the total area of their effective glazed surface

is 435 feet, or about 22 feet per bed, and when all are opened to their fullest extent the area through which air can be admitted by them into the wards is 573 feet, or 28⅔ feet per bed. All windows are fitted with outside jalousie blinds.

Warming and Ventilation.—The system of heating is said to be that by which air is forced into the various wards through flues radiating from a sub-basement in the central pavilion, and there the air is passed over pipes heated by the circulation of hot water; the flues as they reach the pavilions are carried upwards in the side walls and find an outlet under the heads of the beds and at the floor level; the openings, which are 9 inches square, are fitted with dampers to control the admission of heated air. In warm weather fresh air is also brought into the wards in a similar manner; but it was not apparent whether the same flues answered this purpose. The extraction of fresh air is said to be provided for by a fan fixed in the roof over each pavilion and communicating with the wards by means of openings, 6 inches square, over each bed, and flues running up the side walls and horizontally through the roof. The arrangements for lighting were not completed when the building was visited.

Floors.—Iron joists and concrete are used in the construction of the flooring, and the surface is finished with polished marble slabs; the ceiling over each pair of beds is vault-shaped, and is supported entirely independently of the floor, in order, it is said, that if the physicians should be at any time of opinion that disease germs have permeated the plaster, these ceilings could readily be removed and danger averted.

Walls.—The walls are constructed of brickwork, and finished on the outside with cement; they are about 4 feet 6 inches thick, and consist of an outer wall, 3 feet 3 inches thick, then a space of 10 inches, and lastly, a half-brick casing, which, like the ceiling, is made capable of removal whenever thought necessary. The inner faces of the walls are plastered.

Baths, W.C.'s, &c.—The water-closets and other like sanitary offices are placed in towers, at a distance of 10 feet from the end of each pavilion, to which they are connected on each floor by means of glazed covered bridges, similarly to those of the Antwerp Hospital, described at page 85. Each turret has two water-closets, 3 feet 9 inches long and 3 feet 3 inches wide, fitted with white earthenware pans and wainscoat seats; and there is besides an urinal fitted with a treadle for flushing, a stoneware slop-sink, 18 inches long and 12 inches wide, with marble slab, 4 feet long and 2 feet 6 inches wide, and, over the same, a dust and a linen shoot. The bath rooms are entered from the corridors running from the ends of the large wards to the tower bridges; they are 11 feet long and 8 feet wide, and are fitted with marble baths.

The lavatories are of the same size as the bath rooms, and are placed on the opposite side of the corridor. They are each fitted with two "tip-up" earthenware basins, and in one corner of the room there is a small spiral staircase, descending to the basement, for the use of the attendants.

Day Rooms.—The day room adjoins the connecting corridor, and forms an entrance hall to each pavilion ward. It has an area of 938 feet, or about 46 superficial feet per patient occupying the large ward.

Separation Ward.—Entered from the end of the large ward is a corridor leading to the end tower, and on either side of this corridor there are two rooms (four in all) each of which is devoted to the use of one patient. Each room has an area of 161 superficial and 2,898 cubic feet.

Duty Room.—The nurses' duty room is entered from the day room. It has an area of 310 feet and is fitted with a marble sink and gas cooking range.

Nurses' Room.—Adjoining and overlooking the large ward is a nurses' or sisters' room, having an area of 160 feet.

Death Chamber.—On the opposite side of the passageway giving access to the ward, and of similar size to the nurses' room, there is a room called "the death chamber"; it would appear to be provided for the separation of the recently dead or dying from the patients occupying the adjoining ward.

Staircase.—Leading out of the day room, and adjoining the connecting corridor, there is a staircase covering an area of 175 feet. The steps are of marble, 13 inches wide, 6½ inches high, and 4 feet in length.

Lift.—There is to be but one lift, and this will be placed in the central pavilion B adjoining the connecting corridor. It will be 7 feet long and 6 feet 6 inches wide, but had not been erected when the building was visited.

Basements.—The basement floors are 13 feet high, and are occupied for the various purposes enumerated at page 232.

Area of Pavilions.—The total area occupied by each pavilion floor, including the outer walls, is 8,419 feet, or nearly 351 superficial feet per bed.

RIGA TOWN HOSPITAL.

RUSSIA.

THERE does not appear to be any general law for the government of the poor of Russia, nor for the regulation of its hospitals. The inhabitants of each town of the Baltic provinces frame rules for their own guidance, and the ordinances under which the rural parishes of this part of the Empire are, in this respect, governed is related by the following extracts from a report made to our Government by Mr. J. Grigurn, H.M.'s Consul at Riga :—

"It is the duty of every parish to support its orphans, foundlings, and children of tender age and unfit for employment, as well as all parishioners who are unable to support themselves on account of old age or sickness, as also those who have no relations of any kind, or who, if they exist, are not in a condition to render assistance. Such persons must, however, be natives of the parish or have resided in it for a period of 15 years. The parish is likewise responsible that medical attendance is given to poor sick members. Finally, the parish is bound to support all insane persons belonging to it out of its own funds, and to afford them all necessary protection. Should, however, a greater number of insane persons be thrown upon the parish than it is in its power to support, it has a right to apply, through the parish court, for an order from the governor of the province that they shall be received into an institution for the assistance of the poor, with or without payment, as the case may be. To the poor wives of recruits and their minor children the parish is bound to allow, in addition to free lodging and fuel, at least 20 quarts of rye or oatmeal monthly for the wife and half that amount for each child. The parish police is also bound to take care that the children of recruits receive free lessons in the parish school, and that the persons charged to look after the interests of the mother shall be proper persons.

"A nominal list is to be made out by the parish police each year of all poor and sick persons requiring aid, fixing, according to circumstances, the amount of allowance for each person in need. This statement is to be laid before the parish committee for preliminary inspection and approval. Should any change be made in the amount of assistance proposed, such change must receive the especial approval of the committee.

"All members of the parish able to work who have repeatedly come on the parish for support, as well as those who have not fulfilled their parish duties during two years, are placed under the special surveillance of the district police. It is the duty of that police to bring these persons before the parish court, which will sentence them to work out their debt by a period of service on public works, either in or out of the parish.

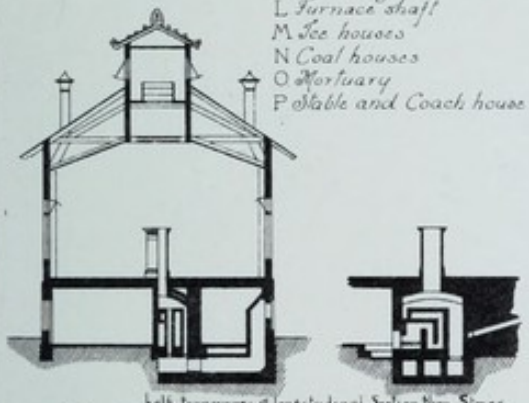
"To cover the charges to which a parish is liable it can have recourse—To the poor funds of the parish, where such funds exist; to the income arising from the produce of land rented or bought by the parish for the use of the poor; to voluntary gifts; to the interest paid on advances made out of the stock magazines. All persons receiving loans from the magazines of grain which exist in each parish pay interest, never more than six per cent., on the value of such loans; to general collections, to be made in each parish every year on the Sunday before Michaelmas Day by persons specially authorised for that purpose by the parish committee; to monies allowed for that purpose out of the general parish funds.

"Should these funds not suffice, the parish court may lay on an extraordinary tax, distributed among farmers according to their rent, and farm servants according to their wages. The sum to be levied must, however, be fixed by the parish at a parish meeting, and must be approved of by the district police. The parish committee controls all parish capital, and other parish property. This committee fixes the amount of the contributions to cover the parish expenditure, and decides the manner in which the necessary sum shall be raised.

"A manager of the poor, called a 'parish warden,' is chosen annually by the parish, subject to the approval of the district police, who, in conjunction with the parish court, have under their care the distribution of all money. The managers of the poor or the parish court must account quarterly to the

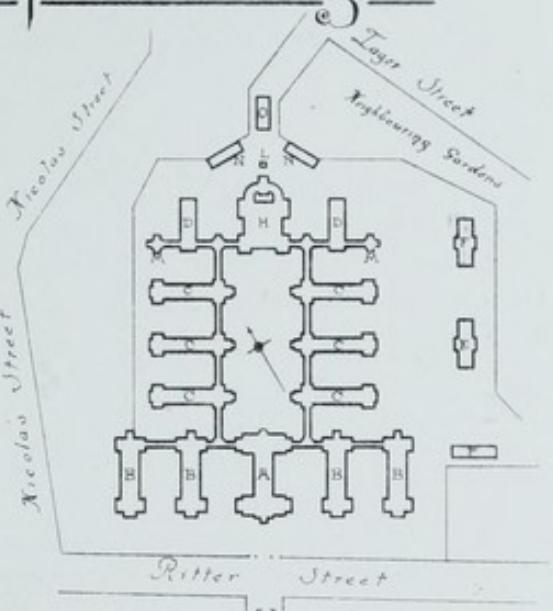
· Town · Hospital · Riga ·

A. Administrative building
B. Pavilions Two stories high
C. do One story high
D. Venereal diseases
E. Lying-in Wards
F. Small Pox Wards
H. Kitchen offices Wash house and Engine house
L. Furnace shaft
M. Ice houses
N. Coal houses
O. Mortuary
P. Stable and Coach house

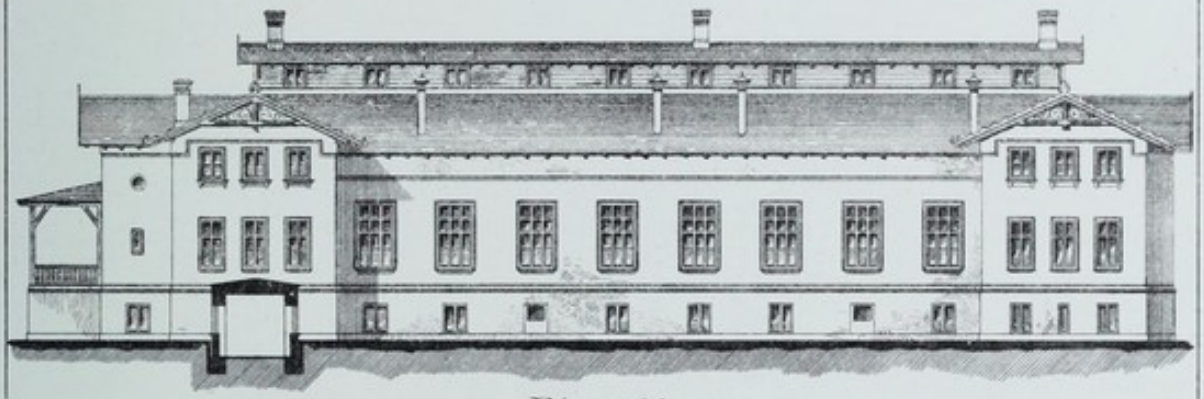


half transverse & longitudinal Section thro Stores

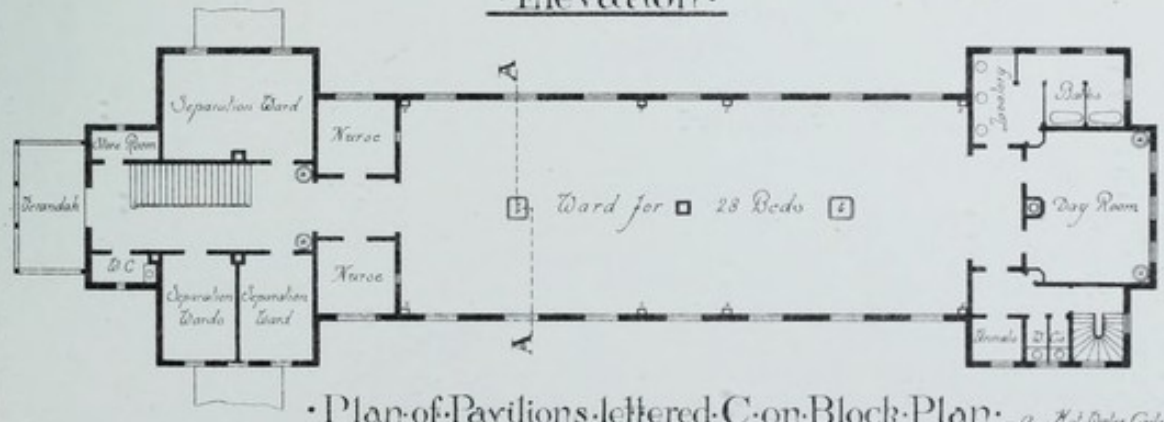
· Section · A.A ·



· Block · Plan ·



· Elevation ·



· Plan of Pavilions lettered C on Block Plan ·

a. Hot Water Coils
b. Rooms over Inlet Pedestals
c. Extraction Shafts

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

district police for all receipts and expenditures. Should the members of a parish court resign, they must give an account to the whole parish of the distribution of the poor money.

"When a parishioner becomes distressed in consequence of his own neglect or laziness, the parish committee has a right to place him, by agreement, with a farmer, with whom he may work to support himself.

"In the town of Riga a tax is laid annually by the alderman charged with that duty on owners of property within the city limits, and also on burghers of the city not holding landed estate, each one being assessed according to his means, real or supposed. The tax thus raised is supplemented by gifts from the general city funds, and by voluntary contributions, and the funds thus supplied prove amply sufficient for the support of the city poor. Officers are chosen from time to time for the supervision and government of the poor. None of these officers are paid.

"I am informed that a similar system exists in all towns of any consideration within the provinces of Livonia and Bourland. The officers referred to are appointed for each district into which the town is divided, and their numbers are calculated upon the number of poor to be relieved in the district. The officers are supplied monthly with sums of money for distribution to the regular pensioners of their respective districts. They are, at the same time, empowered to administer relief in all cases of necessity, reporting the fact to the central committee. The ministers of the several churches also bring to the notice of the committee all cases of destitution arising within their several districts. The amount given to a destitute person ranges from 3 k. to 9 k. monthly according to circumstances, and fuel is also given during the winter months. I do not find that any other relief is given in kind. Refractory paupers, those able but unwilling to work, are sent to an institution where they are compelled to labour on the public account. This institution is not yet self-supporting. All deficiencies are made up out of the general city funds."

LIST OF RIGA HOSPITALS.

Name of Institution.	Founded.	How Supported.	Persons Employed.			Number of Patients received in			
			Doctors.	Midwives.	Attendants.	Winter.	Spring.	Summer.	Autumn.
Alexandershöhe Sick Hospital	1835	By Crown gifts and by payments by patients	1	—	9	129	139	110	101
Do. Insane Hospital	1824	Ditto, ditto	1	—	11	12	18	16	14
Town Poor Hospital and Lying-in Institution	1803	By money from Poor Directory and payment by patients	5	1	25	798	587	481	509
Private Insane Institution at Rothenberg	1862	Private funds	2	—	18	6	12	18	11
Hospital for Diseases of the Eye	1868	By interest on capital and patients' payments	2	—	4	89	155	100	96
Hospital for Skin and other Disease	1867	By payment by patients	1	—	14	18	30	49	17
Seamen's Hospital ...	—	By tax on vessels and payment by patients	2	—	1	7	46	79	55

The Town Hospital referred to in the above list has been rebuilt in accordance with the plan shewn at page 236, prepared by the architect, M. Felsko, of Riga. The foundation stone was laid in the summer of 1870, and the building taken into occupation in the summer of 1873. The plans of the pavilions are avowedly based upon those of the Friedrichshain Hospital, at Berlin, illustrated at page 116, but difference of climate has necessarily caused modifications in some of the details.

Site.—The buildings are erected upon a site adjoining that of the old hospital, this being the highest part of the "Dünenzuge," in the St. Petersburg suburb of the city; it is surrounded by gardens, and is open to the sea breezes. The extent of the site is stated to be 465,500 superficial feet (9,500 square faden), or 10 acres 2 roods 29 perches.

General Arrangement.—The general arrangement of the buildings upon the site is shewn upon the block-plan, and will be seen to consist of a central, or entrance, block, A, containing the general administration offices. Branching off from the rear of and on either side of this building are corridors leading directly to four pavilions (blocks B), two storeys in height, and then two other corridors running at right angles give access to six other pavilions (blocks C), one storey only in height. A further continuation of these corridors leads to two pavilions (blocks D), also one storey in height, and intended for the accommodation of syphilitic patients, and to block H, containing the kitchen offices, laundry and engine-house. Two ice-houses (blocks M) are situated at the extremities of the corridors. Blocks N N are coal-houses. Block O is a mortuary, and block P a coach-house. Block E is the lying-in wards, and block F the small-pox wards. No information is available as to the total accommodation afforded by the various blocks of buildings.

Connecting Corridors.—Unlike its prototype at Berlin, the various blocks of buildings in this establishment are connected by enclosed corridors, the climate being considered too severe to allow of open air communication; the lying-in wards are, however, entirely detached. In order that the corridors shall not impede the light and air around the buildings they are partially sunk below the level of the outside ground, and their upper parts are about on a line with the floors of the wards; they are 8 feet wide and 9 feet high.

Water Supply.—The establishment is supplied by the town with water taken from wells and from the river Dwina, but it is in contemplation to erect a pumping apparatus and raise the water from the numerous springs that run close to the site of the hospital.

Area Covered.—The total area covered by buildings is, as nearly as can be ascertained, 106,607 feet, or about one-quarter.

Cost.—There is no available information as to the actual cost of the various structures, but it was estimated, in the first instance, that the buildings, if erected for 400 patients, would cost £58,125 (450,000 roubles), or about £146 per bed.

Principal Sick Wards.

The following description refers more particularly to the pavilions marked C upon the plan of site, and to the detailed plan upon the accompanying plate.

Aspect.—The axes of the pavilions run from N.W. by N. to S.E. by S., so that the windows of the wards face S.W. by W. and N.E. by E. The front pavilions, marked B upon the block-plan, run in an exactly opposite direction.

Relative Position of Pavilions.—The height of the pavilions, as measured from the lower floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 19 feet, and the distance between the outer walls of the large wards of each pavilion is 65 feet, or about 3½ times the height.

Size of Wards.—Each ward is of parallelogram shape, contains 28 beds, and is 80 feet long, 30 feet wide, and 17 feet 9 inches average height. The total superficial floor space is, therefore, 2,400 feet, or 86 feet per bed, and the cubic contents 42,600 feet, or 1,522 feet per bed.

Bed Space.—The average lineal wall space per bed is 5 feet 8½ inches.

Warming.—A double system of warming has been adopted. All parts, including the corridors, are heated by means of hot-water circulating pipes passing round the various walls, and, in certain places, through coils, but, in addition to this, the large wards are each provided with powerful furnaces, situated in the basement, and the heat from these discharges itself directly into the ward above through pedestals constructed of white china tiles.

Ventilation.—During summer-time the ventilation of the wards is principally effected by means of the windows and by the openings in the roof and lantern, but in winter all such apertures have to be kept entirely closed, and then the supply of fresh air is principally dependant upon that drawn through the calorifers situated in the basement beneath the large wards, whilst the outlets are confined to a few small tubes carried upwards into the outer air, and covered with conical caps. The flow of air in these tubes is controlled by means of valves, so, it is probable, that in practice little or no ventilation is actually obtained in the winter-time. "But then," says Dr. C. Waldhauer in reference to this hospital, "absurd as it seems to say so, yet it is a fact that our people can better put up with foul air, than they can with a cold room." The results of experimental trials of the heating and ventilation of the large wards were satisfactory to the authorities, but the smaller wards and offices were considered to require improvement.

Walls.—The walls, as is usual in this country, are built of wood, the framework being filled in with double upright planks, separated by a thickness of felt; another thickness of this material is laid upon the outside, and forms the groundwork for a layer of plain tiles ("Bieberschwaüze"); the whole is then washed over with a thick preparation of lime, which gives it the appearance of being a stone building, and is stated to be a preservative not only against decay but fire.

W.C.'s, Baths, &c.—The arrangement of the baths, water-closets, and lavatories is almost precisely similar to that of the Freidrichshain Hospital, at Berlin, excepting that they are better separated from each other by means of partitions.

Day Room.—At the end of the large ward, and entered from it by glazed doors on either side of the fireplace, there is a day room, 21 feet long and 17 feet extreme width. The area of this room is 357 feet, after allowing for irregularities in plan, and so each patient occupying the adjoining large ward is provided with 13 superficial feet.

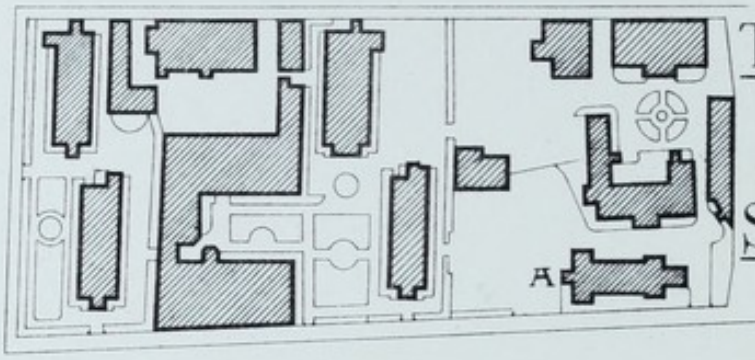
Verandah.—At the end of the pavilion, opposite to the day room, there is a verandah, 17 feet 6 inches long and 9 feet 3 inches wide, upon which beds may be wheeled in fine weather, either with or without the patients on them, as the nature of their cases determine.

Separation Wards.—Each pavilion has three separation wards; two of them are each 15 feet long, 10 feet wide, and apparently 12 feet high, and they contain 1 patient each; the other is 21 feet long, 15 feet wide, and will accommodate 2 patients. The space allowed, therefore, to each patient is respectively 150 and 157 superficial, and 1,800 and 1,890 cubic feet.

Duty and Nurses' Rooms.—Two rooms, adjoining and overlooking the large wards, are devoted to the use of the nurses—one as a sleeping and sitting room, and the other as a day room; each is 11 feet long and 10 feet wide, or 110 superficial feet.

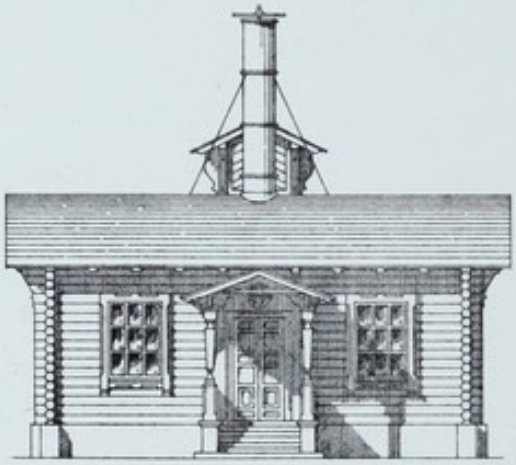
Basement.—The walls are carried down to form a basement, 8 feet high, which may be closed in in the winter time and opened in summer. It contains two large calorifers for warming the wards above, and is itself kept warm by means of hot-water pipes and coils.

Area.—The total area, including the outer walls, covered by the ground floor of each of these pavilions is 5,293 feet, or 165 feet per bed; but if the verandah be included the area is 5,483 feet, or 171 feet per bed.



The Nativity Hospital St. Petersburg

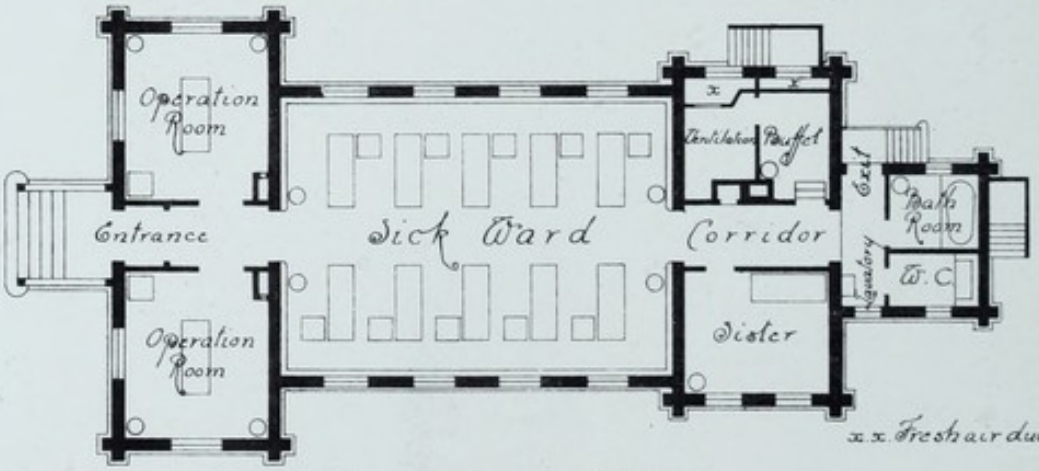
Plan of Site



End Elevation



Section on Line A.B



Ground Plan

Scale of Feet

Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

NATIVITY HOSPITAL.

ST. PETERSBURG, RUSSIA.

THIS establishment has been in existence for very many years, and the original buildings are, as might be supposed, badly planned. The site, however, is extensive, and many modern additions have consequently been made in the shape of huts, or one-storied pavilions. It is proposed to confine this description to the last erected hut, marked A upon the accompanying plan of the site; this, presumably, representing the latest opinions of experts in this part of the world upon the subject of hospital construction.

The idea of erecting the building in question arose out of an attempt upon the part of the members of the Society of St. Petersburg Architects to devise, during the time of the late Turco-Russian war, a feasible plan for the construction of hospital huts for wounded and sick soldiers, easily transportable from one part of the country to another. It does not, however, appear to have been found practicable to design a structure the outer coverings of which should be sufficiently impervious to the intense cold of the Russian climate and, at the same time, be capable of easy removal and reconstruction, and so the project was abandoned. During the time, however, that the question was under consideration subscriptions had been flowing in from various quarters, and it was, therefore, determined to expend the money so received in adding another pavilion to those already existing at the Nativity Hospital.

The institution appears to be administered by a body designated as the Ladies Lazareth Committee ("Damskiy Lazararetniy Kommitet"), and, accordingly, the arrangements of this and all other buildings are subject to the consideration of that body before adoption. The architect, N. K. Reisman, also benefitted by the advice of his brother associates and the more active co-operation of one of the honorary members of the Society, F. S. Kittner. Dr. Balaudin also gave much time and consideration to the perfection of many of the details of the structure. The erection of the building was commenced early in the year 1877, and was ready for occupation by the end of January in the following year.

Site.—The establishment is situated at Sands, a suburb of St. Petersburg, and the main entrance front faces Grechesskiy Prospect.

Cost.—From the following account of the sums expended in the erection of the building in question it will be seen that the total cost of it was £1,560 (14,976 roubles),*

* The relative value of the Russian rouble continually varies. In 1877 the average value was two shillings and a penny.

or £111 for each of the 14 patients that the building accommodates. The furniture and linen cost £112 (1,077 roubles), or £8 per patient.

	£	s.	d.
Excavator	35	1	5
Mason	153	3	6
Carpenter	449	8	11
Roofing	45	8	6
Joiner	36	17	6
Ironmongery, felt, &c.	28	10	11
Painter and glazier	43	12	0
Carried forward	£792	2	9

	£	s.	d.
Brought forward	792	2	9
Heating and ventilation	563	4	9
Locksmith and like appurtenances ...	26	13	0
Water supply	86	12	7
Asphalting	40	2	4
Various expenses during construction	51	4	8
Total	£1,560	0	1

Charitable gifts in Russia are more often made in kind than in money, and in this case we are told that the total cost of the building and furniture was paid for as follows, viz.:—

	£	s.	d.
By gifts of money	590	12	2¼
By labor and materials and assistance given or paid for by various architects and tradesmen	579	13	11¾
Carried forward ...	£1,170	6	2

	£	s.	d.
Brought forward	1,170	6	2
By extra discounts allowed by tradesmen off their accounts	374	2	5
Not classified	127	16	3
Total	£1,672	4	10

Principal Sick Wards.

The building about to be more particularly described is marked A upon the block-plan of the site at page 241 ; a detailed plan, section, and elevation are also illustrated.

Size of Wards.—The large sick ward is of parallelogram shape, contains 10 beds, and is 37 feet 6 inches long, 26 feet 6 inches wide, and 18 feet average height, exclusive of the lantern, which runs the whole length of the room and is 5 feet 6 inches wide and high. The space allotted, therefore, to each patient is 99 superficial and 1,902 cubic feet. During war time the number of beds in each ward is increased to 12.

Bed Space.—The average lineal wall space per bed is 7 feet 6 inches.

Windows.—Each side wall is pierced by four double casement windows, and the lantern has also nine double windows on each side of it. Six of these are hung on their lower and upper rails alternately, and are made to open inwards or outwards by means of continuous rods and double levers acted upon by ropes falling downwards at either end.

Warming and Ventilation.—The system of warming is that of hot-water circulation through iron pipes running to and from a furnace in the basement, round the walls of all the rooms and passages. The heater is situated beneath the ventilation room, and in consequence of the proximity of the water level to the surface of the ground it has been necessary to sink the furnace within an iron caisson. The smoke flue passes through a tile-lined ventilating shaft, which, when the fire is lighted, becomes heated, and draws the foul air out of the various rooms through tubes running from them into the shaft. In addition to this extraction shaft there is another, used chiefly in the summer time, and acting without the aid of heat. The hot-water pipes passing round the walls

are formed with gills beneath the windows in order to increase the heat at those points, and they also communicate heat to four coils, or batteries, placed on either side of the entrance doors at the extreme ends of the large ward. A large chamber leading out of the rear passage way is provided for the purpose of mixing and warming the cold air before it is allowed to enter the various rooms. The cold air enters this chamber under its own window, and that of the buffet adjoining at the points marked X on the plan, and the quantity of air to be admitted is controlled by means of deal shutters placed next the iron gratings in the walls, through which the outer air enters. This ventilation chamber contains a large number of hot-water pipes for heating the incoming air, and arrangements also exist for moistening the air so warmed before it is allowed to pass into the various rooms.

Lighting, Water Supply, and Drainage.—All the rooms are lighted by gas supplied from the town, but no special arrangements appear to exist for conveying away the products of combustion from the various burners. Water is also supplied from the own mains. The disposal of the sewage appears to be effected in a manner somewhat similar to that adopted at the Lariboisière Hospital, and described at page 144.

Walls and Floors.—The outer walls are constructed of baulks of timber, and the inner walls of stout rough planking—the inner surfaces of both walls and ceilings are finished with wrot and tongued boarding. The flooring generally is formed of asphalte resting upon concrete and hard earth well rammed and consolidated.

W.C.'s, Baths, &c.—These offices are not badly placed, being cut off from communication with the main building by means of a cross-ventilated passage. The bath room is 8 feet 6 inches long and 7 feet wide, and is fitted with a metal bath. The water-closet is 8 feet 6 inches long and 6 feet wide; it is not, as may be supposed, fitted with an apparatus worthy of description here. A wash-hand basin is placed at one end of the cross passage, giving access to these offices.

Operation Rooms.—Two rooms situated to the right and left of the entrance corridor are used as separation wards, principally, however, by patients before, during, and after the performance of surgical operations. These rooms are 16 feet long, 14 feet wide, and about 15 feet high, so that, presuming each one to accommodate 2 beds, each patient would be provided with 112 superficial and 1,680 cubic feet of air space.

Duty Room.—A room leading off the passage way in the rear of the large ward, and termed a "buffet," is used as a combined duty, day, and dining room; it is 11 feet 6 inches long and 6 feet 9 inches wide, including the portion over the ventilating and enclosed recess, X.

Nurses' Room.—On the side of the rear passage way, opposite to the ventilation room and buffet, there is a nurses' room, 14 feet long and 11 feet 6 inches wide. This room is fitted as a sleeping apartment.

Total Area of Pavilion.—The total area covered by this pavilion, including the walls surrounding it, is 2,664 feet, or about 190 feet per bed.

JOHNS HOPKINS HOSPITAL.

BALTIMORE, UNITED STATES.

In the year 1873 Mr. Johns Hopkins, a wealthy citizen of Baltimore, gave to certain trustees a large tract of land in that city, together with a sum of money amounting to £416,800 (2,000,000 dollars), the interest upon which, to the extent of £20,840 (100,000 dollars) per annum, he directed should be expended during his lifetime in the erection of a hospital, and also an asylum for orphan colored children. Before the scheme had ripened he died, and then it was found that he had bequeathed, for the purpose of carrying out his intentions, a still larger sum, making in all £625,200 (3,000,000 dollars), and yielding an annual revenue of £37,512 (180,000 dollars). His intentions are very clearly laid down by the following letter, written by him to the trustees:—

"Baltimore, *March 10th* 1873.

"To Francis T. King, President, and others of the Trustees of Johns Hopkins' Hospital.

"Gentlemen.—I have given you, in your capacity of trustees, thirteen acres of land, situated in the city of Baltimore, and bounded by Wolfe, Monument, Broadway, and Jefferson Streets, upon which I desire you to erect a hospital.

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

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

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

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

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

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

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

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

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

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

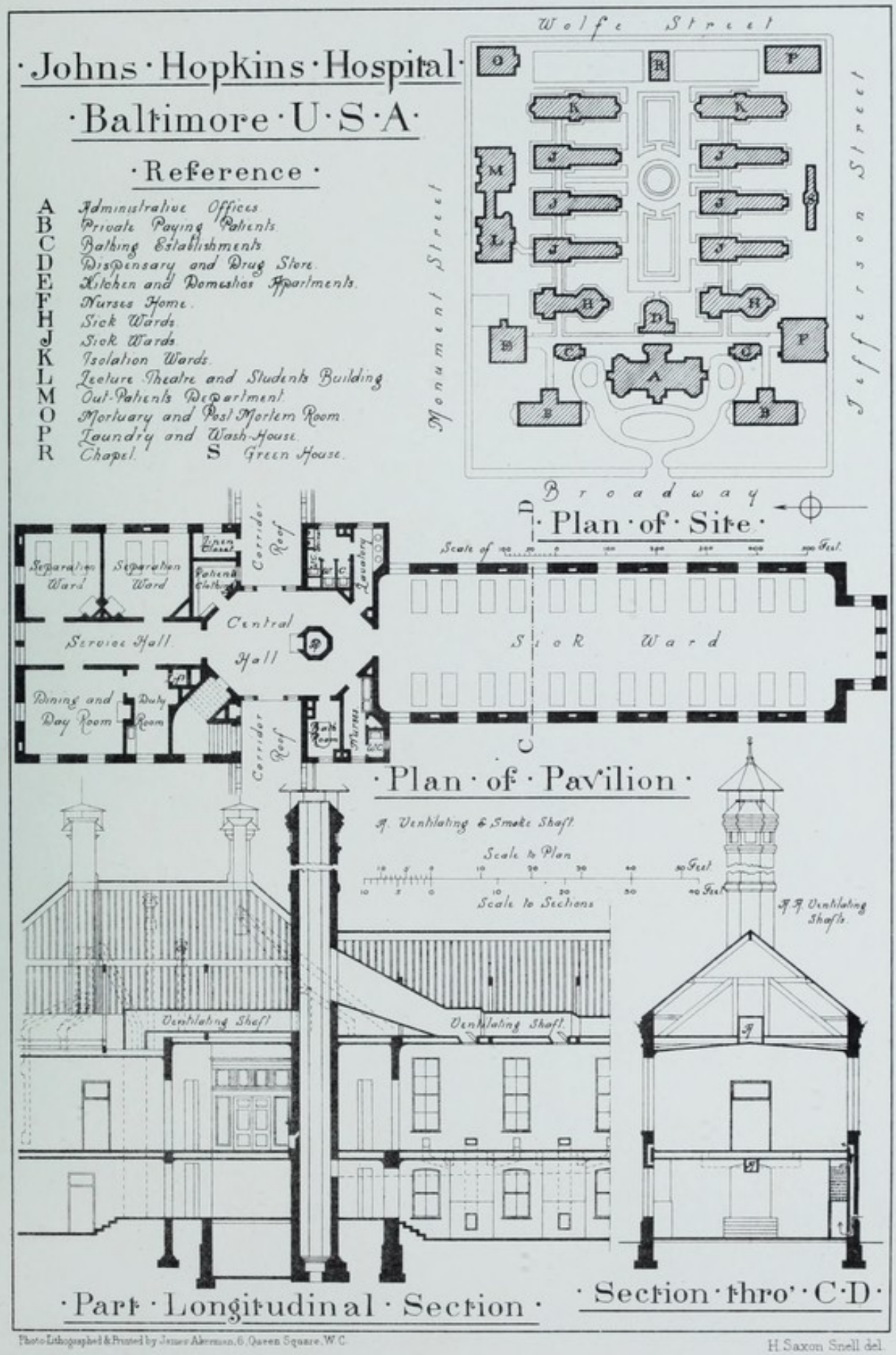


Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

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

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

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

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

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

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

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

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

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

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

"I have felt it to be my duty to bring these subjects to your particular attention, knowing that you will conform to the wishes which I thus definitely express.

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

"I am, very respectfully, your friend,

"JOHNS HOPKINS."

The first step taken by the trustees towards the development of the scheme, as set forth above, was the formation of a Building Committee, which was authorised to confer with five distinguished physicians, and obtain such advice as might be considered needful. The gentlemen selected were John S. Billings, Bvt. Lt.-Col. and Assist.-Sur., U.S.A., Norton Folsom, M.D., Joseph Jones, M.D., Caspar Morris, M.D., and Stephen Smith, M.D., and the following letter was addressed to each of them:—

"Office of the Johns Hopkins' Hospital,

"Baltimore, *March 6th* 1875.

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

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

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

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

"Besides the information afforded you by the letter, some additions are needful to be made, and some corrections which altered circumstances require.

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

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

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

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

"These preliminary statements are made in order that you may have a full view of the subject about which we now seek your advice. It will readily occur to you that the subject most prominent at this day, in the professional consideration of the hospital question as applicable to cities, is the choice between the *pavilion* system, which admits buildings of two or more storeys in height, permanently constructed, of which the Herbert Hospital, in England, and several in this country may be considered good modern types, and the *barrack* system of one storey structures, destructible in whole or in part, which were so successfully used in the late war, but of which no extensive and prominent example is now in operation. In determining the claims of these systems respectively, as applicable to us, careful regard should be had to the character of patients intended to be the subjects of our nursing, so as to avoid the error of building an institution which shall prove not to meet the requirements demanded in the care and cure of women and children, and the generally enfeebled inhabitants of the sheltered lanes and alleys of a city, however much such a structure may have been a success when applied to the uses of hardy men in the field.

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

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

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

"As closely connected therewith we should be glad to have your advice as to the most judicious location of the medical school buildings of the university; that is, whether they should be in close proximity to the hospital, or whether they can, with equal profit and convenience, be erected with the other buildings of the university, a mile distant.

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

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

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

"The location of the kitchen and its appurtenant offices is a subject of great practical importance, upon which new, and, so far as we know, hitherto untried, suggestions have been made. Whether it should be in a separate building from those devoted to administration or to the nursing and care of patients, or in the basement of some one of tnem, or in the upper storey of any, are points open to discussion, and to be carefully considered.

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

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

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

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

"Please acknowledge the receipt of this, and oblige,

"Very respectfully, yours, &c.,

FRANCIS T. KING,

"*President of Board of Trustees.*"

In response to the above invitation five essays were received, each containing suggestions, together with sketches, for the general planning and administration of the

proposed hospital buildings. After due consideration of these, Dr. Billings was requested to supervise the preparation of a plan which, as completed, differs materially from all the plans furnished in the essays, while embodying certain desirable features of each. The architects were Messrs. Cabot and Chandler, of Boston, and Mr. John Niernseè, of Baltimore, and the work is being carried out under the direction of Dr. Billings.

It may be a question as to how far the express directions of the founder have been carried out, that "advice and assistance should be obtained from those *at home and abroad* who have achieved the greatest success in the *construction* and management of hospitals," but whether this has been done or not there can be but one opinion, that the design now being carried out will produce a building worthy in every respect the object of the founder and highly creditable to the genius and ability of Dr. Billings and the architects engaged with him in carrying out the work.

Site.—The building is situated in the eastern part of Baltimore, fronting the Broadway to the west, Wolfe Street to the east, and lying between Monument and Jefferson Streets. The grounds measure about 708 feet from north to south, and about 856 feet from east to west. The height of the ground at the central gate on Broadway is 94 feet "above mean tide," the main floor of the administrative building and kitchen and corridor is 20 feet, and the ward floors are 30 feet higher than Broadway. The block-plan of the site at page 244 shews the hospital as proposed to be completed; the wards on the south side of the central garden are not, however, to be erected at present. The extent of the site is stated to be 14 acres, or 1,689 superficial feet per bed.

Subsoil.—The subsoil is clay, with layers of sand, for a depth of 20 feet, the whole being much contorted, forming sand pockets at irregular intervals, and necessitating special arrangements for drainage.

General Arrangement.—The general disposition of the buildings upon the site and detailed plans of the principal sick wards are shewn upon the accompanying plate, page 244.

The only access to the grounds is through the central gates in Broadway, and the building is entered through the administrative block, marked A on the plan of site. This building, three storeys in height, contains, on the ground floor, a central hall, board room, library, steward's office, matron's office, receiving room for patients, superintendent's and clerk's offices, reception parlor, lavatory, janitor's room, &c. The upper storeys are divided into rooms for resident medical officers and students.

Two buildings, marked B on the plan, are situated right and left of the administrative department last described. Each consists of a central octagonal hall and a corridor, twelve wards for 1 patient each, and one for 2 patients, besides nurses' room, duty room, and other usual offices.

Blocks C C are bathing establishments for the use of male and female patients respectively.

Block D, in the rear of the administrative building, is an "apothecary's building, consisting of a dispensary, pharmacy, and drug store, waiting room for nurses, dining room for medical officers and students, and apothecary's and assistant apothecary's rooms.

Block E is the general kitchen building, three storeys in height above the basement floor. On the ground storey is placed the kitchen, scullery, larder, and stores; also a servants' dining room. The basement contains cellarage, stores, and furnace rooms. Dining rooms for the employés and sleeping rooms for the cooks are situated in the upper storey.

Block F is a nurses' home, four storeys in height, and contains, on the ground floor, a handsome entrance hall and staircase, parlor and reception room, library, superintendent's rooms, and seven nurses' rooms. The floor below contains a training kitchen, a dining room for nurses, a lecture room, sewing room, and store rooms. The two upper floors are devoted to the nurses, each of whom is provided with a separate apartment.

Blocks H H are pavilions, two storeys in height, for the reception of patients, and will consist, on each floor, of a large ward, octagonally shaped on plan, and providing accommodation for 24 patients; also, on each floor, two separation wards for 2 patients each. The plan comprises dining rooms, linen closets, duty rooms, bath-rooms, and other usual offices.

Blocks marked J are six pavilions, one storey in height above their basement floors. Each consists of a large ward of parallelogram shape, for the reception of 24 patients, two separation wards for 2 patients each, and offices as noted above for blocks H H. These pavilions will be more particularly described further on.

Blocks K K, one storey in height above the basement floors, are isolation wards for the reception of patients suffering from infectious or contagious diseases. Each building will contain twenty rooms for 1 patient each, and two rooms for 2 patients each.

Block L is designated as "the amphitheatre," and contains a lecture theatre, with a special operating room, a consulting room, and a recovery room with accommodation for 2 patients, and another for 3 patients; nurses' room and other usual offices are attached. Also in this block there is an accident reception room, an etherizing room, a photographer's room, and a waiting room.

Block M is the out-patients' department, consisting of a large central waiting room, eleven physicians' and surgeons' rooms, and other usual offices. The janitor's apartments are placed in the building marked N, connecting blocks L and M together.

Block O, two storeys in height, is a mortuary and post-mortem room, consisting of an "amphitheatre," a dead house, a pathological laboratory, and a waiting room for the friends of the deceased. The upper floor contains rooms for histological research and photomicrography; also a small museum.

Block P, one storey in height above the basement, is the laundry of the establishment. It has two separate wash-houses, and drying rooms—one for the clothing of the inmates, and another for the officers' clothing; also an ironing room and mattress and hair rooms. The basement contains a chamber and other accessories for disinfecting clothing. The roof of this building is flat, for use as a drying ground.

Block R is the chapel, and block S a green-house for rearing plants to be placed about the grounds and in the wards.

Total Accommodation.—Provision, it will be seen, has been made for the reception, when the building is entirely completed, of 361 inmates; 240 being accommodated in ten wards of 24 beds each, 54 in twenty-seven wards of 2 each, 3 in one ward, and sixty-four in wards containing 1 bed only in each.

Connecting Corridors.—The main corridor at the rear of the administrative building is 14 feet in width, but those running at right angles to it, and connecting together the various sick wards, are 12 feet wide only. The upper parts, which are nearly on a level with the floors of the sick wards, form ambulatories for the use of the patients.

Area Covered.—The area covered by the various buildings is 173,694 superficial feet, or rather more than two-sevenths of the site, and 481 feet per bed.

Cost.—Dr. Billings informs me that the total cost of the building, as nearly as can be estimated, will amount to about £312,600 (1,500,000 dollars), or £866 per bed. The cost of the land has not been made known.

Principal Sick Wards.

The main sick wards, marked J upon the block-plan of the site, are planned as pavilions one storey only in height above the basement floor. A detailed plan and section of them are shown upon the plate at page 244.

Aspect.—The axes of all the pavilions run nearly directly N. and S., so that the windows generally face E. and W.

Relative Position of Pavilions.—The height of the pavilions, as measured from the floors of the sick wards to the junctions of the upright lines of the outer front walls with the sloping lines of the roofs, is 20 feet, and the least distance between any two pavilions is 60 feet, or about three times the height.

Size of Wards.—Each ward is of parallelogram shape, contains 24 beds, and is 90 feet 10 inches long, 27 feet 8 inches wide, and 16 feet average height. At one end there is a square bay-window 8 feet deep and 14 feet 8 inches wide. The total superficial floor space is, therefore, 2,513 feet, or 104 feet per bed, and the cubic contents 40,208 feet, or 1,675 feet per bed.

Bed Space.—The average lineal wall space per bed is 7 feet 7 inches.

Windows.—In each side wall are seven windows, constructed as ordinary lifting sashes, hung with lines and weights; the total area of their glazed surface is about 514 feet, or 21½ feet per bed. If, however, those in the end bays be taken into account the area per bed is 28 feet. When all the side windows are opened to their fullest extent the total area through which air could be admitted into the wards is 268 feet, or 11⅛ feet per bed, but if the sashes of the bay window were added this area would be increased to 351 feet, or to 14⅔ feet per bed. It will be observed that windows are placed between the end beds and the end wall; this is an improvement upon the planning of most other hospital wards.

Warming.—The system of warming is based upon the views expressed by Dr. Billings in the original essay accompanying his design for this building, of which the following is an extract:—

"With regard to heating, it is necessary to keep in view the peculiarities of the climate of Baltimore. . . . . It will be seen that we have to provide for temperatures varying from zero to about 100° F. For,

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

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

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

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

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

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

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

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

"The action of a fireplace in a corner of a ward as a means of exit for foul air, which is the only advantage it has worth considering, can be as well obtained if a coil of hot-water or steam pipes be substituted for the open fire, and this, in my opinion, would be much more satisfactory. As ventilating shafts give better results in the centre of the room than in the corners, partly because the air currents to them do not cross patients' beds, and partly because the air in the shaft is kept at a higher temperature, I should prefer to have them in the centre.

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

In the buildings, as constructed, there is in the basement, immediately underneath each pair of beds, an enclosure containing a coil of sixty heating pipes. The outer fresh air is brought into these enclosures beneath the pipes by means of flues formed in the outer walls and descending from the level of the plinth course, which is about 3 feet

*The opinions here expressed as to the utility and value of open fireplaces in large sick wards is not shared by those in this country who have made the subject their especial study.

above the level of the outer ground. The outer air, having become heated in its passage through the pipe coils, will rise upwards through other flues and be emitted into the wards through grated openings in the walls placed underneath each window. These flues are so contrived that their connection with the heating pipes can be cut off by means of iron valves or dampers, and then in the summer-time the outer fresh air will be made to pass directly into the wards without first coming into contact with the heating pipes. A double-coil of heating pipes passes round the bay window at the level of the floor line. The separation wards, duty and day rooms are warmed by means of open fire-grates.

Ventilation.—The views entertained by Dr. Billings upon the question of ventilation at the time of writing his essay are very valuable, and that they were ably set forth will be seen by the following extract :—

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

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

"I have explained that while this is satisfactory for the gases it is not so for the suspended particles, and, therefore, have proposed that, as far as possible, there shall be no source of infection in the majority of the wards, and, therefore, no necessity for special and costly appliances for their ventilation.

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

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

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

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

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

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

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

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

"This second plan is the one ordinarily used, and the main point to be attended to in it is the mode of aspiration to be employed. This may be effected by fireplaces in the corners or centres of the ward, by flues passing upwards, or by flues passing downwards to a larger flue, which is connected with an aspirating or ventilating chimney, which may be warmed either by the waste heat from the boilers and furnaces connected with the administration, or may have a separate fire for that purpose. The placing of upward ventilating flues in outer walls does not, so far as my experience goes, give satisfactory results in very cold weather, and they will vary in action with the direction and force of the wind. Other objections to them in point of view of construction are given by General Morin, and will be familiar to the architect. To rely entirely upon fireplaces placed in the corners of the ward as means of ventilation will not, I think, be satisfactory, and, so far as regards ventilation, I should prefer to have them in the centre and to use heating coils instead of open fire. But if a satisfactory aspirating shaft can be constructed which will take the air from the sides and corners of the room near or through the floor directly downwards to a horizontal duct beneath the ward, and thence to an aspirating chimney, I should prefer it to any other mode of effecting ventilation on the second plan.

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

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

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

"To secure proper ventilaton of a ward in warm weather, by what is called the natural system of ventilation, it is desirable that the ceiling shall not be flat, and it is owing to the fact that an arched or peaked ceiling can be so much more readily obtained in a room which has not another over it, that is due to the superiority of one-storey over two-storey buildings for hospital wards during warm weather. On the other hand, rooms with high or peaked ceilings are much more difficult to heat, and in our one-storey barrack hospitals with ridge ventilation it was found necessary to take extra precautions to close all apertures, in order to keep them moderately comfortable, with the outside temperature at or below the freezing point.

* A cubic foot of air at temp. 60° and 30′ Bar. weighs about 532 grains if perfectly dry, and 528·6 grains if saturated with moisture. In the first case, 13,157·9 cubic feet will weigh about 1,000 lbs., and in the second, 13,242·5; or, as a mean result, one pound of air measures 13·2 cubic feet, and a ton of 2,000 lbs., 26,400 cubic feet.

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

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

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

The mode of ventilation actually adopted is as follows:—Fresh air is brought into the wards in the manner described under the head of heating, and, in summer-time, this can be supplemented to a greater or less extent by opening the windows.

The extraction of fouled air is provided for, thus:—In the centre of the ceiling of the large ward there are, at equal distances apart, six openings, each about 24 inches square, having hinged flaps which open into an iron horizontal channel, 3 feet 9 inches wide and 1 foot 9 inches high at the furthest end, but increasing in height as the number of openings into it increase to 4 feet 3 inches; continuing onwards it increases to 8 feet in height, and then enters an aspirating shaft that ascends vertically from the basement through the entrance-hall, and terminates much above the level of the surrounding roofs.

In addition to this means for extracting foul air from the upper part of the room, there is, under the foot of each bed, a grating through which air will be drawn by a flue, first downwards through the thickness of the floor, and then horizontally into an iron channel running on a level with the basement ceiling, also into the aspiration shaft. This channel tapers from 2 feet wide and 1 foot deep at one end, to 4 feet wide and 2 feet deep at the other, where it joins the upright shaft.

The aspiration shaft is octagonal on plan, 4 feet 8 inches diameter, 60 feet in height above the level of the sick ward floor, and is crowned with an iron conical shaped wind guard. It is very powerfully heated by means of a coil of pipes placed above the level of the roof ridge.

For the ventilation of the separation wards, day room, patients' clothing store, and duty room, a separate iron extraction shaft is placed above the level of the ceiling of the corridor, and, rising upwards to a height of 9 feet 6 inches above the level of the adjoining roof ridge, it is crowned, in the same manner as the large shaft, with a conical wind guard, and is also heated by a coil of pipes placed above the level of the foul air ducts passing into it. A similar extraction shaft, 24 inches diameter, is placed over the central hall and provides ventilation for the water-closets; and two smaller shafts are provided for the ventilation of the linen closets and lifts respectively.

Floors and Walls.—The floors are of fireproof construction, and finished with hard pine. The walls of the wards are generally 26 inches in thickness. They are built hollow, and are formed of brick, with external dressings of dark blue stone. The internal faces are finished with "hard trowelled sand finish," and will ultimately be oil painted.

W.C.'s, Baths, &c.—The positions of the water-closets in this building by no means accord with modern sanitary rules; those used by the patients are entered through the lavatory, and this room opens directly out of the central hall. They are, however, well ventilated, and this is apparently considered a sufficient precaution against the escape of foul air into the building. The compartment containing these offices is 11 feet 6 inches long and 8 feet 8 inches wide, and in it are two water-closets, each 2 feet 8 inches wide, and 5 feet 3 inches long, a slop sink, and two urinals; the adjoining lavatory averages 5 feet 6 inches wide and 14 feet long. A separate compartment of the same size as the lavatory is fitted with a nurses' closet and a bath. The patients' bath room is 11 feet 6 inches long, 7 feet 7 inches wide, and is fitted with a fixed bath.

Day Room.—On the opposite side of the entrance-hall and main corridor is a suite of rooms, one of which is the day and dining room, 19 feet 7 inches long and 16 feet 10 inches wide, the total area being 329 feet, and giving, therefore, 11¾ superficial floor space to each of the 28 patients occupying the pavilion.

Separation Wards.—Two wards, each for the occupation of 2 patients, are also placed in this part of the building. They are each 16 feet 10 inches long, and respectively 15 feet 2 inches and 17 feet wide, and they, therefore, provide each patient with an average space equal to 135 superficial and 1,890 cubic feet.

Duty Room.—Adjoining the dining room, and entered from it, and also from the corridor, is a duty room, called, as on the Continent, a "tea kitchen." It is 8 feet 6 inches wide, 16 feet 10 inches long, and is fitted with the usual accessories.

Staircase and Lift.—A food lift, 3 feet square, ascends from the basement to the duty room last described, and a flight of stairs, 6 feet wide, gives access from the corridor floor below and also to the attics above. The steps have each a rise of 6 inches, and the treads are 12 inches wide.

Clothing Store.—Entered from one side of the octagonal central hall is a room fitted up with divisions for the safe custody of the patients' own clothing, and an adjoining closet forms a store for the clean linen used in the pavilion.

Basement.—The principal floor of each pavilion is raised 13 feet above the level of the outside ground, and a basement is so formed 11 feet 6 inches in height beneath the wards and 9 feet in height under the other portions of the building. Immediately beneath the corridor floor a tunnel, 7 feet high, is formed for the conveyance of the various pipes to their respective destinations. The basement is enclosed by lifting sashes immediately beneath those of the floor above. The whole of the ground beneath the various buildings is covered with a layer of concrete.

Total Area of Pavilions.—The total area covered by each floor of these pavilions, including the surrounding walls, is 6,664 feet, or 238 feet per bed.

In conclusion, I have to acknowledge the kind assistance of Dr. Billings in sending me the drawings and particulars from which the above account is taken.

HULL GENERAL INFIRMARY.

YORKSHIRE, ENGLAND.

MANY hospitals exist, the bad planning and general arrangements of which are capable of improvement; and, where the available funds will not permit the pulling down and re-erection of such buildings upon modern principles, it becomes necessary to consider how the work of re-arrangement can be most judiciously effected.

There are, no doubt, some good examples of such alterations having been successfully executed; but in a large majority of instances the supposed works of improvement have simply resulted in intensifying the evils they were supposed to correct, and this has been especially so where enlargements of the buildings have at the same time been necessary.

It will, therefore, not be undesirable to attach to these types of hospital construction an account of the alterations about to be effected at the Hull General Infirmary, and the more so that the history of the previous enlargements of the building may be taken as fairly illustrative of the errors referred to in the previous paragraph.

The accompanying plate shews the principal floor of the building as it at present exists, and is so numbered as to indicate the various additions that have been made from time to time.

The original building contained accommodation for 70 inmates, and consisted of three storeys of rooms, numbered from 1 to 10 on the plan, ranged along the principal front and connected together by means of a corridor running along the back front.

The foundation stone was laid in the winter of 1782, and the building was opened on the 1st September 1784. Its cost was £3,000; but the total outlay, including the site and other expenses, is stated to have been £4,216.

In the year 1842, the external brickwork was cemented over and the façade next Prospect Street re-designed by Mr. Lockwood. The wings containing the wards and offices, numbered upon the plan from 11 to 13, were also added, and so far the building was as good a hospital as any erected at that date, and before the introduction of the pavilion or block system of construction. But the work of deterioration shortly afterwards began—first by the erection, in 1858, of a wing containing the rooms numbered 14 to 17; then, in 1853, the commencement, and subsequently, in 1864, the completion, of the wing containing Nos. 18 to 20, thus cutting off much of the sunlight from the rear portion of the building and destroying the free circulation of air that previously existed round all parts of it.

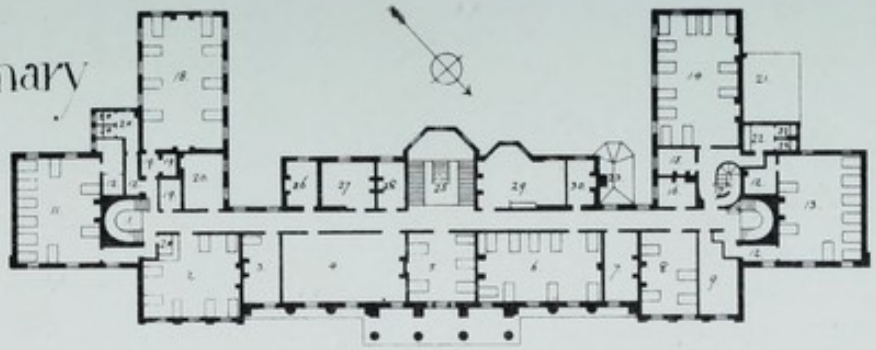
The additional offices, numbered 21 to 24 on the plan, were also added at various times; but the climax of injudicious extension was reached when the three storeys of rooms numbered from 25 to 30 were erected, thus effectually closing in on each floor the only ventilated sides of the corridors of communications.

The living rooms of the officers and the wards containing the sick now open in common on to the same unventilated passages, and it will not, therefore, be surprising to

Hull · General · Infirmary

as · Altered

and · Enlarged

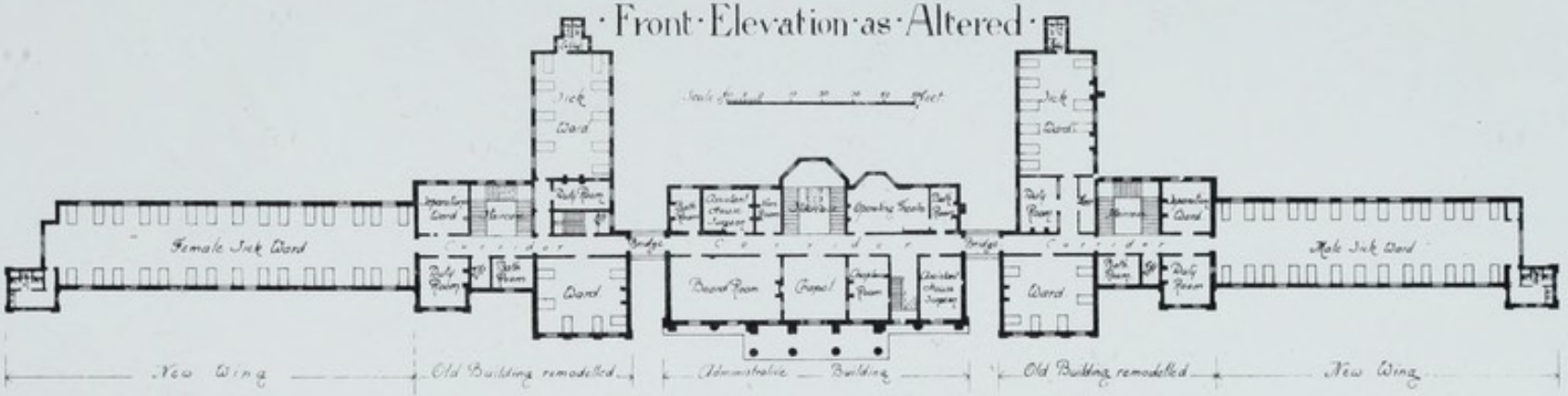


Nos 1. 10. 25 ..... Staircases
do 2. 3. 5. 6. 8. 11. 13. 14. 18 ..... Sick Wards
do 4 ..... Chapel
do 7. 9. 28 ..... Officers Bed Rooms
do 12. 17. 19 ..... Passages Lifts Closets &c.
do 15. 16. 20 ..... Duty Rooms
do 21 ..... Roof of Operating Room
do 22. 24. 26 ..... W.C.s Slop sinks. Lobbies
do 23 ..... Roof over Physicians Consulting Room
do 26. 30 ..... Bath Rooms
do 27 ..... Ass.t House Surgeons Bed Room
do 29 ..... Operating Theatre

· Plan · of · First · Floor · before · Alteration ·



· Front · Elevation · as · Altered ·



· Plan · of · First · Floor · after · Alteration ·

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learn that Dr. Hagyard, the house-surgeon, found it necessary in his medical report to draw attention to the fact that, although "a great number of deserving cases had to be sent away for want of room and for fear of overcrowding the institution, and rendering it unsanitary," yet that there had been "a great deal of sickness among the resident officials, nurses, and servants, principally of a kind pointing to unsanitary conditions of the hospital." Further, he points out that, on the contrary, the night nurses who, for want of space in the main building, are located in one of the adjoining houses in Brook Street, "have been singularly free from sore throats and other septic ailments."

It is, however, not only in the general planning of the extensions above referred to that errors have been committed, but even greater blunders occur in matters of detail. For example, the small room numbered 2 A is a combined scullery and lavatory, with a washing-up sink; its only light is obtained through the glazed partition that separates it from the adjoining ward, and it ventilates itself into the corridor leading to the sick wards and offices. Again, the air from the water closets numbered 24 and 22 also passes into the corridor, for these offices are unprovided with cross ventilation, and the higher temperature of the inside of the building consequently induces currents of air to pass from these water-closets along the corridors rather than outwards and through the windows.

Such, then, is the building that the present members of the Committee of Management have had to work since entering upon their duties, and it need hardly be pointed out how many difficulties they and the medical staff have had to contend with in the administration, under such adverse circumstances, of so large and important an institution. By dint, however, of strenuous and unremitting exertion, a substantial building fund has been collected and the work of improvement will be proceeded with forthwith.

The first action of the committee towards the expenditure of the subscribers' donations was a consideration of the best means of enlarging the building to accommodate the increasing numbers of applicants for admission. It was at first proposed to run out at right angles from the main building one or other of the wings indicated upon the plan by dotted lines at page 260, but it is obvious that the adoption of either of these suggestions would only have rendered the existing defects, so far as regards air and sunlight, still more defective.

The plan that the committee subsequently, acting upon my advice, decided upon carrying out is also shewn upon the plate at page 260, and will be seen to consist, so far as increased accommodation for patients is concerned, of two additional wings running parallel to and in a line with the axis of the existing main building.

The separation of the officers' quarters from their present connection with the sick wards will be effected by cutting two gaps through the main building to the right and left of the centre of it and removing the sick from the central to the two side detached blocks thus created. At the same time the officers' apartments and the administrative offices generally will be concentrated in the central block. Communication between the two blocks is provided for by means of light iron bridges spanning the separating gaps.

But for the short arms running out at right angles to the side pavilion blocks, and which it would have been desirable to remove, did the funds permit of their erection elsewhere, the building in its altered state will be as near an approach to the recognized

type of English hospital construction as is possible under the circumstances. It will certainly, so far as regards the separation of the sick from each other and from the officers, be vastly superior to the arrangement of the Glasgow Western Infirmary.*

In a new building the sick pavilions would, of course, have been removed further from the central administration block, and the dimensions of the wards and the arrangements of their offices would have been in some respects different if unfettered by the necessity of retaining, as nearly as possible, the levels of the present floors, preserving the external character of the present building and other like considerations.

Although, therefore, the details of the new wards, to be more particularly described further on, may be taken to generally represent good ordinary hospital construction, as applied to a three-storied general hospital building, they must not be looked upon as illustrating what I should recommend were the building a new one, and the designs for it unfettered by the restrictions mentioned above.

It will be seen that the plans for the enlargement of the establishment contemplate the erection of a new out-patients' department at the point marked K, and a wash-house and laundry at L, also concurrently the removal of the dead-house, post-mortem room, and wash-house from D, as well as the laundry and out-patients' department from their present position in the main building.

The block marked C was erected for the accommodation of 16 patients in the year 1874, from the designs of Mr. Botterill, and cost £4,293, or £286 per bed. It was intended for the isolation of patients suffering from infectious or contagious disorders, but now all cases of this kind will be sent to a hospital in the town specially devoted to the treatment of those classes of diseases, and the building will consequently now be converted into a nurses' home.

Another arrangement proposed by me was that the new wings should be altogether detached from the present structure, and be turned at right angles to the ends of it, thereby making five separate blocks instead of three. The consideration of this was, however, abandoned because it necessitated the removal of very valuable shop property, whereas by the present scheme the property to be taken down immediately is comparatively valueless. It is, moreover, doubtful whether this first plan, if worked out, would have proved a better or so good an arrangement as the one adopted.

Site.—The extent of the present site is 92,270 superficial feet, being 2 acres and 19 perches. When enlarged it will contain 142,419 superficial feet, or 3 acres 1 rood 3 perches, and 518 feet per bed.

General Arrangement.—Block-plans at page 260 shew the extent of the sites and the general positions occupied by the buildings as they at present exist, and also as they will appear when altered. First, as to the distribution of the buildings before the alterations.

The main entrance to the premises is by gates adjoining the porter's lodge at A. Block B shews the position of the main building, containing the administrative offices, sick wards, and out-patients' department, intermingled one with the other as shewn more in detail by the plan at page 256.

* *See* page 43 *ante.*

Block C was, as before stated, erected for the isolation of patients suffering from infectious or contagious diseases. Block D contains the wash-house, dead-house and post-mortem room. The kitchen and laundry are placed on the ground floor of the adjoining front wing of the main block, B.

In the building as altered, the entrance gates and lodge will remain; two gaps will be cut through the present main building, B, thus forming it into three blocks. The central block, E, will be devoted exclusively to the use of the officers and the administration generally, whilst blocks F F will be re-arranged in the manner hereinafter described for the reception of 54 male and 53 female patients. Blocks H and J are new wings also for the accommodation respectively of 78 male and 90 female patients.

In future all infectious cases will be sent to a hospital in the town specially devoted to that class of diseases, and block C being, therefore, no longer required for its present purposes, will, as before stated, be converted into a nurses' home.

Block K will be a new out-patients' department, with an entrance for patients from Brook Street.

Block L is the proposed site for a new wash-house and laundry.

The above alterations necessitate the acquirement and removal of some comparatively valueless houses in Mill Street and Brook Street.

The property at the corner of Brook Street and Prospect Street, although consisting of low buildings, is shop property, facing a main thoroughfare, and being, therefore, more valuable will not be purchased until the available funds will allow.

The general arrangement of the principal or first floor of the old and new main building is shewn at plate 256. As altered, the central block will contain, upon the ground floor, the entrance-hall and staircase, a waiting room, lady superintendent's sitting and bed room, house surgeon's and first assistant house surgeon's sitting and bed rooms, a dining room, secretary's room and medical officers' consulting room; on the first floor, a board room, chapel, chaplain's room, second assistant house surgeon's sitting and bed room, an operating theatre and dressing room; on the second floor, the kitchen, scullery, and stores, the housekeeper's apartments and domestics' dormitories.

The south-east wing will contain, on each floor, one ward for the accommodation of 30, one for 9, and one for 6 beds, and also a separation ward for 2 beds. One of the wards on the upper floor being for children will contain two additional beds; the small ward on the ground floor adjoining the entrance-hall will be used as an accident ward.

The corresponding wing on the north-west side will contain, on each floor, one ward for 26, one for 10, and one for 6 beds, besides a separation ward for 2 beds. The small ward on the ground floor will, like that in the opposite wing, be available for cases of accident.

Total Accommodation.—The total accommodation will, therefore, be for 275 beds, viz.:—Three wards for 30 patients each, three for 26, one for 11, three for 10, two for 9, six for 6, and six for 2 beds each.

Connecting Bridges.—The three blocks of buildings will be connected on each floor by light iron bridges, 6 feet wide and 12 feet long.

Area Covered.—The area covered by buildings will be 35,370 superficial feet, or about an eighth part of the site, and about 128 feet per bed.

Cost.—It is estimated that the cost of the proposed new and altered sick wards, and the re-modelling of the central building, will amount to £25,000, or about £91 per bed.

The cost of the out-patients' department, new wash-house, and other minor alterations will probably amount to £5,000, thus bringing the total contemplated outlay to about £109 per bed. Allowing, however, a considerable margin for contingencies, there can be no doubt that the ultimate expenditure will be less than one-half the cost of a new building.*

PRINCIPAL SICK WARDS.

A detailed plan and section of the new south-east wing, to which the following description applies, is shewn upon the accompanying plate; the opposite wing, it will be remembered, is similar, excepting that the large sick ward will be longer and contain more beds.

Aspect.—The axis of the new wings will run from N.W. to S.E., so that the windows, generally, will face N.E. and S.W.

Size of Wards.—The large wards will be of parallelogram shape, and each will contain 30 beds, their length being 112 feet 6 inches, width 26 feet, and height 13 feet 6 inches.

The total superficial floor space, including the bay window, will be 2,992 feet, or 100 feet per bed; and the cubic contents 40,398 feet, or 1,346 feet per bed.

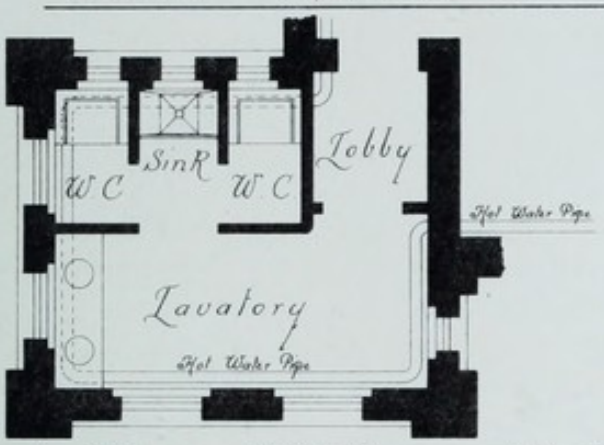
Bed Space.—The average lineal wall space per bed will be 7 feet 6 inches.

Windows.—Eight windows will be ranged along each side wall, the total area of their effective glazed surface being 562 feet, or about 18⅞ feet per bed; but, if the end window is included, the total glazed surface will be 20½ feet per bed. When the windows are opened to their fullest extent, the total area through which air can be admitted by them into the wards will be 669 feet, or about 22¼ feet per bed, but, if the end window be included, the area per bed will be 22¾ feet. All the windows will be glazed with plate glass, the lower parts of them being constructed as casement sashes, carried down to within 10 inches of the floor line, and 8 feet 9 inches in height. Each sash opening inwards, the heads of the patients as they lay in bed will be protected from draughts passing through the ward from one window to another, and thus cross ventilation need not at any time be stopped through fear of inconveniencing the patients. So far, these windows will be constructed in the same manner as those at St. George's Union Infirmary, described at page 233, but in other respects the detail is different, for instead of the upper portions opening as ordinary lifting sashes, they will be hung upon their lower rails and open inwards by means of Adams' apparatus, thereby causing the incoming air to be deflected upwards towards the ceiling. Another important change will be effected by fixing the venetian blinds outside the frames, so as to allow of the windows being opened at all times, whether the blinds are or are not drawn down; this, it will be seen, is not the case when the blinds are hung on the inside of the ward.

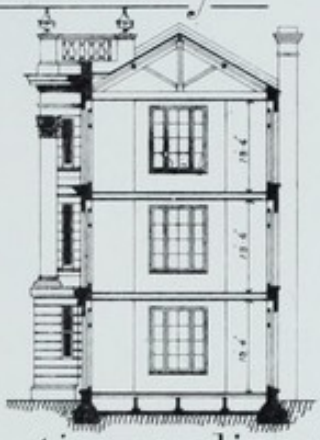
A prejudice exists in the minds of many as to the adoption of casement windows of any kind, because, as a rule, and, as ordinarily constructed, they are less wind and water-tight than ordinary lifting sashes; but those who are interested in the matter would do

* *See* the end of this Section for a summary of the cost of various modern hospitals.

Hull General Infirmary

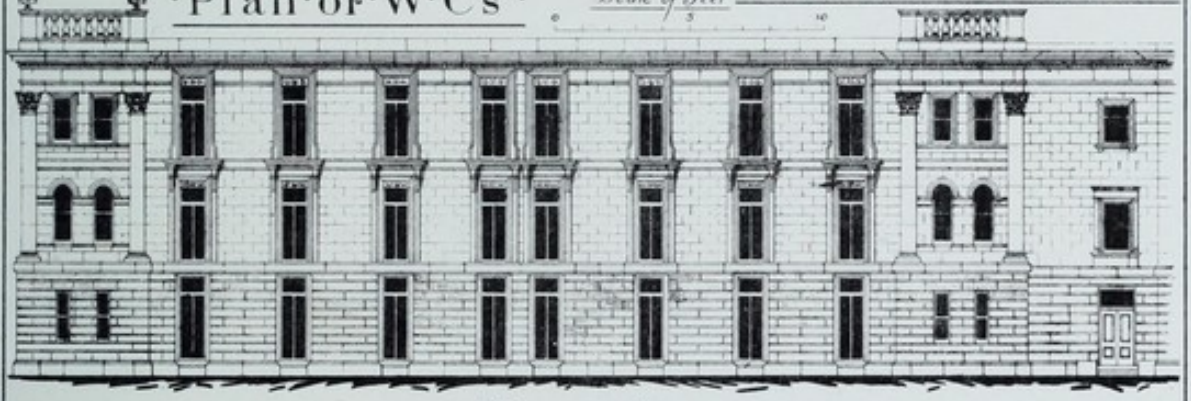


Plan of W Cs

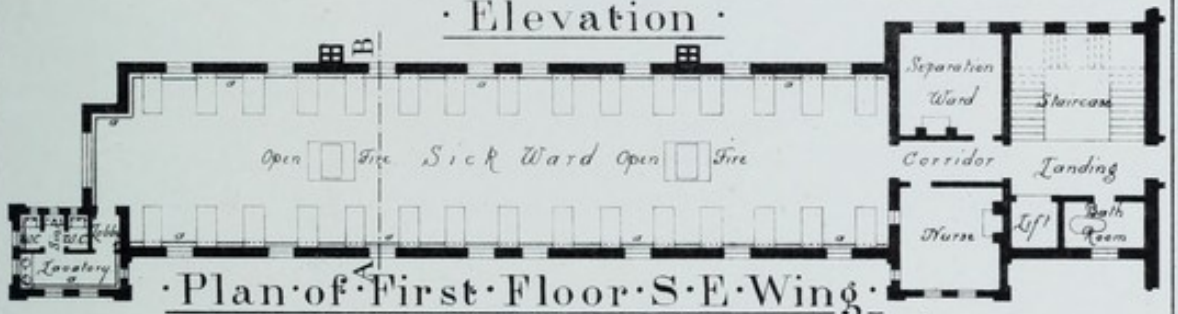


Section on line A B

Scale of Feet 0 5 10



Elevation

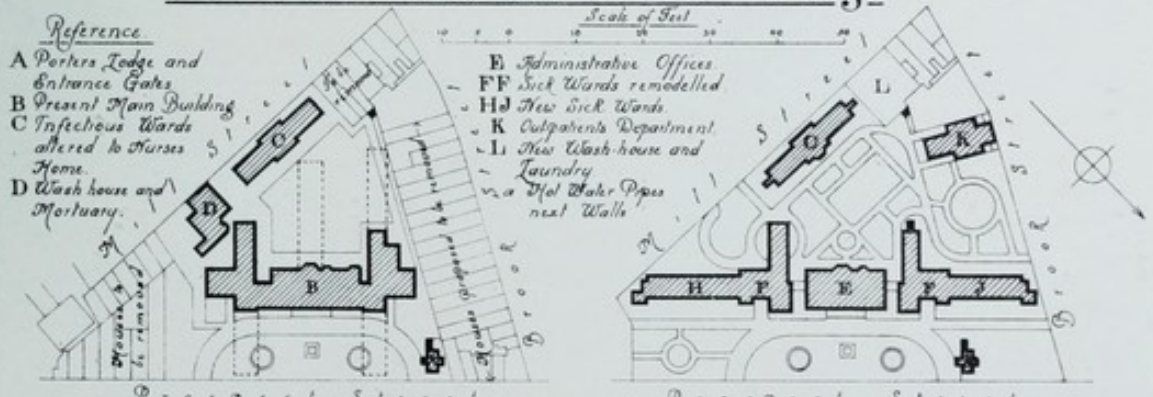


Plan of First Floor S E Wing

Reference

A Porters Lodge and Entrance Gates
B Present Main Building
C Infectious Wards altered to Nurses Home
D Wash house and Mortuary.
E Administrative Offices
FF Sick Wards remodelled
HJ New Sick Wards
K Outpatients Department
L New Wash-house and Laundry
Hot Water Pipes next Walls

Scale of Feet 0 50 100 200 300



Plan of Site at present Plan of Site as altered

Scale of Feet 0 50 100 200

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H Saxon Snell del.

well to pay a visit to the new lying-in wards of St. George's Union Workhouse in the Fulham Road, or the sick wards of the adjoining Infirmary, and they will there see that it is quite possible to construct casements free from the above objections.*

Warming.—Each ward will be warmed by patent double open-fire hot-water apparatus (Thermhydric grates), illustrated and described at page 62 of this section, and hot-water pipes next the outer walls. Improvements have, however, been made in the manufacture, by which the operation of sweeping the flues is made much more simple than heretofore.

Ventilation and Lighting.—The ventilation of the wards will be effected by purely natural means, the windows being chiefly depended upon for the supply of fresh air; in addition, however, inlets for the admission of fresh air are contained in the walls between each pair of windows, and generally consist of two flues, 9 inches wide by 4½ inches deep, running vertically up each pier, and opening outwards through gratings fixed upon the face of the wall at about the level of the floor line, and inwards to the wards at the level of the floor, and also through hoppers fixed about 30 inches below the ceiling line, and having the fronts so inclined as to deflect the incoming air upwards and towards the ceiling. These flues will be provided with flaps, the opening and closing of which by the nurses will regulate the quantity of air to be admitted at times when the wind may be blowing too strongly towards the inlet gratings. Removal of the fouled air of the ward will also be provided for by means of shafts, 12 inches square, constructed in the ceilings between the joists, and continued upwards through flues in the side walls. These flues will terminate in grated openings fixed on the outer faces of the walls. The lighting of the wards at night will be effected by means of gas burners placed under inverted wrought-iron japanned basins; ventilating pipes will run from the upper parts of these basins through the ceiling ventilating channels into the shafts last described, and thus not only will the products of combustion be carried away from the wards, but the extraction of foul air from them will be assisted.

Floors.—The flooring will be formed of ordinary timber joists, covered with oak flooring boards, wax polished; the ceilings will be plastered. It is seldom that floors above 20 feet bearing are constructed with single joisting; but joists 12 inches deep, 3 inches thick, and 11 inches apart are all-sufficient for hospital wards 24 feet in width, and many advantages arise where this method of construction can be adopted.†

The wards of this building being 26 feet wide, it would, perhaps, have been found more economical to construct the floors on the double framed principle, but then the depth would have been nearly double that of a single joisted floor, and the height from floor to floor being restricted by the levels of the old building, this loss of space could not be afforded; it has, therefore, been determined to use single joists, 12 inches by 3 inches, and to reduce the bearing to 24 feet by the introduction of stone templates and brick corbelling.

* For detailed drawings of the construction of these Infirmary casements, *see Charitable and Parochial Establishments*. Batsford, London, 1881.

† Tredgold and other authorities recommend joists of this size, 12 inches apart, for floors not exceeding 20 feet bearing.

Walls.—The outside walls are of brick, the exterior faces being covered with Portland cement, with cornices and other architectural features to correspond with the classical character of the adjoining building. The inside faces will be covered with Keene's cement and painted.

W.C.'s, Lavatories, &c.—The plan and position of these offices were determined by the architectural character of the present building, necessitating the construction of towers or such like features at the junctions of the new buildings with the old, in order to break the otherwise apparent incongruity of the windows and strings being at a different level. These features then being formed by projecting forward the duty rooms, it was desirable that similar projections should, for the sake of uniformity, be constructed at the other ends of the wings, and here, therefore, it was determined to place the water-closets and lavatories.

Each water-closet will be 5 feet long and 2 feet 9 inches wide, and there will also be a compartment, 5 feet 6 inches long and 3 feet wide, containing a slop sink. These offices are in both cases cut off from the wards, first by lobbies and then by wide cross ventilated and well lighted passage ways, and they will be warmed by means of gas stoves placed in the angles, and having flues running up the walls for the purpose of carrying off the products of combustion. Wash-hand basins supplied with hot and cold water for the use of the patients will be placed in these passages.

The bath rooms are situated in the extreme ends of the present buildings as re-modelled; they are each 11 feet 3 inches long and 7 feet 6 inches wide, and will be fitted with a fixed earthenware bath. A bath, moveable on wheels, will also be placed at the bottom of each staircase, and will be available for the use of patients on the upper floors by means of the lifts, which rise from the level of the entrance-hall.

The soil and waste pipes will be formed of cast-iron hot-water socketted tubes caulked with gaskin and red lead, and carried down the outside walls. They will generally be constructed and ventilated in a manner similar to those at St. Marylebone Infirmary, described at page 66.

Day Rooms.—It is to be regretted that the available space does not admit the provision of separate day room accommodation for the patients, when the building contains its full number of inmates; when, however, the numbers will permit it, the wards shewn on the upper floors to contain six patients each will be available as separate recreation or day rooms for the patients generally.

Separation Wards.—A separation ward for two patients is planned on each floor adjoining the large wards, and they will be 16 feet long, 14 feet 6 inches wide, and 14 feet high; each patient occupying them will, therefore, be provided with 116 superficial and 1,624 cubic feet of air space.

Duty Rooms.—Attached to and overlooking each of the large wards will be a nurses' duty room, having an average area of 210 feet, and being fitted with a range, sink, and racks and shelves for ward crockery, &c. The nurses' sleeping apartments will be, as previously pointed out, situated in the old central building, and in other parts of the establishment.

Lifts.—Leading out of the entrance-hall on the ground floor, there is a lift, 7 feet 6 inches long and 6 feet wide, for conveying patients, coals, and food to and from the various wards.

Staircases.—The principal staircases of each pavilion will occupy an area of 405 feet, the hard Yorkshire stone steps being 5 feet long, with a tread of 12 inches and a rise of 6 inches.

Total Area of Pavilions.—The area covered by each floor of this new wing, including the staircase, bath room, duty room, separation ward, and all surrounding walls will be 4,619 feet or about 165 feet per bed; but if the old building, so far as it is adapted to the use of the sick patients, be added, the corresponding area will be 7,428 feet, or 169 feet per bed.

As space will allow, it may be well to say that since the above account has been written the one hundred and first annual meeting of the Governors of the Institution has been held, under the presidency of the Mayor, Dr. Rollit. Mr. Henry Simpson, Chairman of the Board of Management, explained in great detail the considerations which led to the adoption of the present plan for altering and enlarging the building and rejecting the proposal for erecting a new one. He also paid a well-merited compliment to the professional skill of the local architects, and explained the reasons which guided the Committee in their determination to employ, in this instance, the services of one who had made the construction of hospitals an especial study.

The action of the Board of Management was unanimously approved by the Meeting, and a cordial vote of thanks passed for its unremitting labors in the matter.

M. TENON'S PROPOSED HOSPITAL.

FEW works have been written upon the subject of hospital construction without reference being made to the rules laid down by M. Tenon in his great work, entitled "Memoirs sur les Hôpitaux de Paris,"* and as this has been many years out of print, and is scarce, it will not be inappropriate to make my readers acquainted with the general principles laid down by him for the construction of hospitals; especially so that these principles gave rise to the system, now so generally adopted, of erecting hospitals on the pavilion system. The scope of this work will not, however, permit so lengthy a notice of M. Tenon's views as their interest would otherwise demand; it must therefore suffice that I give, in addition to illustrating his proposed plan for a model hospital, the substance of his general opinions, as set forth by a Committee of the Royal Academy of Sciences, of Paris, appointed in the year 1787, to examine and report upon the memoirs above referred to.

"EXTRACT FROM THE REGISTERS OF THE ROYAL ACADEMY OF SCIENCES, SEPTEMBER 1787.

"The Academy having directed the Hospital Committee to examine the Memoirs on Hospitals, collated and presented to the Academy by M. Tenon, we proceed to give an account of them.

"This interesting work is composed of four memoirs, and we will give to the Academy an idea of each of them successively.

"The first is a table of the hospitals of Paris, shewing their particular purposes, and the total amount of help they give to the poor of the capital.

"We there see that Paris has 48 hospitals for the poor, 22 being for sick, 6 for sick and healthy, 20 for the healthy only.

"In these hospitals, the number of sick aided may be put at 6,236, and of healthy and infirm about 14,105; then, if we add the 15,000 foundlings who are brought up, it will be seen that the City of Paris administers help to 35,341 poor. This number is large relatively to the population of Paris, supposing this to be, as M. Tenon puts it, 660,000; it results that one individual in every 18½ requires charity of this kind. Leaving out the foundlings, the poor of Paris are to its population as 1 to 33, and the poor sick as 1 to about 106. M. Tenon, in finishing this memoir, observes that two additional hospitals are still required in Paris, one for the treatment and cure of the blind, another for the inoculation of the people's children.

"After this general table, based on the results and the calculations of the first memoir, the second enters into detail as to the different hospitals; their form is described and their purposes shewn. M. Tenon also remarks on their conveniences or inconveniences. The object of M. Tenon's enquiry into the condition of the hospitals of the capital has been to ascertain what should be avoided and what initiated in the establishment of any new hospitals; also to collect together information as to all that is good in those which have been built up to the present time, and so give a quantity of information as to this important object that will not only serve as a guide to the building projects of the present time, but in all those which may be contemplated in the future.

"In one of these hospitals, M. Tenon learns that wards for putrid fever must not be placed near the wards of the wounded. The fact was disclosed to him that the wounded whose beds were near the doors of communication of these wards did not get cured at all, or were cured with greater difficulty. In a second hospital, he remarks that the linen and clothing were separated according to the locality of the different diseases, so that the linen, even when clean, is prevented from being taken from one kind of sick person to another. In a third, he discovers that furious maniacs have rooms where they are shut up and are not mixed with the more quiet inmates. In others, he observes that the beds or the window frames are of

* Paris, 1788.

Hospital Construction and Management.

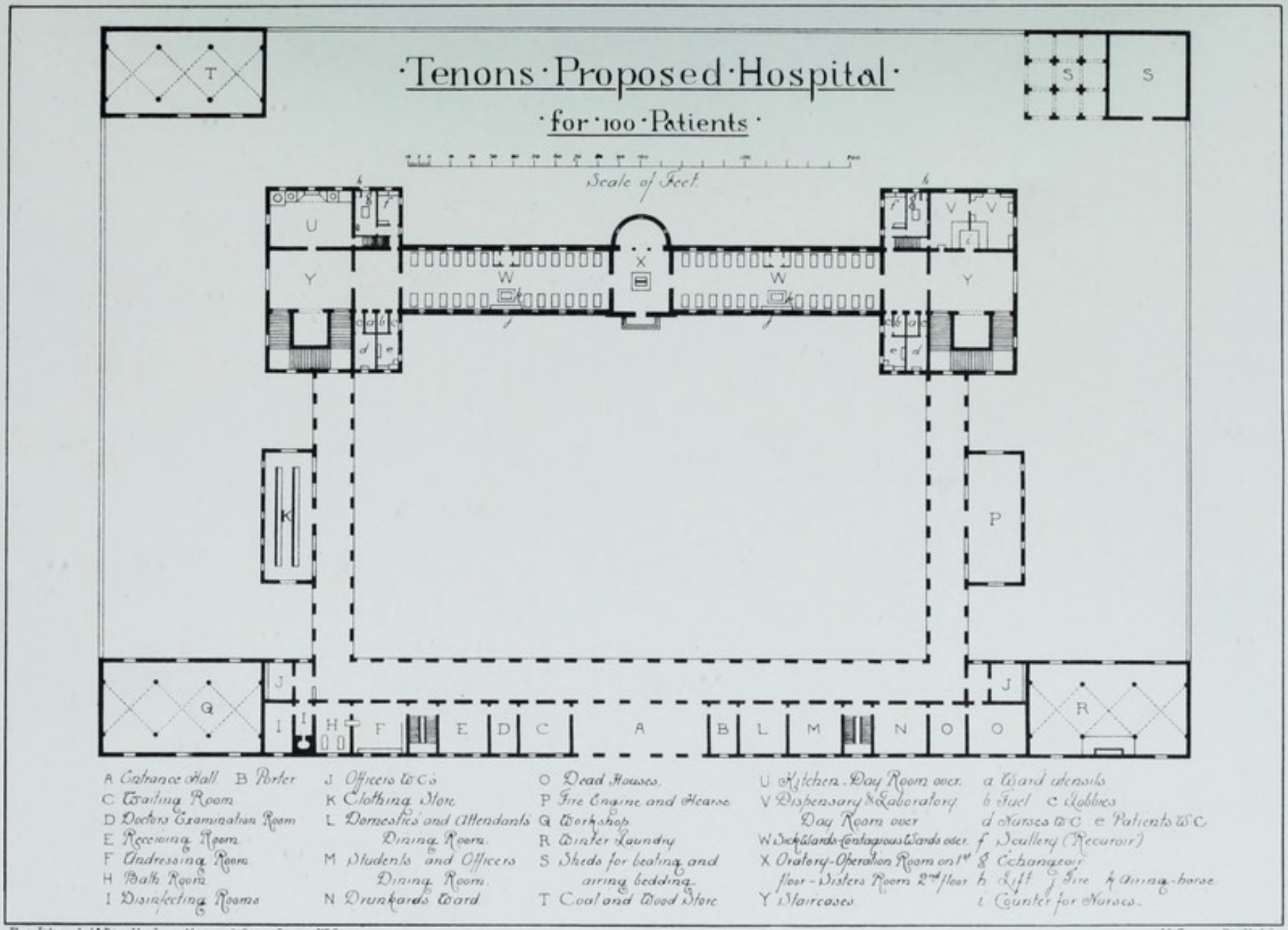


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H. Saxon Snell del.

iron, the kitchen utensils of wrought-iron, that linen may be washed out by payment, and that the supply of food may be contracted for.

"His observation of the hospitals of Paris collectively lead him to a recognition of the fact that the convalescents are in proportion to the total number of sick as 1 to 3, and the wounded as 1 to 5; and also that of all these the women are to the men as 1 to 3. These important elements will be useful when considering questions as to the distribution and attribution of beds to the different diseases in hospitals, that it may in future be proposed to erect. He observes that, generally, the hospitals of Paris are not sufficiently provided with water, whereas it is necessary that they should have an abundance, since it is upon this abundance that the cleanliness and, consequently, the salubrity of the place, and the cure of the sick depends. We think it useful also to mention here a hope of M. Tenon, that the reservoir commenced in the neighbourhood of the hospital of the Valpêtriere, having become useless for its purpose, should be immediately filled up; the water stagnates in dry weather, and the exhalations cannot, therefore, but be fatal to the sick of this hospital, besides possibly being noxious to the inhabitants of the capital, when the exhalations are blown about by the winds.

"M. Tenon, having thus first instructed himself by detailed investigations of all the hospitals of Paris, passes to a consideration of the Hôtel Dieu, which appears to be the principal object of his work, forming as it does the subject of the third and fourth memoirs, which are much more extended than either of the others. M. Tenon considers separately the buildings of the Hôtel Dieu and its dependencies, its furniture, its sick, and its attendants. All these matters contribute their part to the well-being and comfort of the sick, and they form separate articles, each of which being treated with sufficient detail, it is possible to acquire a considerable knowledge as to building and appurtenances of the Hôtel Dieu.

"In this examination, M. Tenon finds more to avoid than to imitate; there is useless multiplication of administrative offices, complication of administration, confusion of the departments, and an improper accumulation of sick in a space too small for the 3,400 patients which the Hôtel Dieu accommodates, calculating only four sick per bed,* there are 2,600 in the single building of the Rue de la Bucherie, and on an area of 970 "toises"; the disposition of the staircases is bad, they are without air, and are infected; the rise of the steps, although sufficient for healthy people, is not correct for convalescents; there are double wards where the air is renewed with difficulty; large quantities of combustible materials are placed under the wards. No ambulatories are provided for the convalescents, at least, there is but one for men, and this for all maladies. Women are unprovided with this important assistance towards the cure of their complaints. We will not enter into the details of the article which treats of the furniture, and we will only repeat a curious and interesting extract as to the inconvenience of placing three, four, and six patients in the same bed; the physical causes, from which the danger and sickness of the patient result, are developed thereby, and this result which has been inferred from an extract in the first report of the committee is known to the Academy. We hasten to pass to the article which deals with the sick. M. Tenon remarks, first of all, in comparing the Hôtel Dieu with various other hospitals, that it is the only one where the number of the wards is so small in comparison with the number of the sick; the result being that each ward contains too many patients, and M. Tenon protests with reason against this abuse; he comes to the conclusion that it is absolutely necessary to so multiply the number of the wards, that each should contain a moderate number only of sick. M. Tenon devotes himself next to the dimensions of the wards, and shews that their length is regulated by the number of the beds, and their width by the eighth of a man, from which it results that for two rows of beds, the width of the wards must be 25 "pieds"; lastly, that their height is regulated by the class of patient. Inflammatory diseases require high rooms; old or debilitated people who require warmth must have rooms less lofty. M. Tenon has devised a means of comparison in this respect of wards one with the other; it is to consider the quantity of air each patient has to respire, and its circulation and renewal. The Hôtel Dieu in confounding all the departments, and bringing together all classes of diseases, develops the cause of a frightful mortality, and has shewn M. Tenon the

* It will be observed that at page 151 reference is made to M. Husson's work, "Etudes sur les Hôpitaux," where doubt is thrown upon the assertion that four, six, and more patients laid in this hospital in the same bed, because "nothing in the archives justifies such an assertion," and that the "Mémoire of the Physicians of the Hôtel Dieu, presented in 1756, makes no allusion to the circumstance, although a description of the form of the beds occupies a large share of the report;" but here we have the testimony of M. Tenon, confirmed by his colleagues in the year 1787, that the average *minimum* number of patients to each bed was four.

necessity for the classification of these diseases, and for their separation as much as possible. There are above all, in the Hôtel Dieu, six classes which should be separated in a well-ordered hospital; those who are attacked with contagious diseases, lunatics, ordinary sick, wounded, pregnant or lying-in women, and the convalescent. It would be desirable to determine from a large number of sick, such as that of the Hôtel Dieu, the relation of the number affected by these different maladies to the sum total of the inmates; but the registers of the Hôtel Dieu were unattainable by M. Tenon, as they were by the Commission of the Academy. M. Tenon, nevertheless, considers he may believe that there are 130 small-pox cases at times of overcrowding in the Hôtel Dieu; and it is useful to know that he desires the small-pox cases to be for ever separated from the other sick, and that he considers those attacked by measles should also be separated. Itch is again an important malady at the Hôtel Dieu; the Hôtel Dieu gives it and does not cure it, since it refuses those who have it without another accompanying malady. M. Tenon believes that as many as 1,200 is the number of those, both sick and attendants, who are thus attacked; he thinks also that scorbutic, scrofulous and cancerous patients should be separated from the other sick; they are, in fact, at the Hôtel Dieu, for they are all such patients as are sent to Saint Louis. M. Tenon proposes also to separate malignant fever and dysentery cases.

"The lunatics are an important department at the Hôtel Dieu, for it is the only place in Paris where they are treated. This establishment is necessary, not only for the poor, but for those who, without being absolutely poor, are not in good enough circumstances to undergo an expensive treatment. M. Tenon takes notice of the necessity for a separate room for violent patients, in order that cases of hydrophobia may not be confounded with madness, as is the case at the Hôtel Dieu; but the two most important articles are those on the wounded and lying-in women; these two departments are numerous. The State has the greatest interest in caring for individuals in good health but wounded by accident, and mothers in the flower of their age, both of which renew the population. These two subjects have been treated by M. Tenon with a care proportionate to their importance. He remarks and proves that everythiing which is essential to the wounded—pure air, cleanliness, and quiet—are wanting at the Hôtel Dieu. He asks that the wards for the wounded shall be well ventilated, kept clean, separated from any bad odours, and preserved from the noise of the house and the street traffic. He asks for wards for inmates in preparation for operation, wards to carry out the operation, and wards to achieve the cure. By these means more wounded may be cured in a hospital, and the State thus preserve a large number. As for the lying-in cases, we will not repeat here the table which the notes and observations of M. Tenon (of which this memoir is the result) have enabled us to trace in this report to the Academy; we have shewn to us the confusion of all the parts of this department—the want of air, damp, and all other causes of danger which threaten the lying-in cases. There are some curious facts concerning the number of Cæsarian operations and laborious accouchments; but these have already been given in the report. We could not then say anything on the mortality which is the result of the bad arrangement of the Hôtel Dieu; we did not have the abstract of the registers. M. Tenon has procured it, and it goes over a period of eleven years. The result is to shew that whilst the mortality of the British hospital is 1 in 51 that of the Hôtel Dieu is 1 in 15⅝; a frightful mortality, and which alone would necessitate the reform of the Hôtel Dieu; for it is as well to observe that it is not a question either of a period of epidemic, or where puerperal fever makes ravages. The mortality in these cases has often been half, and sometimes 19 out of 20. M. Tenon, to remedy this mortality, proposes to entirely separate lying-in cases from the other sick—above all from the wounded; to put a smaller number in the same wards; to ventilate these wards; to shelter them from damp and noise; to separate healthy pregnant women from unhealthy; and, for the sake of morality, prostitutes from poor and honest women.

"M. Tenon again asks that there should be a room or the patients to work in whilst waiting delivery, and a private promenade where those who desire it may retire and not be seen. M. Tenon then passes on to the convalescent, who require great care in a hospital, as much from their number (about one-third of the sick) as from the necessity of completing their cure, and also to avoid anything which may cause a relapse, or otherwise retard their complete cure. M. Tenon asks for them open promenades, with covered ones in bad weather; he desires to see them lodged on the ground floor and that they should descend to their walks by gentle slopes, to save the stepping up and down of those with weak legs. He desires them to be well clothed, as at the Charité, and he proposes that they should have gentle exercise to hasten the return of their strength. Above all he recommends that the different species of convalescents should be separated—small-pox, itch, and all those recovering from contagious diseases. They should have their own separate promenades, and even their own wards.

"We had already announced this work in the report which we have made on the actual state of the Hôtel Dieu. We then said that we would not enter into an infinity of the details which the salubrity and the cleanliness of the hospital and the care of the sick might demand, because these details were included in the work which one of us, M. Tenon, had communicated to us, and which he had the immediate intention to publish. It is the fruit of a twenty years' study of hospitals that the committee had charged M. Tenon to publish. We then announced that this work would be useful both to the architect charged with the construction of a hospital and to the administrator who would govern it. What we said on a first examination we repeat to-day after a deeper one. The memoirs and the observations which M. Tenon has communicated to us have supplied the information we required concerning the Hôtel Dieu. The Academy, in the account we have just rendered, may recognise several of the elements of our report. This knowledge, which has been useful to the Academy in forming a judgment on the project for new hospitals, will be equally useful to those who propose to construct them. We look upon this work as the most profound and the most complete of its kind, and we believe it deserves the approbation of the Academy and to be printed under its privilege.

"At the Louvre, September 5, 1787. Lassone, Tillet, Laplace, Daubentar, Darcet, Coulomb, Lavoisier, Bailly.

"I certify the present extract to be conformable with the original and the judgment of the Academy at Paris, September 7, 1787.

"THE MARQUIS DE CARDORCET."

As a further exemplification of the views laid down in the memoirs referred to, M. Tenon gives a plan shewing how he would arrange a hospital for 100 inmates. This plan is illustrated at page 264, and the following is his explanation of its principal features:—

Entrance.—The entrance in the centre of the front block is the only one to the establishment; this is insisted on by M. Tenon as a proper arrangement for all hospitals, in order that there may be one porter responsible for every person or thing entering or leaving the establishment. The vestibule, as will be seen, is very large.

Offices of the Governing Body.—Above this entrance are the offices of the governing body of the hospital, consisting of two ante-chambers, clerks' office, board room, private room, room for the archives, and a treasury. These are approached at either end by the two staircases shewn on plan, and are on the first floor above the entrance and between the two staircases.

Officers' Apartments.—On the second floor, above these offices, are the steward's rooms and the apartments of the various officers and attendants, whose duties would be in this front building.

Porter's Rooms.—On the right hand side of the vestibule is the porter's office and night room.

Waiting Room.—On the left hand side is the waiting room for the sick and their friends, with benches around, and warmed by a stove, which also supplies warmth to the doctors' consulting room.

Doctors' Room.—Adjoining this waiting room is a doctors' room, where all the patients are seen on their entry, and where persons found either drunk or insensible in the night would be brought to be seen by a doctor, who should always be in attendance.

Receiving Room.—This room, which adjoins the doctors' room, would have two counters, one for registering the name and other particulars of the patient admitted, and the other for registering their portable property, which would be deposited in a strong room under the staircase.

Dressing Room.—This room, leading out of the last, is for the purpose of clothing the admitted patients, and preparing them for admission to their allotted ward.

Bath Room.—Adjoining is a bath room, with two baths and linen closets for bathing the patients. Hot water would be supplied by a stove placed in the undressing room.

It should be observed that there are wide doors exactly opposite one another in all these reception rooms, in order that a patient on a litter may be carried through without much disturbance.

Disinfection Chambers.—The disinfection chamber is furnished in one part with a stove for burning sulphur, and a vaulted room adjoins it with racks for placing clothes containing vermin, or contagious miasmas, and exposing them to the vapour of the sulphur.

Inmates' Clothing Store.—All the clothing of the patients during their sojourn in the hospital would be taken from them, cleaned, and disinfected, and placed in this room, which is entered from the left hand corridor. It should be provided with numbered lockers, each about 2 feet wide, 2 feet deep, and 20 inches high ; they should be quite open on racks, and not above arm's reach. The windows should be glazed, the sashes and skylights being closed in warm and opened in cold weather. M. Tenon gives his reasons for this, as follows:—

"These precautions are necessary to guard against moths and dormestidue, voracious insects which swarm in a temperature of 5 degrees of heat, and certain species of which devour animal substances, particularly woollen stuffs; the least clean woollen stuffs, stuffs which are least woven, those of a velvety nature, those but slightly dyed, are in general more exposed to the voracity of these insects.

"The laying time of moths is, in our (the French) climate, during April, May, June and July, and during these seasons most care should be taken of the clothes of the poor, inasmuch as these give out bad odours. The clothing store is one of the unclean departments of a hospital, and this is why I have put it at a distance from the sick wards ; and for convenience of service it is placed in the neighbourhood of the undressing room and the disinfection room. . . . . Nothing better is known, in the second hand clothing shops of Paris, where quantities of old clothes are stored, than the practice of opening each packet once every fortnight during summer, brushing gently and then refolding them."

Attendants' Dining Hall.—On the right hand side of the entrance is the dining hall for the attendants.

Officers' Dining Hall.—Adjoining the above is the dining hall for the medical students and upper officers generally.

Room for Drunkards.—Beyond the right hand staircase there is a room for keeping drunken and other non-sick patients found during the night, until they are restored to their families.

Dead House.—Adjoining the above are two dead-houses.

Officers' W.C.'s.—At the ends of the corridors of this first block are w.c.'s, &c., for the use of the attendants and officers.

Steam and Fire Pump Shed.—Leading out of the right hand corridor is a shed for containing a covered bier and a pump and buckets for extinguishing fire.

Workshop.—At the extreme left end of the first block is a workshop.

Laundry.—At the extreme right end is a laundry, for use in winter.

Wood and Coal Store.—In the large courtyard on the left, and on the top left hand corner, is a large wood and coal store.

Bed Clothes Shed.—In the large courtyard on the right and in the top right hand corner are sheds for beating and airing the bed clothes, &c. M. Tenon says that those simply charged with dust should be beaten every fortnight in the yard and exposed to the air, and that those charged with vermin or contagious miasmas should be first washed in potash and water, say about 1 lb. to a mattress.

Sick Ward Block.—M. Tenon considers it indispensable in cold and damp countries that this block should be raised three or four feet out of the ground and built on vaults.

Kitchen.—The kitchen, as shewn on the ground plan, is in the left hand wing, and in the basement would be the scullery and the stores.

Dispensary.—On the ground floor of the right hand wing, and in a similar position to that of the kitchen, is the dispensary and laboratory. At the entrance is a place for the distribution of medicines, surrounded with tables to contain the numbered baskets from the sick wards. At the back is a proper laboratory for preparing medicines, washing bottles, &c., and stores would be provided in the basement. The tisane is here prepared in an apparatus consisting of two tanks of lead, with a pipe leading into the corridors and furnished with taps for drawing off at will.

Principal Sick Wards.—One of the two wards on the ground floor is for men and the other for women. Each is of parallelogram shape, contains 24 beds, and, as shewn by the drawings, is 98 feet long and 28 feet wide. The total superficial floor space is, therefore, 2,744 feet, or 114 feet per bed; the cubic contents cannot be stated, as no section is shewn. The average lineal wall space is 8 feet 2 inches per bed.

The ward is warmed by a stove placed in the centre against the front wall, and at the back there is a horse for warming the linen of the patients.

The small cabinet shewn in the centre of the ward is for a night nurse, and on either side are tables with cupboards under.

Oratory.—Between these two ground floor wards is an oratory for the use of the sick.

Other Sick Wards.—On the first floor these wards are split up into five, three being for women, and two for men; the first women's ward is for fever cases, the second for wounded, and the third for operation cases; the first men's ward is for wounded, and the second for operation cases.

Operation Room.—In the centre, over the oratory, is the operating room.

Sisters' Room.—The second floor is divided into various wards for the use of the sisters.

Staircases.—These, as designed by M. Tenon, are in three flights, with two landings provided with seats, both sides are hand-railed; the steps are 10 feet long, 14 inches wide and 4 inches high.

Water Supply.—Above the staircases are two large reservoirs to hold water.

W.C.'s, &c.—These are approached by a lobby with double doors: there are two water-closet seats, with a leaden trough underneath and a water tap and waste leading into the lead down pipe from the upper w.c.'s. The slop sink is formed of a slab of hollowed stone covered with lead, with water tap and waste to the leaden down pipe; it is covered with a wood seat, and used for emptying chambers, &c. The urinal is a long trough of hollowed stone covered with lead, and laid to slope to the down pipe; it is provided with a water tap, and the wall at the back is dressed 4 feet high with lead. There is also a

sink to take the drainage of the floor, which is covered with "Canigou," and laid to fall towards this sink.

Stores.—At the ends of the wards there are closets for fuel, bed linen, and general ward stores.

Lavatory.—This room, called by M. Tenon, "Récuroir," is approached from a lobby, and contains several sinks for washing purposes, constructed of stone lined with lead. It also has a grating for drying the utensils over a fire after washing.

Ward Laundry.—Adjoining the "Récuroir" last described, is a room which M. Tenon would devote to the washing of the ward linen immediately after its removal from the patient, it being considered desirable that the linen from one class of patients should not be intermixed with that of another, as is the case when a general laundry is provided for the purposes of the whole establishment. A lift is shewn in one corner of this room for raising the articles when washed to the attic floor, where means would be provided for drying, &c.

Day Rooms.—Above the kitchen and dispensary are the day rooms, which, together with the very large vestibules and lobbies, give ample space for convalescent patients.

· The · Takhtsingji · Hospital ·

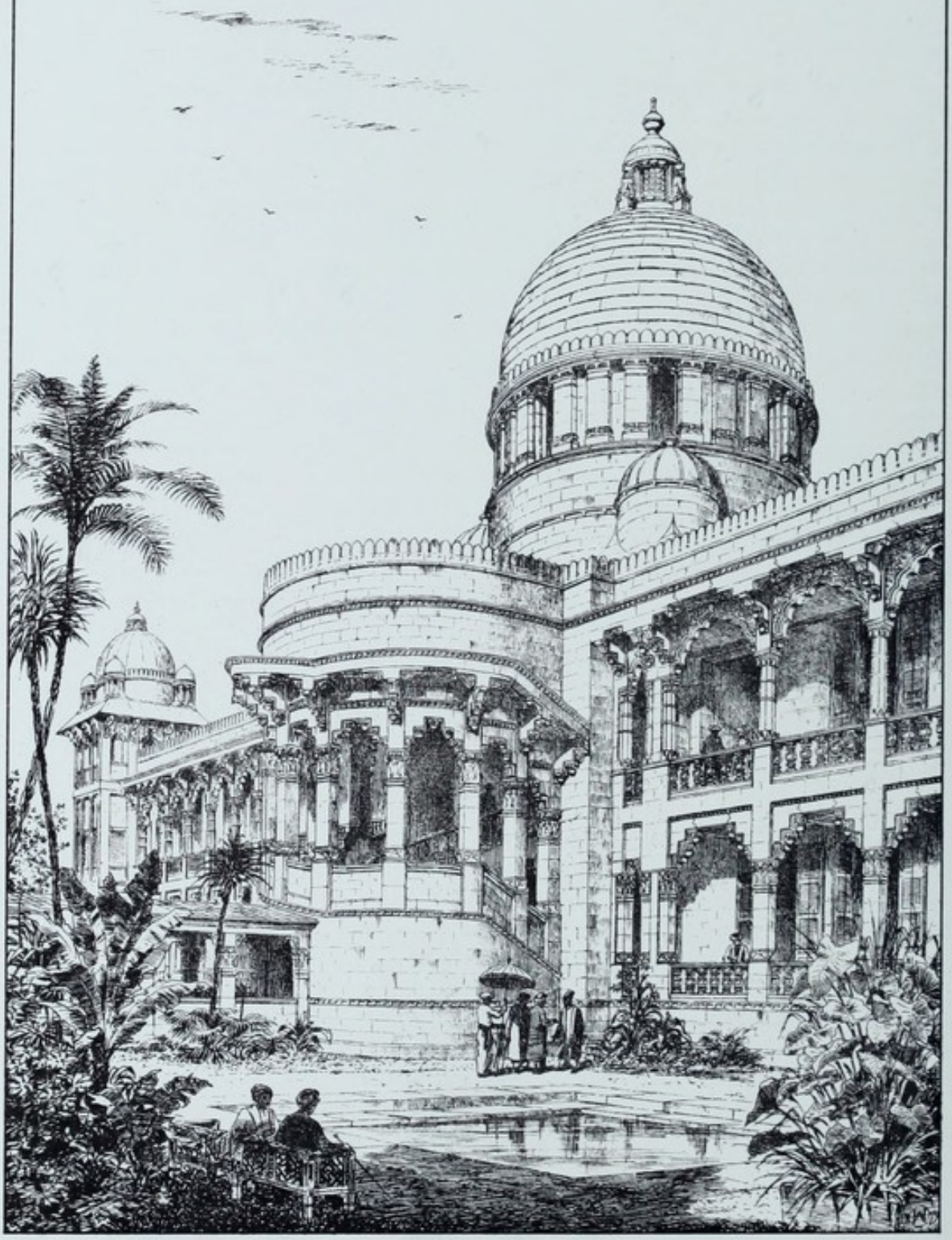


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TAKHTSINGJI HOSPITAL.

BHAVNAGAR, INDIA.

THE more modern hospitals of India have generally been erected from designs prepared by the military authorities or by Government engineers. In some few instances, however, architects in England have been commissioned to prepare the designs, but the erection of the buildings has nearly always been entrusted to local authorities. Such was the case with the Takhtsingji Hospital, illustrated upon the accompanying plates. This building was designed by Mr. W. Emerson, to whom I am indebted for the following brief particulars. Its erection was superintended by Mr. R. Proctor-Sims, Executive Engineer of the Bhavnagar State.

The foundation stone was laid January 1879, by His Highness the Thakore Sahib, on the day of his coming of age. This prince is one of the most popular, as well as advanced, of the native Indian rulers.

An account of the building, written by the architect during its erection, states that "It was desired that the design should depart from the Mahometan type of Indian architecture, which has been adopted in so many of the modern Indian buildings, and a more Hindoo feeling introduced—a somewhat difficult thing to accomplish, as the Mahometan pointed arch lends itself so naturally to the verandah requirements. For this reason the lower tier of openings has square columns and corbelling. In the upper tier, instead of horseshoe arches, an arcade of a sort of cusped arch is introduced, mainly because it was desired that the building should be elaborate in carved work, and the spandrils of the arches seemed the most suited for enrichment, following many good examples of the transition period. The balusters, some 800 in number, will be sent from England, cast in Portland cement concrete, colored to match the stone of which the hospital is being built. These are being made by Mr. W. H. Lascelles; and also the dome, which is of peculiar construction, with ribs, forming a sort of fixed centreing, on which the roofing slabs will be laid—the ribs and lower rings of the slabs being of concrete as heavy as Portland stone, the upper rings and lantern with lions of similar material but as light as pumice stone. The whole building, except the roof timbers, will be fireproof."

Site.—The building stands upon one of the most elevated parts of Bhavnagar, overlooking the town on the north and north-east of the site. A number of small hills, rising about 80 or 90 feet above the plain, are ranged at a distance of about a quarter of a mile.

The site had no defined boundary at the time these particulars were taken, so that the area cannot be stated.

General Arrangement.—The building consists of two blocks, connected together by a long corridor; the front block being devoted to the patients, and that in the rear to the administrative department. The patients' block consists of a double pavilion, having,

on the ground floor, a large central entrance-hall and staircase, store rooms, dispensary and waiting room; also one sick ward for 14 ordinary patients, and another for 6 patients suffering from contagious diseases. The bath rooms, lavatories, and water-closets are placed in towers at the four angles of the building; they are completely isolated from the wards, and are reached by passing along the open verandahs surrounding the building on each floor. The upper storey contains one ward for 18 beds and five separation wards for 1 patient each, and, although the building is intended principally for the accommodation of male patients, there is an additional ward on this floor for the reception of 10 female patients. An operation room is placed over the entrance-porch.

The rear block of buildings contain the officers' quarters, with separate kitchens for Hindoos and Mahometans, a wash-house, and laundry. The mortuary is placed near to one of the gates giving access to the ground.

Total Accommodation.—The total number of patients provided for is 53, in four wards, containing respectively 18, 14, 10, and 6 beds each, and five wards with 1 bed in each.

Connecting Corridor.—The corridor connecting the front pavilion with the administrative buildings in the rear is 6 feet 6 inches wide and 10 feet high; it is 3 feet 9 inches below the level of the principal or ground floor.

PRINCIPAL SICK WARD.

The following description of the largest ward will sufficiently explain the general arrangement for the accommodation of the patients.

Aspect.—The axis of the front pavilion building runs from N.E. to S.W., so that the windows of the wards face N.W. and S.E.

Size of Ward.—The wards generally are of parallelogram shape, and the one under description contains 18 beds. Its extreme length is 77 feet, its width 25 feet, and its height 15 feet 6 inches, so that the superficial floor space is 1,925 feet, or about 107 feet per bed, and the cubic contents 29,838 feet, or 1,658 feet per bed.

Bed Space.—The average lineal wall space per bed is 8 feet 6 inches.

Windows.—All the windows open on to the verandah, and are double folding casements or doors, 14 feet high. The outer casements open towards the verandah, and their panels are filled in with deal louvres, the opening or closing of which can be regulated at pleasure. The inner casements open inwards, and are glazed in the ordinary manner. The total effective glazed surface of those next the beds is 264 superficial feet, or about $14\frac{2}{3}$ feet per bed, but, if the end window be added, the glazed surface per bed is $15\frac{1}{2}$ feet. When all the windows next the beds are opened to their fullest extent the total area through which air can be admitted by them into the room is 860 feet, or $47\frac{3}{4}$ feet per bed, but, if the end window be added, this area is increased to $50\frac{3}{4}$ feet per bed.

Warming and Ventilation.—No means of warming are requisite, and the ventilation is effected solely by the opening and closing of the windows.

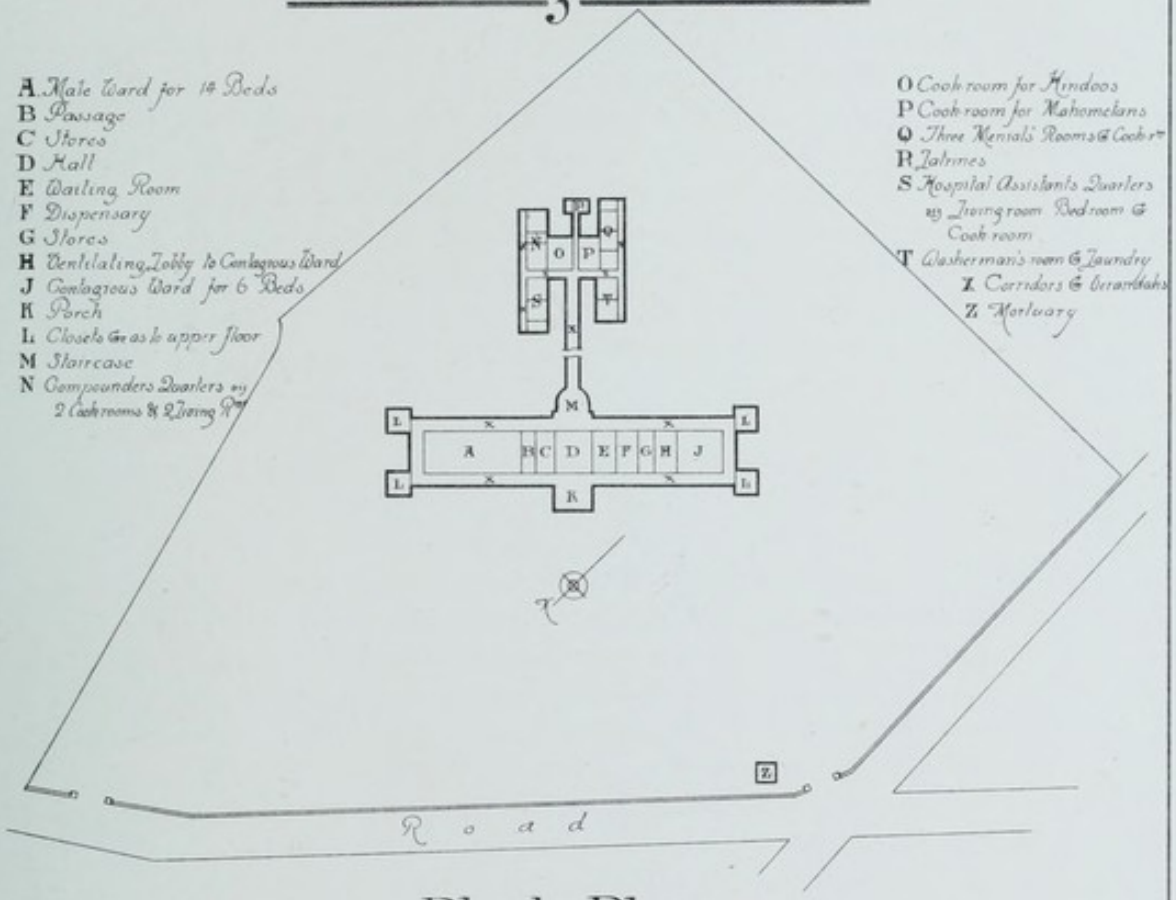
Walls and Floors.—The walls are generally 2 feet in thickness, the external faces being of red sandstone. The floors are constructed with rolled iron joists and concrete, and the surfaces finished with tiles.

W.C.'s, Baths, &c.—The water-closets are each 6 feet 3 inches long and 3 feet 9 inches wide. No drainage from them is provided, moveable pans being employed, and

Takhtsinghji Hospital
Bhaunagar India

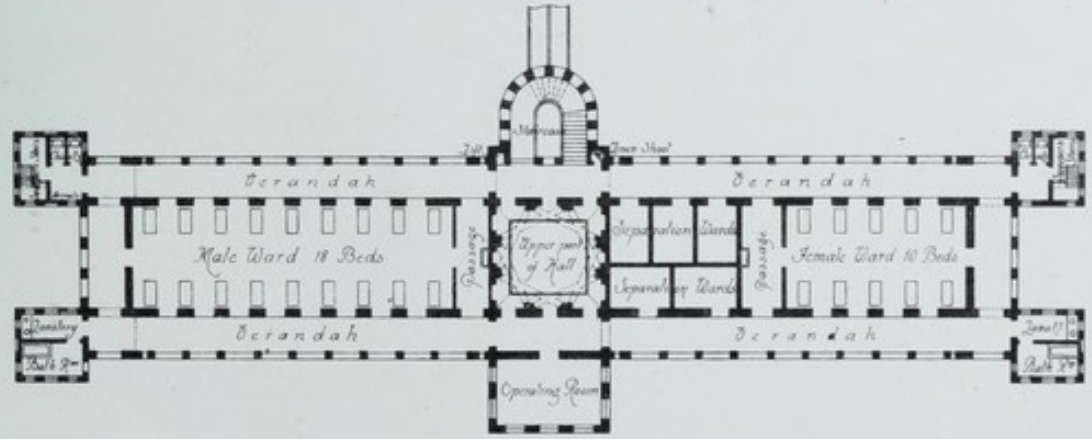
A Male Ward for 14 Beds
B Passage
C Stores
D Hall
E Waiting Room
F Dispensary
G Stores
H Ventilating Lobby to Contagious Ward
J Contagious Ward for 6 Beds
K Porch
L Closets Grs to upper floor
M Staircase
N Compounders Quarters wh 2 Cook rooms & 2 Living Rms

O Cook room for Hindoos
P Cook room for Mahomedans
Q Three Menials Rooms & Cook rm
R Latrines
S Hospital Assistants Quarters wh Living room Bed room & Cook room
T Washerman's room & Laundry
I. Corridors & Verandahs
Z Mortuary



Block Plan

Scale of Feet



Plan of Upper floor

Scale of Feet

Photo-Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

H. Saxon Snell del.

their contents removed daily, and deposited upon the grounds. The bath room is 15 feet long and 8 feet wide, and the lavatory is 15 feet long and 6 feet wide.

Verandah.—The verandahs are 8 feet wide and 15 feet 6 inches high. They encircle the building on each floor, and form ambulatories for the use of the patients.

Separation Wards.—Of the five separation wards, three are 14 feet long and 10 feet wide, and two 15 feet long and 10 feet wide; all are 15 feet 6 inches high, and, therefore, their average superficial contents is 144 feet per bed, and their average cubic capacity 2,232 feet per bed.

Staircase.—The principal staircase has steps each 6 feet long, 12 inches wide, and 6 inches high. Smaller staircases are placed in the two rear angle towers for the use of the attendants. A small food lift and a linen shoot are placed on either side of the principal staircase.

Basement.—Generally there is no basement beneath the lower wards, but under one tower there is a furnace-room for the purposes of the hot-water supply to the various baths and lavatories.

Total Area of Pavilions.—The total area covered by the upper or principal sick ward floor of this pavilion, including the verandah and towers and the outer walls, is about 13,194 feet, or nearly 400 feet per bed.

An account of this building, with further detailed drawings, was published in "The Architect," April 19th 1879. The plate at page 271 is a reproduction of one of those drawings.

DR. BURDON SANDERSON'S PROPOSED HOSPITAL WARD.

It has been shewn that nearly one hundred years ago M. Tenon first published his suggestions for the planning of hospital sick wards upon the pavilion principle, and that it was not until seventy-five years afterwards that these propositions were, for the first time, realized by the construction of the Lariboisière Hospital. The various types illustrated in this Section shew how great has been the improvement made during the last twenty or thirty years in carrying out the details of the system.

M. Tenon's crude ideas, as shadowed forth by his plan, reproduced at page 264, was, as might be expected, defective in many of its minor details, and it is, perhaps, for this reason that the good advice he gave was not immediately appreciated, and in consequence slept for some sixty years or more. Nevertheless, it was undoubtedly the forerunner of the system of hospital construction now generally considered by all experts to be the best.

This should make one careful not to hastily throw aside a suggestion for the improvement of hospital construction, which in its inception may be shewn to be imperfect in some of its details, and especially so when the proposition emanates from the brain of an eminent scientist.

For this reason, and because the principle of destroying contagious matter, whether arising from small-pox or from other less virulent disorders, as soon as possible after it is brought into existence, is undoubtedly a right one; I have thought it would not be inappropriate to place on record the following account of a proposal for the erection of sick wards recently made by our distinguished countryman, Dr. J. Burdon Sanderson, in his evidence before the Commission on Small-Pox and Fever Hospitals,* premising, however, that the principle of passing the vitiated air of hospital wards through fire was previously promulgated by the world-renowned Dr. Benjamin Ward Richardson in a paper read by him at a meeting of the Sanitary Institute of Great Britain.†

Dr. Sanderson's plan is illustrated upon the accompanying plate, and the following extract from the report referred to above gives the details in his own words:—

"I assume in reference to this subject that it is necessary that we should possess in London, hospitals for the reception of the most acute cases of small-pox, and consequently that for that purpose it would be desirable that hospitals should be constructed on a principle not hitherto recognised in their construction, *i.e.*, with regard to the welfare of the surrounding neighbourhood, and not only with regard to the welfare of the inmates of the hospital. With this view it is in the first place necessary that the hospital should be ventilated artificially, in order that the air which is used by the patient may, after it has passed through the hospital, be subjected to high temperature or some other means of destroying whatever dangerous properties it may possess before it is discharged. As the outlets of air are the sources of danger, and not the inlets, it is preferable that the air should be drawn out of the hospital and not driven into it, and consequently we should choose a mode of ventilation accordingly, and, that being adopted, the beds for the patients should be placed as near the outlets for air as possible, and further, the outlets themselves should be as near together

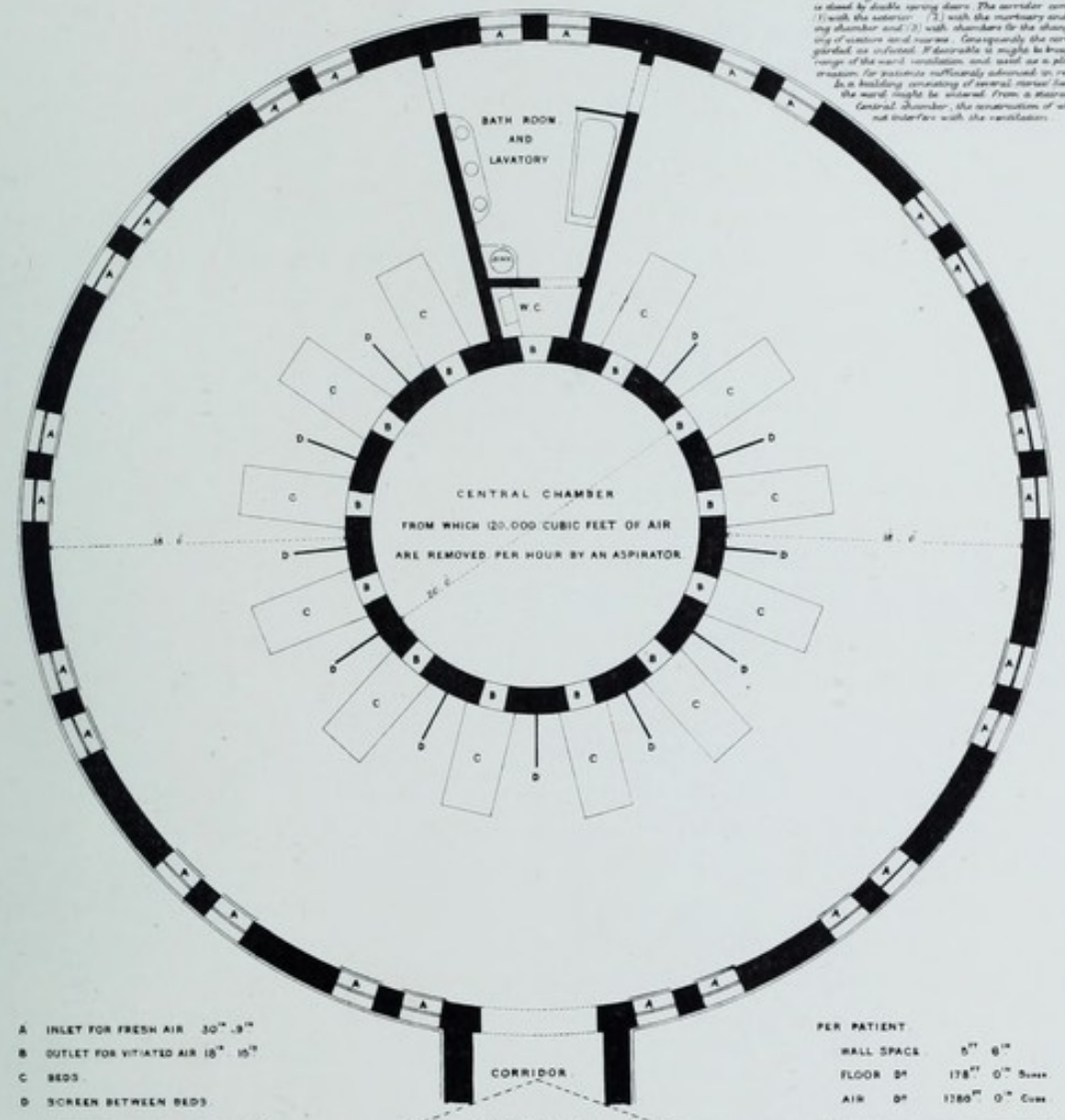
* Eyre & Spottiswoode. 1832. † *Transactions of the Sanitary Institute of Great Britain*, Vol. III.

Hospital Construction and Management.

Annular Ward for the Reception of 12 Small-Pox Patients.

As Proposed by Dr J. Burdon Sanderson F.R.S.

Authentic sketch of Annular Ward referred to in Dr Burdon Sanderson's evidence Qu. 3488, showing the general arrangements and the measurements of the inlets and outlets for air. The following details are omitted. The entrance from the corridor is closed by double spring doors. The corridor communicates (1) with the mortuary and disinfecting chamber and (2) with chambers for the changing of clothing of visitors and nurses. Consequently the corridor is regarded as infected. If desirable it might be brought within range of the ward ventilation and used as a place of retirement for patients sufficiently advanced in recovery. In a building consisting of several wards (in Qu. 3492) the ward might be observed from a staircase in the central chamber, the construction of which would not interfere with the ventilation.

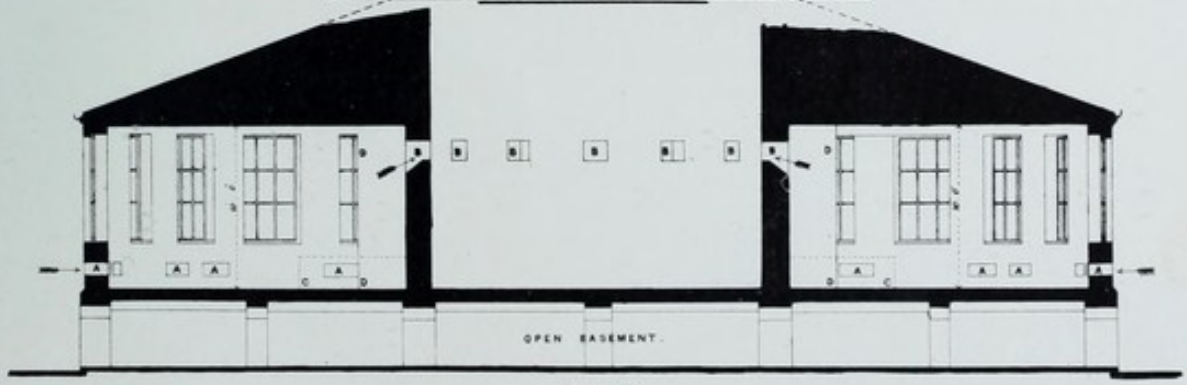


A INLET FOR FRESH AIR 30" × 9"
B OUTLET FOR VITIATED AIR 18" × 15"
C BEDS
D SCREEN BETWEEN BEDS

GROUND PLAN.

PER PATIENT.

WALL SPACE		5ft 6in
FLOOR	5ft	178ft 0in Superf.
AIR	5ft	1780ft 0in Cubic



SECTION.

SCALE OF FEET.

Photo Lithographed & Printed by James Akerman, 6, Queen Square, W.C.

as possible. The communication between the outlets and the source of motion, whatever its nature might be, should be as direct and ample as possible. Considering all these purposes, it is desirable that each ward should be in the form of a ring, with the chamber from which the air is directly extracted in the centre of the ring, the annular being the simplest form that can be given to it, that is to say, the one that makes it possible to make the opening for extraction of air communicate more directly than any other with the space in which each bed is contained. Then for a ward of 12 beds, having a capacity of about 1,200 cubic feet per bed, the removal of air should be about 120,000 cubic feet per hour, and, consequently, the removal of air per patient 10,000 cubic feet per hour. The exact form of the ward which I should propose is shewn by this model which I will proceed to explain. Let me say that this fan which is placed here is not analogous in form or size to the motor which one would actually use for extracting air from a ward; it is analogous in structure, but, in relation to the size of the ward, it is incomparably larger. The annular form of the ward is shewn when I take away this moveable part which represents the external wall. These openings round the lower edge are the openings by which air would enter into the annular space. This is the internal wall of the annular space, and in this internal wall there are twelve openings corresponding to the 12 beds, which are of the same relative size as these. The beds would be arranged as near as possible to and immediately below each extracting opening, and would be placed against the internal wall, and each bed would be placed between two of the septa or screens which pass to a certain distance out from the internal wall into the annular space, so that the head of each bed would be included in the space between each two neighbouring septa. The space within the ring communicates with the annular space which answers the purpose of the ward, by the extracting openings, and also with an extractor, preferably a fan. An extracting shaft might, of course, be substituted for the fan; but I think a fan preferable, on the ground that its action is more independent of temperature and wind, and therefore more constant, and that it is more economical. The fan would collect the air from the ward, and at once discharge it into a chamber, where it could be subjected to a high temperature, so as to destroy all organic matter it might contain. That, I think, constitutes the whole description of the ward. This ward is intended to communicate with the outside only by the corridors, and to have no openings, excepting the openings for ventilation. The windows would not open. There would be two modes of entrance, one for the nurses, which would be, in fact, a dressing closet, that is to say, a closet for changing dress, and another opening from the corridor, principally for the medical attendant, and also a window for the introduction of diets and other things required for the use of the patients. (*See* plan and explanation.)

"Sir RUTHERFORD ALCOCK: 'How do you get your light into the ward?'—'By windows. They are not shewn upon the model, but it is understood that there would be windows all round which do not open.'

"The CHAIRMAN: 'Do those little circles represent the whole amount of incoming ventilation?'—'Yes, although they appear small, each of them represents openings of two square feet, and, of course, they need not be circular. It is intended that there should be twenty-four such openings in the external wall, of which half only would be in use at a time, according to the direction of the wind.'

"Sir RUTHERFORD ALCOCK: 'A fan of some kind is the *modus operandi*?'—'Yes, a fan of some kind. As I said just now, what is required is that there should be removed 120,000 cubic feet per hour from the whole ward, and supposing a ward of 12 beds, that is 10,000 cubic feet for each patient, and that would involve, supposing the air spaces to be as I have represented them, that is upon the scale given upon the model, namely, each of these round outlets having an area actually of about two feet square,* the result would be that the air would pass over the patients' bed at the rate of about one mile per hour. The construction is such that the rate of exhaustion from each opening would be at that rate, that is to say, the motion through the outlet would be at the rate of about one mile per hour, and consequently there would be no unpleasant draught, although the ventilation would be very abundant. (*The Witness exhibited the working of the plan upon the model*). I think all I have to add is in reference to the administration of such a ward. A ward of this kind would require probably two nurses at least to administer it and take charge of as many as twelve severe cases. I assume that they would remain on duty not more than eight hours at a time, and consequently they would not need to be provided with any of the comforts which are usually placed at the disposal of hospital nurses when they have to remain the whole day. As regards the medical administration it is obvious that the ward must be open to the visits of the resident medical officer, and that the whole of the management of the ventilation should be under his superintendence, otherwise it would not be possible to carry out the thing satisfactorily; the plan adopted involves the necessity of controlling the openings for ventilation; if, for example, all the openings were opened upon the wrong side

* Two square feet?

you might disturb the action of the ventilation in such a way as to render it futile. I assume that the ventilation would be placed under the direction of an intelligent man who would know on what principle to regulate the openings. Then as regards warming; the method of warming would be this:—Hot water pipes will be carried round in front of the external openings, that is in the neighbourhood of the inlet openings for air, and in that way the ward would be quite sufficiently warmed. I have already said that the system should be enforced of nurses completely changing their dress after entering the ward and leaving it, and that the nurse should have no need to do anything except attend upon the patient during her eight hours of service, It is quite clear that in order to carry out the whole purpose which we have in view there should be attached to each hospital a properly constructed disinfection chamber, meaning by the term "properly constructed" such a chamber as is usually used in London, and I would take for example the one now used in the Strand district, which is well arranged and constructed for the purpose of completely disinfecting the clothes of patients by heat. That, of course, must be attached to the hospital. I have ascertained by consulting with the architect that no difficulty exists as regards the form which I propose for my ward, namely, the circular or annular form of the ward, There would be no constructive difficulty in carrying out an hospital upon such a plan.

"CHAIRMAN: 'It would be a one-storey building?'—'It could be constructed equally well in three storeys.'

"'That is to say a building for 36 patients?'—'Yes.'

"'The air would be delivered where the fan is at the top?'—'Into one cylindrical cavity in that case; the only thing necessary would be a cylindrical cavity in the middle, which communicates with the fan.'

"'When you have got the air to the fan, and ejected it by the fan you send it to the hot chamber?'—'Yes.'

"'Which probably would be in the roof of the house?'—'Yes.'

"'And there you would have your furnace?'—'Yes, a gas furnace.'

"'It strikes one the amount of air you would have to treat with is something very enormous; it is a quarter of a million cubic feet for every patient per diem?'—'Yes.'

"'Do you say that the heat is easily attainable for that?'—'Yes, I think it is perfectly possible, though not easy. There are other means of disinfecting the air, but I think heat is the plan upon which we ought to depend.'

"Sir RUTHERFORD ALCOCK: 'You are pre-supposing that the hospital should entirely consist of this circular ward of one or two storeys; that would comprise the whole hospital apart from the administrative portion?'—'No, you might double it; you might have two such buildings, consisting each of one, two or three storeys.'

"'But one circle in each storey?'—'The three storeys in each building would form a tower, and you might have two towers.'

"CHAIRMAN: 'In the form of a figure 8?'—'Yes.'

"'With the two shafts communicating and worked by one fan?'—'No, it would be more economical to work each by a separate fan; to have each tower, as it were, completely separate.'

"'Would there be any means by which, when it is constructed, we should be able to tell whether it was answering or not; whether it really prevented the spread of infection?'—'I am afraid you could only judge of that by statistics; by trial.'

"Mr. PEMBERTON: 'The air must go out there?'—'Yes. We can perfectly well test the mechanical action of the thing.'

"CHAIRMAN: 'You would say, I suppose, that it would be impossible that the matters contained in it could go out living?'—'Yes.

'There are no scientific means of ascertaining whether the air is pure or not?'—'I am afraid that is impossible.'

"Dr. BROADBENT: 'Would it be possible, do you think, on a cold winter's day to keep up a fair temperature, seeing that that amount of air has to be warmed simply by going between ordinary steam pipes?'—'Yes, I think so because acute cases of small-pox can be treated satisfactorily and well in a ward which is not quite up to the temperature of a comfortable living room; a temperature of 50 for example.'

"'The only method proposed of keeping the wards at a habitable temperature is that the cold air coming in should pass between the steam pipes with no fire place and no stoves?'—'It is not necessary to exclude stoves.'

"'Then there will be a question in connexion with bath rooms and closets?'—'If I had brought with me my drawings they would have shewn that one of the bed spaces is to be occupied for bath rooms and closets.'

"'All within the sphere of the ventilation?'—'Yes.'

"'Of course that would require very careful supervision otherwise you would run the risk of bringing up sewer gases; however, if it is within the same sphere of ventilation of course it is provided against?'—'I think, as regards closets, we ought to adopt the principle of removal rather than drainage, and as regards baths the water could of course be removed from the bath without difficulty. With regard to the closet you might adopt the earth system or some plan of that kind.'

"Dr. CARPENTER: 'There would be no difficulty in cutting them off so as to get no kind of air from the closets?'—'No, I think not.'"

The following objections to Dr. Sanderson's scheme have been made by Dr. John S. Billings, Surgeon, U.S.A. No doubt they are in the main correct; but the points touched upon are matters of detail, and such only as might fairly be expected to arise from an examination of the first enunciations of any great principle. I have not the slightest doubt that in the near future this system of preventing the dissemination of contagious matter will have become perfected and be generally adopted in all infectious hospital wards.

"It is evident that while it is theoretically possible to thus disinfect all the air passing through a small-pox ward, it would be at a relatively great expense. The circular ward is used in the new City Hospital at Antwerp, and the same principle is employed in the Octagon Ward of the Johns Hopkins Hospital, at Baltimore; but in both these the beds are arranged against the outer wall, having the heads towards the windows, which is a much more convenient way of arranging them than the plan proposed by Dr. Sanderson, both because it allows more space about each bed and because it does not put the patients facing the light, which would be extremely unpleasant in the acute stage of small-pox.

"A second objection is that the central shaft is unnecessarily large, as are also the inlets into it. It is not desirable to reduce the velocity of the air at the outlets or in foul air ducts below four or five feet per second, because at very low velocities a very slight thing will disturb the currents. The velocity at the outlet has comparatively little to do with the production of draughts. There seems to be no necessity whatever for the use of an aspirating fan in the plan proposed. If the air is to be heated to a temperature of 250° F. and upwards, which is necessary to secure its disinfection, this heat will in itself furnish all the aspirating power required. The use of gas to produce the heat required for such large quantities of air would also be unnecessarily expensive; a coal furnance would do the same work at half the cost.

"In the plan proposed, in cold weather, a large amount of the incoming fresh air, and the heat employed in warming it, would be wasted, since it would rise rapidly from the point of entrance, taking almost a direct line to the point of exit, and passing above the beds, the occupants of which thus get no benefit from the main stream of fresh air, but must rely on what comes to them from a sort of eddy and from diffusion. It would have been much better to introduce the greater part of the air through a grating beneath and between the beds, in which case the patients could be kept bathed in a steadily ascending stream of air, moving at the rate of say four miles per second*; and this would be effected with less than half the amount of air and expenditure of fuel required in the proposed plan. It should be remembered that in a hospital of this kind, where special arrangements are to be made to secure a steady, uninterrupted stream of air through the ward, the allowance of floor space and cubic air space per patient become of secondary importance, so far as ventilation is concerned, and may be fixed mainly by considerations of convenience of administration. This ward might be made ten feet less in diameter and the central shaft reduced to four feet in diameter, with good effect.

"These suggestions are made, not for the purpose of fault-finding, but because everything which comes from such distinguished authority should be made as perfect as possible."

* Per hour?

SUMMARIES.

TABLE No. 1.

IN making a comparison of the relative cost of the buildings, as shewn by this summary, it is important to bear in mind, in all cases, what are the dates of erection; because, the prices of building materials and labor have, in all countries, advanced from 20 to 30 per cent., and more, within the last ten or twenty years. The buildings of the Herbert Hospital, for example, cost twenty years ago £330 per bed, but if erected now they would, in all probability, cost between £400 and £450 per bed. Again, the Berlin Civil Hospital authorities state that the average rise of prices during the six years the building took to erect was 54 per cent. (*see* page 104 *ante*).

NAME OF BUILDING.	Date of Erection.	No. of Beds.	Area of Site per Bed.	Site covered per Bed.	Connecting¶ Corridors.	Axes of Principal Wards.	Relative Height and Distance apart of Pavilions.	Cost of Buildings per Bed.	Cost of Land and Buildings per Bed.
			feet.	feet.				£	£
Herbert (Military)	1860-4	650	1,162	115	§C E	N.N.E. to S.S.W.	1 to 2·03	330	340
Blackburn	1858-65	154	2,262	162	†C E	E. to W.	‡1 to 1·68	286	307
Leeds	1864-9	328	512	240	C E	N. to S.	1 to 2·27	298	326
St. Thomas'	1868-71	573	660	268	†§C E	E. to W.	1 to 1·60	777	969
Edinburgh	1870-9	586	888	235	†§C E	N. to S.	1 to 2·25	477	587
Glasgow	1871-4	388	1,386	145	None	N. to S. & E. to W.	...	258	318
Norfolk and Norwich* ...	1879-81	218	1,070	237	§C E	N.W. to S.E.	...	248	294
St. Marylebone	1879-81	744	188	82	§C E	N. to S.	1 to 1·90	161	176
St. George's Union	1876-8	808	153	64	C E	N.E. to S.W.	1 to 1·07	97	122
Hull General Infirmary ...	1884	275	528	129	C	N.W. to S.E.	...	109	
Mons	...	146	746	286	C E				
Antwerp	1878	380	1,126	302	§C	.....	1 to 1·85	368	
Heidelberg	1869-76	382	1,071	233	C	E.S.E. to W.N.W.	1 to 3·40	226	241
Berlin (Civil)	1868-74	600	1,713	205	None	N. to S.	1 to 3·85 & 1 to 7·20	351	
Berlin (Military)	1875-8	504	1,309	198	C E	W. by N. to E. by S. & N. by E. to S. by W.			
Königsberg (Military) ...	...	374	1,471	140	C E	E. to W.	...	217	
Düsseldorf (Military) ...	...	150	1,278	185	None	E.N.E. to W.S.W. & N.N.W. to S.S.E.	...	199	
Ehrenbreitstein (Military) ...	...	124	365	132	None	N.N.E. to S.S.W.	...	228	
Cüstrin (Military)	...	170	1,641	172	C E	N.E. by E. to S.W. by W.			
Dresden (new pavilions) ...	1871-73	260	3,297	...	C	N. to S.	1 to 3·80		
Strasburg	1881	122	535	145	C E	N. by E. to S. by W. & W. by N. to E. by S.	...	246	
Moabite	1872	700	1,144	166	None	E. to W.	1 to 5·00	83	
Halle	1876‖	496	1,738	327	None	E. by N. to W. by S.	...	333	374
Lariboisière	1853	613	963	211	§C E	W.N.W. to E.S.E.	1 to 1·15	436	644
Hôtel Dieu	1866-76	566	409	196	†§C	W.N.W. to E.S.E.	1 to 2·00	1,215	2,487
Tenon (Menilmontant) ...	1872-8	726	782	187	§C	N.E. to S.W.	1 to 2·25	419	506
St. Denis	1880-1	166	1,686	296	None	E. to W.	...	241	289
Bichât	1882	180	465	236	†C E	N.N.W. to S.S.E.	1 to 3·00	198	224
Bourges (Military)	... ‖	216	2,490	385	C E	N.W. to S.E	1 to 3·00	148	
St. Eloi (Military and Civil)	1883‖	600	1,615	371	C E	N.W. to S.E.	1 to 3·56	107	113
Utrecht	...	264	1,292	142	C E	N E. to S.W. & N.W. to S.E.			
Amersfoort (Military) ...	1875-7	78	2,953	242	C E	E. by N. to W. by S.	1 to 4·43	192	
Genoa	... ‖	428	1,259	263	C E	W. by N. to E. by S.	1 to 1·25	654	794
Riga	1870-3	400	1,164	267	C E	N.W. by N. to S.E. by S.	1 to 3·42	176	
Johns Hopkins, U.S.A. ...	1875‖	361	1,679	481	§C E	N. to S.	1 to 3·00	866	

* Not entirely a new building. ¶ C indicates corridors roofed only; C E indicates corridors roofed and enclosed at sides.
† These corridors are two storeys in height; all others are on the ground floor. § The roofs of these are terraces.
‡ Pavilions overlap one another, and for one half their length their distance apart is 1 to ·486 only. ‖ Not completed.

TABLE No. 2.

AN abstract of the wall space, area, and cubic contents per bed, also the amount of light and ventilation afforded by the windows of the principal sick wards of various hospitals:—

NAME OF BUILDING.	No. of Beds.	Wall Space per Bed.	Floor Space per Bed.	Cubic contents per Bed.	Window Glass per Bed in side Walls only.	Window Glass per Bed, including end Windows and Lanterns.	Window Ventilation per Bed in side Walls only.	Window Ventilation per Bed, including end Windows and Lanterns.
		ft. in.	feet.	feet.	feet.	feet.	feet.	feet.
Herbert (Military)	32	7 4	97	1,315	17·00	18·84	9·75	10·63
Blackburn, 1st floor	8	9 9	106	1,696	26·37	...	18·75	
,, ground floor	8	9 9	106	1,696	33·90	...	23·37	
Leeds, top floor	32	7 5	107	2,083	24·37	26·00	7·50	7·94
,, lower floor	32	7 5	107	1,763	20·65	22·16	2·87	3·31
St. Thomas'	28	8 0	126	1,886	28·85	32·50	12·32	14·93
Edinburgh (Medical wards), 2nd floor	21	9 0	149	2,239	26·57	30·19	10·09	11·48
,, 1st floor	21	9 0	149	2,201	34·85	38·85	14·95	16·57
,, ground floor	21	9 0	149	2,015	31·43	34·95	11·90	13·38
Glasgow	18	7 10	106	1,620	21·05	26·22	2·77	5·33
Norfolk and Norwich	24	7 10	108	1,511	12·71	15·29	6·13	8·50
St. Marylebone...	28	6 0	72	936	14·50	...	8·04	
St. George's Union	28	6 0	72	936	15·60	...	12·64	
Hull General Infirmary, N.W. wing	26	7 2	95	1,334	17·50	19·46	20·89	21·38
,, ,, S.E. ,,	30	7 6	100	1,346	17·63	19·70	21·10	21·53
Antwerp	20	9 0	149	2,525	28·35	...	40·60	
Heidelberg (Surgical), one-storied ...	16	6 5	94	1,638	12·50	16·75	15·00	20·93
,, (Medical), ,,	14	6 7	97	1,689	14·28	19·14	17·14	23·93
,, (Surgical), four-storied ...	9	8 2	137	2,050				
,, (Medical), ,,	11	7 2	129	1,909				
Berlin Civil (Surgical and Medical), upper floor	28	6 11	108	2,076	23·35	...	24·36	
Berlin Civil (Medical lower floor) ...	28	6 11	108	1,722				
Berlin Military, blocks P P	16	6 6	93	1,273	22·50	...	23·44	
Dresden	24	7 1	119	2,038				
Strasburg (pavilions)	16	6 10	99	1,363				
Moabite	28	6 2	69	864	11·18	...	15·25	17·32
Halle (Medical)	16	9 2	135	2,033	16·50	...	19·00	
,, (Surgical)	24	9 6	140	2,207	26·00	...	32·00	
Lariboisière, 2nd floor...	32	7 10	115	1,850	14·91	...	20·66	
,, 1st floor	32	7 10	115	1,850	16·13	...	22·66	
,, ground floor	32	7 10	115	1,965	17·03	...	23·69	
Hôtel Dieu, 2nd floor	24	8 4	125	2,222	15·92	18·08	21·92	24·33
,, 1st floor	24	8 4	125	2,254	18·42	20·67	24·79	27·29
,, ground floor	24	8 4	125	2,411	19·63	21·92	25·79	28·33
Tenon (Menilmontant), 1st and 2nd floor	22	7 0	107	1,816	17·64	...	26·64	
Tenon (Menilmontant), ground floor	22	7 0	107	2,030	19·05	...	28·37	
St. Denis	16	8 2	112	2,457	25·37	...	38·56	
Bichât	24	7 3	107	2,205	15·75	20·50		
Bourges (Military)	28	6 11	85	1,693				
St. Eloi	28	7 2	108	2,328	16·57	20·75		
Amersfoort (Military)...	12	6 4	83	1,538	15·25			
Genoa	20	7 11	110	2,544	21·75	...	28·65	
Riga	28	5 9	86	1,522				
St. Petersburg	10	7 6	99	1,902				
Johns Hopkins, U.S.A.	24	7 7	105	1,675	21·42	28·00	11·17	14·63

TABLE No. 3.

SHEWING the average area and cubical contents per bed of the separation wards and the area per bed of the day rooms:—

NAME OF BUILDING.	Separation Wards.		Day Rooms.	NAME OF BUILDING.	Separation Wards.		Day Rooms.
	Average Area per Bed.	Average Cubic Contents per Bed.	Average Area per Patient.		Average Area per Bed.	Average Cubic Contents per Bed.	Average Area per Patient.
	feet.	feet.	feet.		feet.	feet.	feet.
Blackburn	152	2,432		Strasburg (pavilions) ...	93	1,272	25·25
St. Thomas'	120	1,800		,, (central block)	103	1,578	12·00
Edinburgh	162	2,268	17·00	Halle (Medical)	175	2,159	
Glasgow	141	2,115		Lariboisière	106	1,731	9·48
Norfolk and Norwich ...	122	1,701		Hôtel Dieu	112	2,159	21·08
St. Marylebone	100	1,300	9·64	Tenon (Menilmontant) ...	111	1,892	9·80
St. George's Union ...	76	994	10·92	St. Denis	...	...	13·63
Hull General Infirmary	116	1,624		Bichât	114	1,368	
Antwerp	133	2,050		Bourges (Military) ...	140	2,000	5·00
Heidelberg (Surgical) ...	81	1,288	21·66	St. Eloi	129	1,680	
,, (Medical) ...			24·75	Amersfoort (Military) ...	88	1,408	
Berlin Civil (Surgical) ...	154	1,783	20·64	Genoa	161	2,898	46·90
,, (Medical) ...	122	1,508	24·00	Riga	154	1,845	12·75
Berlin Military (blocks PP)	90	1,232	14·25	Johns Hopkins, U.S.A. ...	135	1,890	13·75

SECTION III.

ORGANIZATION OF MEDICAL RELIEF IN THE METROPOLIS.

BY

FREDERIC J. MOUAT, M.D., F.R.C.S.

Organization of Medical Relief in the Metropolis.

There are few problems connected with the unprecedented growth and government of London as a whole, that are more complex in character, more encumbered by conditions of life of which little that is certain is known, and, in consequence, more difficult of solution, than that of the relief of the sick poor of an aggregation of human beings on a restricted area, such as the world has never before seen.

Within a limit of 125 square miles, with a pressure of population of 30,718 to each square mile, or 50·8 to an acre, is contained the people of a kingdom. They comprise every caste, class, and almost race and condition of life, from unbounded wealth and luxury, down to some of the most squalid objects of misery, destitution, and suffering to be found on the face of the globe.

To consider the question in all its branches, it is necessary to disintegrate this mass of humanity into its constituent parts, to ascertain for which portions public relief in sickness is really required.

According to the last Census Report, as to Nationality there were, in whole numbers, 50,000 Scotch, 80,000 Irish, and 60,000 European foreigners, with some 4,000 or 5,000 from America, Asia, and Africa, dwelling in London, the remainder of the inhabitants, constituting the bulk of the population, being English.

With respect to occupation, the numbers of the domestic, commercial, and industrial classes are overwhelming.

In the minor professional class were 1,147 males, and 177 females; in domestic services there were 60,850 males and 320,838 females; engaged in commerce were 264,957 males and 4,935 females; in employments connected with agriculture, 21,920 males and 910 females; and in the great industrial class were 677,682 males and 224,867 females, making a grand total of 1,026,560 males and 551,727 females.

Of the first and three last-named classes a considerable proportion are representatives of capital and employers of labour, of whom the exact details are not given in the Census return. They probably represent at least 10 per cent. of the whole, and these are all in circumstances beyond the need of gratuitous hospital aid in sickness. The vast majority are wage-earners, more liable than those better off to disease, accidents, and injuries from their surroundings and occupations, and their more or less precarious means of subsistence.

In addition to the above—exclusive of the great professional class, numbering about 128,000 men and 41,000 women—of persons of no specified occupations, and returned as

of property and rank, there were 431,193 males and 1,117,346 females, a disproportion well deserving of careful inquiry. They do not fall within the scope of my contention.

And last of all were 248,619 boys and 248,425 girls—in all close upon half a million—under five years of age, or nearly an eighth of the whole population. Of these children 148 per 1,000 die under one year of age, and the greater part of this loss of life is among the children of the poor and wage-earning classes, to whom again the larger portion of the half-million of children belong.

For the care of the sick and injured of all the above classes, and of the remainder of the professional and all other classes, there were 3,705 male and 10 female medical practitioners; 1,122 dentists, all men; 2,391 male medical students and assistants and 40 females of the same class, with 307 midwives; and, in subordinate medical work, including nursing, 421 males and 10,176 females. This is irrespective of the number of quacks of all complexions who prey upon the wealthier members of the community, but who may be disregarded in the present argument.

Among the causes influencing the health of this extraordinary and heterogenous community, there is perhaps no more potent factor than the manner in which very large numbers of the poor are housed; and yet, even regarding this state, which is comparatively so easy to ascertain with some approach to mathematical accuracy, we are absolutely without trustworthy information.

Lord Salisbury, in his recent endeavour to solve the question, remarks that the State, having sanctioned improvements which cause congestion, is bound to relieve this by intervening directly in its removal. He adds, "The difficulty is greatly aggravated by the entire absence of accurate information on the subject. Statistics on this point are absolutely silent. That London is overcrowded we know, and that the ill effects of overcrowding on health and character are very terrible. But we do not know even approximately the number of the sufferers, where they live, or what they earn. How are we to judge of the measures required to remove this evil if we have no notion of its extent or how far it is the offspring of mere poverty;" and he concludes that "it ought to be within the means of our central or local authorities to throw light upon the circumstances and conditions of the hardships to which a vast number of the inhabitants of London are probably exposed—hardship which is known to be acute and is believed to be growing." *

If this be so, and it is in truth beyond the reach of doubt or denial with respect to the mere physical facts, which an efficient government of London could readily ascertain, inasmuch as it presents no scientific difficulty and deals with no recondite conditions, how immeasurably is the difficulty increased in relation to the causation and incidence of sickness.

Herein enter a multitude of conditions which are only imperfectly known at the best, and which cannot be determined by any mere numerical test hitherto applied to their solution.

* *National Review*, No. 9. p. 312.

Hence, in attempting to estimate the sufficiency or otherwise of the hospital accommodation of London, we have no standard to lead us even to an approximate conclusion, nor can any other accessible figures guide us in the matter.

For example, according to the most recent returns, in Switzerland, for a scattered population of 2,846,102, with 177 persons to a square mile, there are 17,757 hospital beds, or 1 to 160; in Wirtemburg, with 1,881,505 inhabitants, with an area of 7,675 square miles, there are 8,814 beds, or 1 to 213; in France, with a population of 37,672,048, and an area of 204,177 square miles, with 184 persons to a square mile, there are 140,000 beds, or 1 for every 269 persons; and in Austro-Hungary, with 37,754,942 people, and an area of 940,942 square miles, or 40 to a square mile, there are 38,251, or in the proportion of 1 to 987 persons. In Prussia, in 1881, exclusive of military hospitals, there were 1,032 general hospitals, with 44,784 beds, for a population of 27,279,111 persons. In them were treated 306,715 cases of disease, from which 294,203 persons suffered, exclusive of the incurables in asylums.

It is at once obvious that the conditions of life, climate, soil, and circumstances in all these countries differ so absolutely from those of the poor of London, as to admit of no comparison between them.

The only reliable figures regarding Great Britain itself are contained in the subjoined statement, which covers only a portion of the ground.

In the whole of England and Wales, beyond the Metropolitan area, there appear to be at present available for in-patients of the non-pauper classes 18,181 beds, viz.:—

In General Hospitals and Infirmaries	16,423
„ Fever Hospitals	842
„ Cottage Hospitals...	996

Several of the hospitals under the first-mentioned head were special hospitals, and in this classification all lunatic asylums are omitted, whereas in some of the foreign statistics they are included.

It is not without interest to compare with this, and with the subsequent tables of hospital accommodation in the whole country, including the Metropolis, the amount of hospital accommodation in Paris, where an entirely different system of dealing with sickness among the poor exists.

In twenty-one hospitals for a population of 2,239,928, 11,292 beds are available, the largest of them being—

	Beds.		Beds.
St. Anne	915	Sick Childrens' Hospital	562
St. Louis	843	New Hôtel Dieu...	559
Bicêtre Asylum for Lunatics	720	Charité	504
Pitié	719	Beaujon	422
Lariboisière	706	Necker	418
Foundling	685	Maison Dubois	351
Laennee	628	Maternité	316
St. Antoine	621		

The distribution of the institutions referred to by counties is contained in the subjoined Table, compiled from "Churchill's Medical Directory" for 1884 :—

SUMMARY.

Counties.	General Hospitals.		Fever Hospitals.		Cottage Hospitals.		Dispensaries.	
	Beds.	In-patients.	Beds.	In-patients.	Beds.	In-patients.	Provident.	Free.
Bedfordshire	100	607	50	55	15	63	2	
Berkshire	180	1,464	...	1	6	40	1	4
Buckinghamshire	50	314	...	...	34	257	1	
Cambridgeshire	146	927	10	5	...	...	...	2
Cheshire	398	2,587	28	86	20	172	5	4
Cornwall	111	473	...	...	8	20	...	8
Cumberland	170	817	40	122	...	...	...	2
Derbyshire	545	3,572	...	...	8	49	1	2
Devonshire	860	4,372	...	...	67	418	5	11
Dorsetshire	132	865	...	...	14	57	1	2
Durham	368	2,690	74	270	7	33	...	5
Essex	156	353	...	...	13	72	1	2
Gloucestershire	785	6,834	28	...	68	425	2	12
Hampshire	704	3,449	...	...	29	164	3	1
Herefordshire	87	528	...	...	11	84	...	5
Hertfordshire...	121	950	...	...	8	57	...	1
Huntingdonshire	38	179						
Kent	643	3,111	...	...	26	235	3	11
Lancashire	2,752	22,105	290	757	24	43	...	24
Leicestershire	237	2,229	...	...	...	...	1	1
Middlesex	52	504	...	...	34	371	...	3
Lincolnshire	270	1,469	...	...	29	175	3	5
Monmouthshire	39	135	...	...	...	...	...	3
Norfolk	349	1,749	...	...	8	30	1	
Northamptonshire	186	1,913	...	...	...	...	...	1
Northumberland	317	2,281	61	371	...	...	...	8
Nottinghamshire	349	2,326	...	...	...	...	...	3
Oxfordshire	163	1,593	...	...	14	50	...	1
Rutlandshire	...	...	...	...	...	...	...	1
Shropshire	158	1,284	...	...	23	120	1	6
Somersetshire	521	3,934	...	...	38	163	1	9
Staffordshire	654	4,624	...	...	104	744	3	
Suffolk...	242	1,384	...	...	8	50	...	3
Surrey...	138	1,090	24	72	93	610	2	3
Sussex	409	2,261	...	...	19	100	2	9
Warwickshire	1,012	8,851	...	...	...	50	2	4
Wiltshire	132	5,888	...	...	22	64	2	1
Worcestershire	290	2,715	...	...	21	125	...	8
Yorkshire	1,901	16,390	202	792	118	713	...	21
Wales	484	2,623	25	...	37	222	1	4
Channel Islands	150	19						
Isle of Man	24	123	...	...	...	...	...	1
Total	16,423	121,582	832	2,531	926	5,776	44	191

In them there is stated to have been treated as in-patients, an average in 1883 of 129,888 persons.

It is obvious that, with the exception of the number of beds and institutions, which are fixed figures, the return cannot be accepted as more than an approximate estimate altogether deficient in scientific accuracy.

The return again is defective in not containing any account of the pauper infirmaries scattered over the country, which greatly exceed the whole of the voluntary institutions in numbers and in the beds provided in them. It is not easy to understand why the Local Government Board, with a well organized Statistical Department, should not see the necessity as well as public and professional advantage of procuring and publishing annual returns of the sickness and mortality among the inmates of the many important institutions under its charge. There are, it is true, more hospices, refuges for the very young, and the aged, infirm, and incurable of the destitute classes than hospitals properly so called ; yet very large numbers, at the active periods of life, find their way to them, and much more use ought to be made of them than is done at present.

In the General Report of the Registrar General on the Census of 1881, the numbers in the general and special hospitals in the country on the day of enumeration were stated to have been, in

1851,	...	7,619 or 49	to every	100,000	of the population.
1861,	...	10,414 or 52	,,	,,	,,
1871,	...	19,585 or 86	,,	,,	,,
1881,	...	24,087 or 96	,,	,,	,,

Remarking upon this, the report says that—

"It is scarcely necessary to point out that the proportion of patients in the hospitals to the general population is a matter rather of the relative amount of hospital accommodation at these four censuses, than of the relative amount of sickness prevailing in the country. It is an undoubted fact that in recent years the amount of hospital accommodation has increased at a greater rate than the population, mainly through the erection of a large number of cottage hospitals and of hospitals for infectious diseases."

In 1871 the number of the latter institutions included in the Registrar General's annual report was 346 ; in 1881, 691. Regarding the workhouse infirmaries, the Registrar General had no means of ascertaining what proportion of indoor pauperism was due to sickness, and yet this is one of the most important factors connected with the working of the Poor Laws, and one which, by a better system of administration, could easily be ascertained. The cause is that medical matters in the existing system, receive less attention and supervision than they require.

In addition to all the above, there appear to have been in the last year 44 provident and 191 general (free) dispensaries for the treatment of out-patients in the provinces. The greater number of the latter are attached to the general hospitals, and, with regard to them all, no means at present exist of ascertaining even the roughest approximation to the number of cases treated.

The provident dispensaries are destined to play a prominent and wholesome part in the future inculcation of habits of thrift and economy among the labouring classes.

Although it is true, as shewn by Mr. Giffen and supported by Professor Leone Levi, that the material prosperity and consequent comfort of the labouring classes in

Great Britain have increased very considerably in the last half-century, the facts adduced, valuable as they are as indicative of the general prosperity of the nation, scarcely touch, even if they reach, the circumstances of life, and sickness and mortality of the great mass of the lower stratum of the working classes in London, and other great centres of industrial populations. Very many of these are only just raised a step, and that a very short step, above the destitute and those in receipt of relief as paupers, and to them has fallen no share of the prosperity above referred to. The mortality of the London hospitals, averaging nine per cent. of their inmates, is probably chiefly among these classes. But unfortunately we need much more exact figures than we possess to determine its exact amount, and the number of persons not really poor, who are received and die in those institutions.

It is impossible to gather from the out-door medical relief returns of the Local Government Board, even for the Metropolis, in 1883 the exact numbers who were treated at their homes, or at the poor-law dispensaries as paupers.

The number of relief orders issued in that year was 111,410; 59,098 at the public dispensaries, and 52,312 at their own homes, in which latter were included 1,081 midwifery orders. Some of the orders were unlimited in duration, some during illness, and the remainder varied from 28 days to three months.

To obtain anything approaching to an average from such figures is impracticable, but I think it may be reasonably assumed that not less than 80,000 persons received this medical relief, out of a mean average of 50,038 who were in receipt of relief, the actual numbers having been 47,990 on the 1st July 1882, and 52,085 on the 1st of January 1883, in all 100,075.

The daily average number of sick in the poor-law infirmaries and sick asylums was, in 1882, 8,267·4. This is exclusive of 4,710·9 in the imbecile asylums, and 877·9 in the small-pox and fever hospitals.

From all these figures, again, no approximation to the real numbers of the sick poor of London in the year can be obtained.

It is much to be regretted that all of these, being institutions under the control of the State, are not compelled to submit details of their sickness and mortality as those in the Metropolis do of their expenditure, in the form that should be adopted for all hospitals. In 1874, I endeavoured, with the authority of the then President of the Local Government Board, to obtain the figures from all the workhouse infirmaries in England and Wales, but as I was unable to procure a return of the sickness which caused the deaths, I did not recommend the Local Government Board to publish them, the more especially as the death rate calculated on the average number of the inmates in some of the large workhouses, the only sound basis for such calculations, was so large that, in the absence of specific explanation, it might have excited public alarm.

To return to the Metropolis, estimated by parishes the following Table gives the statistics of the hospital accommodation of the Metropolis in 1881, but as there are many parishes in London in which there is no hospital, I have not been able to adopt the parish for the basis of my map, or the foundation of a scheme for the organization of

medical relief in this wilderness of habitations. Yet it appears to me to be desirable to shew the nature and extent of the hospital accommodation in those areas.

Parish.	Area of Parish in Acres.	Population in 1881.	Number of Persons per Acre.	Number of Hospitals, &c. in each Parish.	Number of Hospitals to the Square Mile.	Number of Beds.	Ratio of Beds to the Population. 1 to
Battersea	2,170	107,262	49	1	1 to 3·4	380	282
Bethnal Green	755	126,961	168	2	1 to 0·59	574	221
Bow	563	37,074	66	1	1 to 0·9	1,641	23
Camberwell	4,450	186,593	42	3	1 to 2·3	873	213
Chelsea	796	88,128	111	7	1 to 0·2	1,511	58
Clapham	1,137	36,380	32	1	1 to 1·8	56	649
Deptford	1,680	84,653	50	1	1 to 2·6	330	256
Fulham	1,716	42,900	25	1	1 to 2·7	240	179
Greenwich	1,741	46,580	27	1	1 to 2·7	247	188
Hackney	3,297	163,681	50	4	1 to 1·3	864	182
Hammersmith	2,287	71,939	31	1	1 to 3·6	44	1,635
Hampstead	2,248	45,452	20	2	1 to 1·8	342	133
Islington	3,107	282,865	91	6	1 to 0·8	1,492	189
Kensington	2,190	163,151	74	3	1 to 1·1	1,667	98
Kingston	7,229	35,829	5	1	1 to 11·3	150	239
Lambeth	3,942	253,699	64	5	1 to 1·2	2,185	116
Lewisham	5,774	53,065	9	1	1 to 9·0	33	1,608
Mile End Old Town ...	679	105,613	156	1 & 1 partly	—	453	—
Newington	631	107,850	171	1	1 to 1·0	572	188
Paddington	1,251	107,218	86	3	1 to 0·6	221	485
Plumstead	3,388	33,250	10	1	1 to 5·3	213	156
Rotherhithe	754	36,024	48	1	1 to 1·2	388	93
Saffron Hill	30	3,980	133	1	1 to 0·05	24	166
St. Andrew, Holborn ...	112	28,874	258	6	1 to 0·03	100	28
St. Anne, Soho	54	16,608	307	5	5 to 0·08	148	112
St. Bartholomew-the-Less ...	4	819	205	1	1 to 0·006	710	1
St. Clement's Danes ...	53	10,280	194	1	1 to 0·08	200	51
St. George, Hanover Square	1,119	89,573	80	3	1 to 0·56	418	214
St. George, Southwark ...	284	58,652	207	3	1 to 0·14	386	152
St. George in the East ...	243	47,157	194	1	1 to 0·4	453	104
St. Giles in the Fields ...	123	28,701	233	1	1 to 0·2	25	1,148
St. James, Westminster ...	162	29,941	184	1	1 to 0·3	21	1,426
St. John, Westminster ...	211	35,496	168	1	1 to 0·3	12	2,958
St. Leonard, Bromley ...	608	64,359	106	2 & 1 partly	—	Included in Bow	
St. Luke	239	46,849	196	4	1 to 0·09	260	—
St. Margaret, Westminster.	604	24,430	40	1	1 to 0·25	215	113
St. Martin in the Fields ...	286	17,508	63	2	1 to 0·2	430	41
St. Marylebone	1,506	154,910	103	9	1 to 0·27	575	269
St. Olave	48	2,274	47	1 partly	1 to 0·1	690	4
St. Pancras	2,672	236,258	88	6	1 to 0·7	988	239
St. Saviour, Christchurch ...	77	13,663	177	1	1 to 0·1	12	1,139
St. Stephen	27	1,799	67	1	1 to 0·04	100	18
Shadwell	68	8,170	120	1	1 to 0·1	90	91
Shoreditch	648	126,591	195	3	1 to 0·3	987	128
Spitalfields	73	21,340	292	1	1 to 0·11	30	711
Stoke Newington	638	22,781	36	1	1 to 1·0	28	813
St. Saviour, Surrey... ...	127	14,999	118	1 partly	1 to 0·4	—	43
Wandsworth	2,433	28,004	12	2	1 to 1·9	1,190	24
Whitechapel	170	30,709	181	2	1 to 0·1	1,489	21
Total... ...	64,404	3,380,892	52	110	1 to 1·1	24,037	1 to 14

In an excellent diagram of Metropolitan Medical Relief, prepared in 1878 by the Charity Organization Society, for London and its suburbs, the whole area was divided into two-mile squares, in which were placed the poor-law dispensaries, general and special hospitals, general, special, and provident dispensaries. I am compelled to reject this form also, from the impossibility of correctly estimating the population of those squares, as well as from the risk of so overcrowding the map with signs and figures as to render it difficult to consult, on the scale compulsory to suit the volume in which it appears.

For my present purpose, I have, therefore, taken the registration area for the construction of my map, as it is divided into five groups, of which the limits and dimensions are accurately determined, and all references to them and the institutions within their boundaries, are easily found and verified. In addition, I have placed in it one-mile circles, to permit of distances being accurately and easily determined—Charing Cross being taken as the centre.

The subjoined table contains the particulars of each of the great districts, as to area, population, and hospital accommodation for in-patients. The sub-divisions of the registration districts are shown by the zig-zag red lines.

Districts.	Area in Acres.	Population in 1881.	No. of Persons per Acre.	No. of Hospitals in each District.	No. of Hospitals to the Square Mile.	Number of Beds.	Ratio of Beds to the Population.
West District ...	10,399	669,633	64	27	1·7	4,497	1 to 149
North ,, ...	13,468	905,947	67	29	1·4	4,289	1 to 211
Central ,, ...	2,132	282,238	132	17	5·2	1,979	1 to 142
East ,, ...	5,500	692,738	126	15	1·7	5,717	1 to 121
South ,, ...	43,835	1,265,927	29	23	0·3	7,555	1 to 168
Total... ...	75,334	3,816,483	51	111	0·9	24,037	1 to 159

The parishes to which reference is made in the first table are shewn by the large red figures. The hospitals, general and special, poor-law institutions, and lunatic asylums, are indicated by appropriate signs—a star, a cross, and a solid circle.

An index to the map is appended to this part of the work.

A glance at the map shews how very unequally the means of dealing with the sick poor, beyond the pauper class, are distributed. Taking Charing Cross as a centre, there are within a radius of half-a-mile, 6 hospitals; within a mile, 19, with a poor-law infirmary in the same radius; within a mile and a half, 31, with a poor-law institution and a lunatic asylum; within two miles, 39 hospitals and 2 lunatic asylums; and within a radius of three miles from the centre indicated, are all the principal hospitals of London. In the seven miles beyond this to which the registration area extends, there are barely a dozen hospitals, none of them of any magnitude or importance. In this outer ring, however, are the chief poor-law separate infirmaries, at present exclusively devoted to paupers. In the two parishes of St. Anne's, Soho, and St. Andrew's, Holborn, are 11 hospitals. In the former there are 6 hospitals, or one to 0·2 square mile, and one bed to every 28 inhabitants, and in the parish of St. Bartholomew the Less, in which there are 819 inhabitants, there is one hospital with 710 beds, or a little less than one bed to each inhabitant.

Taken by registration districts, the same inequality is brought out even more prominently.

For example, the registration district of Lewisham, marked xxxix, has the nearest point of its boundary about five miles from Charing Cross, and the farthest a little more than ten miles. It has an area of 11,436 acres, and a population 73,314, so scattered as to have only 6 persons to an acre. It has one hospital for women at Upper Sydenham for the 18 square miles, and this gives a proportion of one bed for every 2,222 persons, and that confined to a special and limited class.

Greenwich, which is continuous with London, with an acreage of 3,427, and a population of 131,233 persons, has two hospitals, with one bed to each 227 of the inhabitants.

In fact, the great growth of London has been in the southern and northern districts, and the grouping of the hospitals has no longer any relation to the needs or accommodation of the people. This is best seen in the grouping of the hospitals, in the Registration Districts of the Registrar General.

Registration Districts.	Area in Acres.	Population in 1881.	Number of Persons per Acre.	Number of Hospitals in each District.	Number of Hospitals to the Square Mile.	Number of Beds.	Ratio of Beds to the Population.
West District.							
Kensington	3,441	270,369	79	6	1·2	1,888	1 to 143
Fulham	4,003	114,839	29	3	·5	556	1 to 207
Chelsea	796	88,128	111	7	5·8	1,239	1 to 71
St. George, Hanover Square	1,943	149,748	77	5	1·6	645	1 to 232
Westminster	216	46,549	215	6	17·1	169	1 to 275
North District.							
Marylebone	1,506	154,910	103	10	4·3	856	1 to 181
Hampstead...	2,248	45,452	20	2	·6	342	1 to 133
Pancras	2,672	236,258	88	6	1·5	707	1 to 334
Islington	3,107	282,865	91	6	1.25	1,492	1 to 189
Hackney	3,935	186,462	47	5	·8	892	1 to 209
Central District.							
St. Giles	245	45,382	185	1	2·6	25	1 to 1,815
Strand	403	33,582	83	3	4·7	430	1 to 78
Holborn	816	151,835	186	11	9·1	714	1 to 212
London City	668	51,439	77	2	2·0	810	1 to 63
East District.							
Shoreditch	648	126,591	195	3	3·0	987	1 to 128
Bethnal Green	755	126,961	168	2	1·8	574	1 to 221
Whitechapel	378	71,363	189	3	5·1	1,519	1 to 47
St. George in the East ...	243	47,157	194	1	2·6	453	1 to 104
Stepney	462	58,543	127	1	1·4	90	1 to 650
Mile End Old Town ...	679	105,613	155	1	1·0	453	1 to 233
Poplar	2,335	156,510	67	4	1·1	1,641	1 to 95
South District.							
St. Saviour, Southwark ...	1,119	195,164	174	5	3·0	970	1 to 201
St. Olave	1,506	134,632	89	2	·85	1,078	1 to 125
Lambeth	3,942	253,699	64	5	·8	2,185	1 to 116
Wandsworth	11,455	210,434	18	4	·2	1,626	1 to 129
Camberwell	4,450	186,593	42	3	·4	873	1 to 214
Greenwich	3,427	131,233	38	2	·38	577	1 to 227
Lewisham	11,436	73,327	6	1	·056	33	1 to 2,222
Woolwich	6,500	80,845	12	1	·1	213	1 to 379
Total	75,334	3,816,483	51	111	0·9	24,037	1 to 159

In further explanation of the tables and the map, the subjoined detailed classified enumeration shews the number of each description of hospital, with the number of beds in each, and this completes the information necessary to grasp the whole question—in somewhat tedious detail, but it is difficult to condense so large an amount of information intelligibly into a smaller compass.

1.—General Hospitals.

	Beds.
Charing Cross Hospital	180
The French	35
The German	125
Great Northern	30
Guy's	690
King's College	200
London	800
Metropolitan Free	40
Middlesex	310
Total	2,410

	Beds
Royal Free Hospital	150
St. Bartholomew's	710
St. George's	353
St. Mary's	200
St. Raphael's	15
St. Thomas's	572
University College	160
West London	44
Westminster	215
London Homœopathic	70
Temperance	51
Total	2,540

2.—Special Hospitals.

Accidents—	Beds.
Poplar Hospital	48
Cancer—	
St. Saviour's Cancer Hospital	45
The Cancer Hospital	70
Total	115
Chest Affections and Consumption—	
City of London for Chest Diseases	164
Hospital for Consumption	331
North London, for Consumption	42
Royal National, for Chest Disease	26
Total	563
For Convalescents—	
Metropolitan Convalescent Institution	179
For Cure of Deformities of the Limbs—	
City Orthopædic Hospital	24
Hospital for Hip Disease in Children	7
National Orthopædic Hospital	35
Royal Orthopædic	45
Total	111
Epilepsy and Nervous Disorders—	
Hospital for Diseases of the Nervous System	30
National Hospital for Paralysis and Epilepsy	102
Total	132

Affections of the Eye—	Beds.
Royal London Ophthalmic Hospital	100
Royal South London	14
Royal Westminster	50
Western Ophthalmic	20
,, Eye Hospital	12
Total	196
Fever—	
London Fever Hospital	180
Fistula—	
St. Mark's Hospital for Fistula, &c.	34
Heart—	
National Hospital for Diseases of Heart and Paralysis	20
Incurables—	
British Home for Incurables	56
Home for Incurable Women	31
Hospital of St. John and St. Elizabeth	46
Royal Hospital for Incurables	190
Total	323
Lying-in Hospitals—	
British Lying-in	25
City of London Lying-in	40
General Lying-in	20
Queen Charlotte's Lying-in	50
St. Saviour's Lying-in	17
Total	152

2.—Special Hospitals—(*continued*).

Diseases of Children—	Beds.
Belgrave Hospital	20
Cheym, for Sick and Incurable Children	33
East London (1)	92
East London (2)	61
Incurable Children	13
Hospital for Sick Children	156
North Eastern, for ,,	63
Royal Infirmary for ,,	50
,, Free, for Women and Children	52
Victoria, for Children	65
Total	605
Affections of the Ear and Throat—	
Central London Throat and Ear Hospital	20
Hospital for Diseases of the Throat and Chest	21
Metropolitan Ear and Throat Hospital	—
Total	41
Skin Diseases—	
Hospital for Skin Diseases	12
St. John's Hospital for Skin Diseases	12
Total	24

Small Pox—	Beds.
Small-Pox and Vaccination Hospital	108
Stone and Urinary Diseases—	
St. Peter's Hospital for Stone	40
Women—	
Hospital for Women (1)	61
Hospital for Women (2)	8
Hospital for Women and Children (1)	33
Hospital for Women and Children (2)	12
New Hospital for Women	26
Total	140
Invalids—	
Asylum for Invalids	28
Lock—	
Lock Hospital for Women	188
Lock Hospital for Men	20
Total	208

Poor Law Asylums.

	Beds.
Deptford Epidemic	330
Fulham	240
Homerton Fever Hospital	200
,, Small-Pox ,,	102
Hampstead Small-Pox ,,	300
Stockwell Fever ,,	200
,, Small-Pox ,,	102
Total	1,474

Lunatic Asylums.

Bethlehem Hospital	311
Hanwell Asylum	2,073
St. Luke's Hospital	200
Wandsworth Asylum	1,000
Bethnal House	410
Camberwell House	489
Grove Hall	452
Hoxton House	266
Peckham House	375
[a] Leavesden (Poor Law)	2,000
[a] Caterham ,,	2,000
[a] Darenth ,,	1,600
Total	11,176

Metropolitan Separate Workhouse Infirmaries.

Parish.	Union.	Beds.
Battersea	Wandsworth and Clapham	380
Bromley (Middlesex)	Poplar and Stepney	586
Camberwell	Camberwell	232
Chelsea	Chelsea	272
,,	Fulham Road	776
St. George's East	St. George's East	317
Greenwich	Greenwich	247
Hackney	Hackney	437
Islington	Holborn	617
,,	Islington	540
Kensington	Kensington	592
,,	Marylebone	744
Lambeth	Lambeth	622
Leonard, St.	City of London	645
Newington	St. Saviour's	1,010
Plumstead	Woolwich	213
Rotherhithe	St. Olave's	388
Shoreditch	Shoreditch	472
St. Pancras	Strand and Westminster	583
	St. Giles & St. George's, Bloomsbury	281
Whitechapel	Whitechapel	680
	Total	10,634

(*a*) These, although without the Metropolitan area, receive the imbeciles of the Metropolis.

A summary of the foregoing gives the following results:—

(a) METROPOLIS.

	No. of Beds.
General Hospitals	4,950
Special Hospitals:	
Accidents 48	
Cancer 115	
Chest Affections and Consumption 563	
Convalescent 179	
Deformities of the Limbs 111	
Diseases of Children 605	
Affections of the Ear and Throat 41	
Epilepsy and Nervous Disorders 132	
Affections of the Eye... 196	
Fever 180	
Fistula 34	
Heart 20	
Incurables 323	
Lying-in Hospital 152	
Skin Diseases 24	
Small-Pox 108	
Stone and Urinary Disorders 40	
Women 140	
Invalids 28	
Lock 208	
	3,247
Poor Law Asylums	1,474
Lunatic Asylums	11,176
Metropolitan Separate Workhouse Infirmaries	10,634
Grand Total	31,481

(b) ENGLAND AND WALES OUTSIDE THE METROPOLIS.

General Hospitals	16,423
Fever ,, ...	842
Cottage ,, ...	996
	18,261
Grand Total	49,742

These figures cannot be compared with those of France, Prussia, and Austro-Hungary, partly for a reason above mentioned, but chiefly because there are no returns of the Poor Law Hospitals outside the Metropolitan area.

It is to be hoped that this want will be supplied ere long, now that public attention has been directed to it.

Returning to London, and omitting the special and fever hospitals, and the lunatics, there are 15,584 beds devoted to general sickness, accidents, and injuries, of which at present only one-third are available for the million and a quarter of the industrial classes, and the 360,000 of the domestic services, of whom at least one-half may be safely assumed to be unable to pay for medical care and nursing in sickness. It would be difficult to indicate more strongly the utter insufficiency of the supply of beds

without a change in the law, and the necessity of the abolition of the distinction between paupers and non-paupers, advocated by the Royal Commission in the case of small-pox and infectious fevers, and equally applicable to all kinds of sickness among the poor in the general interests of the community. Indeed, an eminent statesman, the Marquess of Salisbury, has recently said, that a population could not be pauperized by giving them hospital accommodation. In all London, then, including hospitals of all kinds, but excluding lunatic asylums, there appear to be somewhere about 18,831 beds available for diseases and accidents generally, and 1,474 permanent beds for infectious fevers.

The Royal Commission on Small-Pox and Fever Hospitals estimated the probable needs of the Metropolis at from 2,800 to 3,600 for those diseases in ordinary or non-epidemic times.

We have, unfortunately, no reliable statistics of any kind of the extent of serious sickness generally, to indicate the approximate number of beds which should always be kept ready for immediate occupation—early, being one of the most essential conditions of successful treatment, in acute disease.

Dr. Buckle, of King's Lynn, writing on the vital and economical statistics of the hospitals and infirmaries of England in 1863, stated that in London alone 1,018,941 patients were treated, exclusive of clubs and poor-law medical relief, of whom 41,567 were in, and 97,343 were out-patients, from an estimated population of 2,803,034 inhabitants, giving a ratio of in-patients to population of 1 in 67.43 at that time.

I know not where Dr. Buckle obtained his figures then, for no such figures are at present procurable from any authentic published reports, with the much larger population now included in the registration area.

Dr. Oppert, writing in 1867, estimated that there should be four beds for every 1,000 inhabitants, and that 12,000 beds would then have been sufficient; and, in 1883, the same careful and thoughtful authority fixed the figure for London at 16,000 beds for poor patients. If this be so, even with our present increased population, there is adequate hospital accommodation in existence, if it were properly distributed, and the beds were only occupied by the bonâ fide poor, and a large number of them were not possessed by persons able to pay for medical attendance at their own homes. It is manifest that this is not only a grave abuse of charity, but so unjust to the poor as to need an entire change of system in the management of our hospitals, and in their distribution, for it is abundantly evident that the precarious aid of private charity can no longer be entirely relied upon; that some of the voluntary unendowed hospitals are perceptibly consuming their capital; that the resources of the endowed hospitals are being strained, and, in some, believed to be in part devoted to purposes for which they were not intended; that one of the most valuable institutions in London, dating its existence from the commencement of the century, contemplates the closing of its doors after so many years of valuable work; and that a remedy must consequently be applied before some such calamity shall occur, as will profoundly shock the public feeling.

In these painful circumstances the points to be considered are: As to how the aid required can best be afforded; the admitted abuses of the present system best be

remedied ; and the organization and control of the hospital system be so ordered as to subject these essentially public institutions to such regulations as shall secure their proper management, both as all important agents for the relief of suffering, and as necessary instruments for the education of the medical profession, and the advancement of the art and science of medicine and surgery.

It is difficult in treating the question as a whole, dealing as it does with so vast and composite an aggregation of human beings, to consider it in a strictly logical manner. It appears to me, therefore, to be best to commence with the question of public feeling, which is at the root of the matter. This, in truth, underlies, if it does not cause the failure of all plans heretofore tried in recent times to secure to the honest and deserving poor, massed in large numbers, needful help in sickness without the intrusion of any element of moral or social degradation.

Private charity, when well and wisely directed, which it too seldom is, may, and for a long time did suffice to cover the whole ground in comparatively small communities, of every member of which the lives, character, and condition were known. But, even in this limited field it became so mixed up with other matters, chief among them religious sentiment and proselytizing tendencies, as to be no longer in harmony with the spirit of the age, or the willingness of any class of the community to submit to the domination of doles, in such circumstances.

The first, the most important and the most difficult step, then, in the organization of the relief in sickness of the poor of London, is the separation of such relief from that of ordinary destitution, and its transfer from the direct administration of the poor laws to that of the public health authorities, or some independent body appointed specially for the purpose, as will be explained hereafter.

I have studied carefully, with special reference to this point, the poor laws and the parliamentary and public discussions regarding them, so far as I have been able to consult them. They cover a vast field, and are extremely discursive and disconnected in their character, touching the many issues involved in the great change which took place when the valuable Act of 1834 was passed. This examination failed to afford me any definite information as to the direct relations of sickness to destitution, and the proper manner of dealing with the former, in such serious cases as necessitate hospital means and agencies for their effective treatment, without the attachment of the taint of pauperism. As a means of out-door relief, cases of accident and sickness occurring among the paupers of each district, are treated by district medical officers, appointed by boards of guardians, subject to the approval of the Poor Law Authorities, and the medicines and other agencies of relief are supplied at the public cost, under certain defined rules contained in the Consolidated and other Orders of the Local Government Board. The receipt of relief even in this form, however, pauperizes the recipients, and subjects them to all the civil disabilities of the Poor Laws, for visitations which are usually beyond their control, and yet deprive the bread winners of the power of earning their own livelihood, and of keeping their families off the rates. There is also no part of the present Poor Law system that is said at Poor Law conferences to be more in need of reformation than that of out-door medical relief.

The only other method is that of an order for the house, which too often breaks up the artizan's and the labourer's home, and is the first step on the downward path—far more pernicious and destructive in its effects, than any well administered form of out-door medical relief can possibly be.

So far as I have seen of medical arrangements under the Poor Laws, except in the Metropolis and two or three of the great centres of industry, the large workhouse infirmaries, as a rule, are not models of good and efficient management; the nursing and medical arrangements are not as satisfactory as they might easily be made; and the sick poor have not the exceptional care and skill which are required for their proper treatment, from the defective nature of the ill-paid agency employed. It is purely a question of money. For inadequate remuneration skilled agency of a high order cannot be obtained, and for thoroughly efficient management agency of a high order is absolutely necessary.

This, however, opens a large question not immediately with my subject except as respects accidents and injuries at all ages, and acute attacks of disease among the bread-winners at the active periods of life. These need for their complete and rapid restoration to health and strength, when practicable, the best surgical and medical skill which the healing art can afford, and this, in existing circumstances is not and cannot be found in Poor Law institutions of any class, whether within or without the precincts of the workhouses.

The separation, then, of all detached workhouse infirmaries, and of such large infirmaries as are still contained, but should no longer be so, within workhouse walls—as in Birmingham, Manchester, Liverpool, Sheffield, and Newcastle—from the operation of the Poor Laws and their conversion into general hospitals, I hold to be a necessity of the organization of medical relief in London, and in all our great towns and cities. For the country generally and for smaller towns I advocate the extension of the cottage hospital system—the workhouse infirmaries proper, large and small, which must still be retained, being reserved for the aged, bedridden, and permanently incurable destitute of all ages, who are fit subjects for hospices, but for very many of whom no proper asylums at present exist.

To accomplish all this will need a change in the existing laws relating to the poor and to public health, and probably demand a careful preliminary inquiry by a competent Royal Commission, before amended legislation can be applied for or considered.

Among the points on which information is at present required are—the influence of unhealthy dwellings on the health of the poor, and the causation of sickness among them; the formulation of the facts already known regarding the effects of occupations and industries on the health and lives of the labouring, industrial, and artizan classes; and street and other accidents from machinery and similar agencies; and the effects of crowding in its simple, and compound relations to health and disease. The former where the circumstances and surroundings are not in themselves inimical to health, but become so from undue pressure of population on occupied area; and the latter when to defective drainage, ventilation, and water supply, imperfect and improper refuse and excrement removal, defective food, clothing and warmth; and the direct evils of vicious habits, such

as immorality, and the abuse of stimulants, are added to crowding in otherwise wholesome tenements. In fact, the proportionate incident of sickness and accidents for which hospital accommodation should be provided in town and country.

Having procured these data, for which the materials certainly exist, how are they to be dealt with by the State? They only need to be gathered by a long and patient systematic inquiry, such as has not yet been made or attempted, with the authority of the legislature. A plan can surely be devised that will not dry up the resources of private charity and benevolence in the support and maintenance of unendowed hospitals, general and special; that will secure the strict devotion of the funds of all charitable bequests and foundations intended primarily, if not exclusively, for the sick poor, to their proper purposes; that will not interfere with the cultivation of thrift, and the manly self-reliance which are at the bottom of our national character in not relying upon the State, for all that we can best manage for ourselves.

Will it be by any compulsory plan of universal insurance, such as some philanthropists believe in, and advocate; by the modified form, such as alone would be accepted in England, of the State Socialism urged by Prince Bismark in relation to sickness, and the Marquis of Salisbury with regard to the dwellings of the labouring classes; by the appropriation of a portion of the poor rates now levied for the relief of destitution, to the maintenance of some, and in aid of other existing hospitals, or by the way of a special rate for the purpose; by compelling all employers of labour to contribute towards the maintenance in sickness of those who work for them; by exacting from all who can afford it the payment of some part, however small, of the cost of their treatment in hospital; by inducing the benevolent public, or any portion of it, to pay their hospital contributions to a common fund, and to forego the personal luxury of the benevolent bestowal of doles which so often foster imposture, malingering, and the other evil effects of unwisely distributed charity? Although much has been written and said on each and all of these topics, the only correct and conclusive method of dealing with them, the collection and careful collaboration of the facts and figures regarding them, has not yet been essayed, and cannot even be attempted without the aid of the State.

So many vested interests would be touched by such an inquiry; so much of the information needed would never be voluntarily given, and could only be extracted by the irresistible action of legislative authority; and so many deeply ingrafted sentiments in the minds and hearts of the truly sympathetic and philanthropic would be disturbed, that no other action than that of a carefully selected Royal Commission, without passion or prejudice, could have any hope or chance of success, in the gathering together the information required for legislative action.

The cardinal conditions to be faced are—that the hospital system of the Metropolitan area is gradually breaking down; that the funds of the endowed hospitals are no longer sufficient to fill their wards, or to fulfil their purposes; that the voluntary institutions are beginning to consume their capital, without increasing their subscriptions; that the distribution of the means of treating the sick and injured within reasonable distance of their homes has not followed or kept pace with the movements of the population;

that the expropriation or compulsory change of domicile of the poor or labouring classes is not preceded, as it ought to be, by the provision of proper and efficient means of making the unavoidable removal as little irksome as possible; that the most deserving classes of the sick poor do not obtain the relief they need in acute attacks of disease, as quickly as the successful treatment of such diseases demands; that much of their time, with a serious aggravation of their maladies, is too frequently wasted in the attempt, often unsuccessful, to obtain admission to general hospitals, near or far; that their pauperization, by the occurrence of accidents or diseases for which they are in no way responsible, is neither just nor equitable; and that it is to the interest of the community in general, and the advantage of the sick and injured in particular, who are unable to bear the cost inseparable from such afflictions, that the State should grant its aid in alleviating and removing these unavoidable miseries as far as possible, without violating any of the sound or established principles which should always regulate the action of the ruling power amongst a free and self-reliant people.

This can only be done by the State taking the relief of sickness into its own hands, to at least the same extent as it controls the relief of destitution, but in a somewhat different manner, viz., by supplementing the resources of all the existing general hospitals of the metropolis by grants in aid from a common fund, in such measure as to enable them to afford immediate aid to all the sick poor in their vicinity to the full extent of the accommodation at their disposal, at all times and in all circumstances; by the abolition of the stigma and disabilities of pauperism from sickness and accidents in all cases which afford any reasonable hope of recovery, or are in the prime of life and recuperation—the aged, bedridden, and permanently incurable of the poorest classes being provided for, as at present, in properly constructed and managed workhouse infirmaries.

The only exceptions to this arrangement should be special institutions or wards for the treatment of cancer, consumption, the infectious fevers, and such diseases as cannot safely or profitably find a place, in the ordinary sick wards of a general hospital.

State aid should, in the same manner and to the same extent, be granted to such special institutions as lying-in hospitals, ophthalmic hospitals, and orthopædic infirmaries. For epileptics and the insane State provision is already made, and its application to other places intended for the relief of suffering involves no change of principle inconsistent with our habits or methods of dealing with evils incidental in a great measure to the changed conditions of life, resulting from the gravitation of rural populations to urban centres, in such masses as to constitute entirely new conditions of life in association.

The funds for this purpose would best be supplied either by a special sickness rate, or by an extension of the present poor rate, calculated in somewhat the same manner, and a proportionate amount to be made over to a common sick fund for distribution by a competent central authority, with some designation as the "Hospital Board of London." The rateable value of London in 1883 was £27,544,446, and a penny in the pound on this sum would yield £104,768 10*s*. 6*d*. annually. This point I will again refer to, when treating of the cost and finances of our Metropolitan hospitals as they are.

The constitution of the Hospital Board should consist partly of members nominated by the State, in part by one or more representatives of each of the existing hospitals, and in part by selected members from the Boards of Guardians in the Metropolis, should any portion of the cost of their maintenance be levied on the rates.

Now, to what extent should the State interfere with the control and management of all such institutions as exist at present, or may hereafter be created, for the care and treatment of the sick poor? It should, I am of opinion, neither possess nor exercise any power of direct interference with local action, all control and immediate management being placed entirely in the hands of those in whom the direction of the institution is placed, either by selection, election, or the manner in which these appointments are at present made. But it should both possess and exercise authority to cause all such institutions to be inspected periodically, simply to see that all rules and regulations for their management are carefully observed; that their books and records are properly kept; that all proper facilities for admission and treatment are afforded; and that the funds are not wasted by needless extravagance of any kind, either for building or management, or in the maintenance of the schools attached to the hospitals, which should all be self-supporting.

The inspector should invariably be accompanied in his visit by the resident superintendent of the institution, to explain all matters that may need explanation, and to afford any information the inspector may deem it necessary to call for. There should be nothing inquisitorial or calculated to interfere with local action or to diminish personal responsibility in this inspection, the result of which should be duly reported to the Hospital Board for consideration and action, when any action appeared to be required.

At the recent Conference on the subject held in London, our hospitals were defined to be "private associations performing *public duties*," and this being admitted, a public duty involves a public responsibility for its due and proper performance. By whom should this responsibility be controlled in the public interests? It cannot be by a private body for obvious reasons, and, if it were, to what body could the public look for the proper exercise of such control? Assuredly not to any private association, with no legal power or authority, however carefully selected the members of such a body may be.

In the case of mental disease, all private asylums, which are more strictly private property than the unendowed hospitals, are subject to supervision by the Lunacy Commissioners; all charitable institutions to that of the Charity Commissioners; and even insurance companies, benefit societies, factories, mines, and other institutions of a similar strictly private character, are all subject to State interference to the extent which I consider to be more required in the case of hospitals, than in most of those mentioned above. In them are contained the most helpless of all classes of the poor, the sick poor, and they ought neither to be left to the fitful stream of eleemosynary aid or the chronic, plaintive, and pitiful cry of "funds urgently required, and beds unoccupied" which are urgently needed, which prove how great is the present pressure and break-down in our hospital system.

In a remarkable letter, addressed to the *Times* of May 2nd 1878, by Sir T. Fowell Buxton, who presided over the first day's meeting of the Hospital Conference of July 1883, occur the following apposite remarks:—

"From a long acquaintance with hospital management I am convinced that its principal defects, both in London and the country, arise from want of organization and co-operation, and from the absence of all central control and of Government inspection. If the hospital system were complete, each central hospital would be surrounded by its satellites of dispensaries, cottage hospitals, special hospitals, convalescent homes, &c., which would intercept numberless cases, which otherwise burden the wards of the hospital, and would furnish advanced education for the pupils of its school. Without some such authority as is possessed by School Boards, it is impossible to organize such a body as this, or to promote the scientific training of nurses. I entirely concur in the proposal of a Conference, not that of itself it would effect much, but it would pave the way to the appointment of a Royal Commission, and ultimately to Parliamentary action. I do not believe that hospitals, upon which the demands increase year by year, can much longer keep pace with the requirements of modern medical practice or the precarious support of voluntary contributions, and I earnestly hope that Parliament will take the matter in hand, before it is forced upon its notice by the collapse of some important institution."

Such a collapse in one of the most important and efficient of them appears, from their own statement, not to be far distant, if the present diminution of public support continues and increases.

In no single particular is such central control more needed than in the public audit of the accounts of the hospitals of the country. By far the most detailed, accurate, and consequently trustworthy figures which have been collected on the subject are those of Mr. Burdett in his monograph on "Hospitals and the State," * published in 1881.

In it he shewed that in sixty-one general hospitals, the nature and objects of which are generally identical, the cost of management varied from 2½ to 27½ per cent., and the weekly cost from 9*s.* 4*d.* to 45*s.* 2*d.*

In the 110 institutions, of all classes, general and special, endowed and unendowed, from which he obtained returns, subjected by him to careful scrutiny and skilled examination on a uniform basis, the ratio of cost of management to that of maintenance oscillated between 3½ and 55 per cent., and in one instance 1½ per cent. in a convalescent home; the expenditure for in-patients from 9*s.* to 63*s.* 3*d.*, the latter, however, for a higher class of patients.

The figures represent the average of the three years, 1876, 1877, and 1878, and represent as fair an approach to exactness as can at present be obtained.

Mr. Burdett's zealous and intelligent devotion for some years past to the hospital question, and the industry with which he has endeavoured to obtain from reliable sources facts and figures illustrating the various points of interest and value connected with their structure and arrangements, entitle him to a foremost place among hospital reformers. No more useful service than that rendered by him, has been performed by anyone in this great cause.

The blanks in Mr. Burdett's tables are significant, and the absence of the exact details of each item of in-maintenance, renders it impossible to determine correctly the real causes of these extraordinary and unnecessary differences.

* *Hospitals and the State*, by H. C. Burdett; London, 1881.

In addition to an efficient public audit, and the submission of an annual return of expenditure to an authoritative central administration, a budget, prepared in detail, of the various heads of expenditure required for the succeeding year, based on the full occupancy of each bed, should be exacted from every hospital. It is well and widely known to medical practitioners, that the therapeutical armoury contains in reality but few remedies, either of specific or general efficacy, that the Materia Medica include a vast number of inert substances, or mere placebos which certainly do not need to be used in hospital practice; that compound and complex combinations of remedies in prescriptions are of more than doubtful efficacy, and are as much things of the past, as the cabalistic signs and questionable Latinity which are still employed, in an age from which classical learning is well nigh banished from an ordinary medical education, and all mysteries are rightly regarded as mere cloaks to conceal ignorance and pretension.

The lesson of the economical treatment of the diseases of the poor has still to be taught in our schools, and to be practised in our dispensaries; and the abuse of stimulants in private and public practice requires to be controlled with a firm hand, if extravagant and wanton outlay is to be checked, and habits which are prejudicial in health are not to be implanted during sickness, for the relief of which they are not really necessary, in the vast majority of cases.

This will doubtless be met with the customary cry of improperly checking the free exercise of the judgment of the practitioner in the treatment of disease, of diminishing his responsibility in the momentous issues of life and death in urgent circumstances, and of interference with that liberty of action which induces us to tolerate all sorts of abuses, from the profligate propagation of loathsome diseases, to the evils attendant upon the hysterical sentimentality which is the reproach of the time in which we live.

In my lectures, when I was a Professor of Physic, and in my practice as a Hospital Physician, I endeavoured to impress these doctrines on my pupils, and to exhibit their efficacy in my wards. When occupying the position of Deputy Apothecary General, in Calcutta, at an earlier period, I disallowed all extravagant indents for drugs, in which absurd and even outrageous demands were neither few nor far between—and I am satisfied that a judicious and well-considered control over hospital expenditure in England, would be attended with beneficial results in the direction of economy, without hindrance or detriment to the proper treatment of the sick and suffering.

Finance of Hospitals.

Although I advocate strongly the granting of aid by the State in relief of sickness among the poor, so as to secure continuous attention without spasmodic intermission from want of funds, to their urgent needs at all times and in all circumstances, I by no means underrate or undervalue the inestimable advantage of continuing to enlist private charity in the same desirable direction. It was hoped and believed by those earnest workers in this great cause, who viewed with alarm the growing decrease in the subscriptions to unendowed hospitals, that the establishment of the Sunday and Saturday funds would replace the diminished stream of support, and tap sources of supply not previously touched. These anticipations have not fully been realized, the progressive

exhaustion of the funds of most of these institutions continues, and the application of a remedy seems to me to be so urgent, as to admit of no further avoidable delay.

Among the means best calculated to stem this disastrous tide I consider to be additional encouragement to the endowment of beds in particular wards and hospitals; the entire abolition of the hospital letter system; and the formation of a special ladies' committee in connection with every hospital, to collect funds for its special behoof and advantage in *its own district*. Such a committee has been successfully at work for several years in connection with the Presbyterian Hospital in Philadelphia, and it might be imitated with advantage in London. The collection of funds by such agency would cost nothing; its distribution would be attended with no heartburnings; the donors would know exactly to what institution their gifts would be devoted; and house-to-house visitations by accredited agents of high character and unimpeachable motives, would leave no stone unturned in the accomplishment of so thoroughly good a work. The extent to which aid was afforded by this means would, in the annual budget grant, diminish *pro tanto* the supplementary grant from the Common Hospital Fund.

If the numerical test could be applied to the collection and distribution of money at present bestowed lavishly, but without reflection, for charitable purposes I am quite certain it would be found that what is now freely given, but not always wisely, would be more than sufficient to provide the sick poor with all that it is needed, without State or any other aid, to which objection may be taken. Charity organizations, hospital dinners, benevolent bazaars, and all similar means of collecting funds for hospitals have had their day, and have manifestly failed to meet the want. The apparent harshness, although it is really benevolence in disguise, of organized charity is repellant to very many who cannot yet be brought to regard ill-bestowed doles as powerful instruments of evil, but at present the feeling cannot be overcome by reason or argument. In the expenditure on a dinner an undue proportion of the money intended for the charity is unavoidably wasted, and charity bazaars are organized devices for obtaining funds on an unsound economic basis, of which the good is more than counterbalanced by the evils.

The only serious obstacle in the way, is the belief that when the State steps in to aid, the public would lose its interest in the institutions; that their supporters would fall away; and that the labouring classes would cease to exercise thrift in providing against sickness, even to the extent they now practice it, in becoming members of sick clubs and benefit societies.

I do not for a moment believe that this would be the case. There are no people kinder to one another in distress, in proportion to their means, than the labouring classes. There is not the same indisposition to resort to a hospital than there is to enter a workhouse, and if they were assured of timely aid when it is most needed and welcome, without wasting hours and sometimes days in endeavouring to procure letters of admission, they would soon learn to contribute to its maintenance as a possible and probable harbour of refuge for themselves, when their own hour of trial came. From this none are exempt. It is, in my opinion, an absolute delusion to imagine that the more intelligent of our artizans, and even of our hewers of wood and drawers of water, are not thoroughly alive to their own interests, or that they are possessed of erroneous notions of

social economy in relation to their immediate surroundings. It is also a dangerous delusion from which there is every indication of a rude awakening, now within measurable distance of realization.

It would be an undeserved reflection upon those better off in the world, to suppose that they would close their hearts and their purse-strings to appeals, properly preferred, even when a part of the burthen of support is borne by the community at large, through the agency of the State.

The really unselfish, charitable, and benevolent are the few; the selfish, indifferent, and improvident are the many. The whole burthen of contributing to the wants and alleviating the afflictions of those of the poor who do not recruit the army of paupers, falls upon the former. Any plan, then, that distributes the duty equally amongst all bound to contribute to it, in a manner which admits of no evasion, will enable the well-disposed, Christian, and kindly to continue their present efforts with a better chance of success than now obtains. There will always remain a wide margin of distress which no public agency can touch, and which must ever remain the privilege of those whose ears are open to the cry of anguish, and whose hearts are moved to its relief by the agency of personal sympathy and support.

Out-Patient System.

Of all the abuses of the present hospital system, that of the treatment of out-patients is undoubtedly one of the most flagrant. It has been estimated that when the population of London was much smaller than it is now, a million annually, one in four of the people received advice and medicine gratuitously, one in two at Liverpool, and one in three and a-half at Birmingham. The average attendance of each patient is from three to seven hours before their cases can be attended to; the cost of medicines alone for 600,000 persons who annually resort to thirteen of the best hospitals in London was estimated to be £15,000; and the time given to the diagnosis and treatment of their diseases is so infinitesimally small, as to be well nigh valueless.*

Their presence in crowds in the lower wards of the larger hospitals cannot but be injurious to themselves, and to the sick in the upper wards, for the construction of most of them favours the distribution of bad air throughout buildings which are multiple storied, and not arranged in separate or detached blocks. This was pointed out by Mr. Erichsen in his lectures on Hospitalism, and is as rife and rampant now, as it was when that eminent surgeon wrote some years ago.

But the worst feature of the whole proceeding is the manifest evidence afforded by the clothing and appearance of the majority of them, that they are well able to pay for their medicine and attendance, either by subscribing to the sick clubs of their districts, by joining the provident dispensaries, or being attended at home by the general practitioners in their vicinity. No efficient means have yet been devised to check this growing evil and transparent fraud. To attempt to exact from each recipient of such misplaced charity evidence of his or her inability to contribute towards their treatment

* Burdett, *Hospitals and the State*, pp. 3 and 4.

would be manifestly impossible with the multitudes who crowd the out-patient rooms for advice and physic; and nothing short of an entire change in the whole system will be of the least use.

The first, and possibly the last and only necessary step in this direction will be the complete separation of the out-patients from the hospitals, and their being primarily seen and treated in dispensaries, "pauper, public, and provident," in the respective districts in which the hospitals are situated. A proposal similar in character to this was recommended in 1870 by an influential committee of Surgeons and Physicians, all difficult cases of great professional interest or unusual difficulty of diagnosis or requiring exceptional means of treatment being still sent to the hospitals, both for the higher professional knowledge that can be brought to their consideration, and for their being used as means of instruction for the students of the schools attached to the hospitals.

This committee denounced very vigorously the working of the dispensary system of the Poor Laws, but their own plan would not work as well, if at all, unless the dispensaries are affiliated, but not immediately attached to the hospitals. The distinction of pauper and non-pauper must be abolished, and the out-patient department of the hospital be absolutely closed in its present form, no dispensary cases being admitted for examination or treatment in the hospital as out-patients, unless accompanied by a special card or order from the responsible authority of the dispensary.

This would still leave it open to the hospital to receive all accidents and injuries, and such obviously serious cases of acute disease as needed immediate admission and treatment, without the intervention of any intermediate agency. If such admissions were, as a rule, in medical cases restricted to the residents within the boundaries of the district in which the hospital is situated, the recipients of all such treatment could easily be traced and identified, and compelled to pay for it in proportion to their means. Indeed, in such circumstances they would probably attempt no concealment, hence a tariff of payments should be fixed, after careful inquiry, to suit the circumstances of the various grades of the wage-earning classes, somewhat on the principle adopted in Swedish hospitals. This plan should not, however, I think, be mixed up with that of paying hospitals proper, which are not intended for the poor in any sense, and which are themselves extremely liable to abuse. It would diminish the cost of the hospitals, as the employment of all funds so obtained, would be accounted for in the annual budget submitted to the controlling authorities of the hospital.

Now the point to consider is how far the intervention of the State in the relief of the poor who are not destitute until the occurrence of sickness, would be in reality but another form of pauperism in disguise, and tend to intensify and extend all the demoralizing influences of that condition.

In my humble judgment, it would have the very opposite effect. What can be more demoralizing, degrading, and destructive of every feeling of self-reliance and self-respect, than the present wide-spread procuration of medical relief under false pretences, by the majority of the crowds who encumber the out-patient departments of our hospitals?

To the multitude who thus obtain medical relief in so objectionable a manner, must be added the *bonâ fide* paupers, or absolutely destitute persons, who are treated at the

cost of the ratepayers in the poor-law infirmaries and dispensaries of the Metropolis, amounting, according to the latest published Parliamentary report, to a daily average in 1882, of 8,567 persons in the former alone, while of the exact number of the latter, there is no printed record procurable, as mentioned before. In the last report of the Local Government Board, it is stated that when dispensaries, then in progress, were established in three of the five medical districts of the Fulham Union, there will remain only one Metropolitan Union (Lewisham), and one Metropolitan Parish (Hampstead) in which Section 38 of the Metropolitan Poor Act of 1867 has not been acted on.

To unmask and to compel all who are able to do so, to pay at least some portion of the cost of their sickness would be one direct result of this procedure. If properly carried out, under similar guarantees, and by means of somewhat similar agency to those of the poor-laws, while it would secure to every sick person really unable to pay, immediate relief in sickness, the withholding of relief orders would force the others to apply to provident dispensaries, to subscribe to sick clubs, or to procure direct medical attendance at their own homes. To work out such a scheme in all its details will, undoubtedly, be a difficult although by no means impossible task, and its ultimate effect would assuredly be to remove the present blot upon the working of the hospital system of London, which has been so often and so earnestly attempted heretofore in vain. Possibly some modification of the Swedish plan, as described by Mr. Burdett, will be found to fit best into our existing system.

"In Sweden, it is said that the Government have for years worked the hospitals on a system which would confer great benefits upon our towns, by bringing the Poor Law and voluntary institutions into more intimate association, though managed by separate governing bodies. This has been secured in Sweden by a scale of charges demanded from all patients who are admitted to the hospital. The first grade pay a substantial sum, and obtain anything and everything the patient may care to have or pay for, subject to the control of the doctor. The second pay a much less, but a remunerative rate, for all that they receive at the hospital; and the third class are paupers who are paid for on an agreed scale by the Poor Law authorities."*

Mr. Fawcett, the eminent economist, in the new edition of his manual of "Political Economy," in reviewing Prince Bismark's scheme of State Socialism, and proposals brought forward in England to widen the application of the principle involved in Poor Law relief, condemns them all, as opposed to sound principles and as tending to dry up the great stream of self-help and self-reliance, and to teach the working classes to rely upon the State rather than on putheir own efforts, in meeting their wants, physical and mental.

However true his views may be, as to the housing of the poor and the education of their children at the cost or with the help of the State, and even as regards these points there is something to be said on the other side, I do not think that they apply in equal measure, if at all, to the relief of sickness among the really poor, who cannot be regarded as, and are not destitute, so long as they are in health and able to maintain themselves

* Burdett. *Hospitals and the State*, p. 10.

and their families. It is only when not able, on being struck down, to pay anything for medical treatment that they become temporarily destitute.

This is not pauperism in the true sense of the term, and it has been so ruled recently by the Local Government Board.

The burthen of sickness is itself hard to bear by any class, and when it is attended with pains and penalties which cannot be deprived of their character of personal degradation, it becomes well nigh intolerable. The causes of this sickness are in a multitude of cases altogether beyond the reach of the poor man to remove, and for many, indeed most, of them he can be in no way fairly held to be personally responsible. Drink and vice, the most prolific parents of ill-health, are, no doubt, within his competence to avoid, yet for how much even of these, and of the crimes and other evil consequences of their indulgence, is not society itself responsible? And to what extent are they not, more or less, inseparable from the aggregation of dense populations in restricted areas, themselves conditions in some means the result and outcome of the operation of economic laws?

This is not the place to enlarge upon a topic which has been much discussed and is well understood, but the question in its economic aspect alone is deserving of careful consideration.

The laws of political economy are not themselves so fixed and immutable as to fit all the conditions, known and unknown, of modern life. The facts of one generation are frequently the fallacies of its follower, when more extended and accurate means of observation prove them to be erroneous, or when new social conditions demand fresh means of regulation, as so well and wisely argued by Mr. Goschen in his admirable discourse on *Laissez Faire*.

Mr. Edwin Chadwick, the distinguished father and founder of sanitary reform in England, has estimated the cost of avoidable death and sickness to be as great as seven shillings annually for each of the inhabitants of Manchester.

In speaking of this city, which had an average annual death rate in 1881 of 25·2 per 1,000*, the mean of all England in the same year having been 18·9, 26·9 of urban, and 16·0 per 1,000 in rural districts, Mr. Chadwick says:—

"Take the common case of a slum with a death rate of 40 in a 1,000, and of the expense it entails on the community. There will be 25 funerals at £5 each, and at least twenty times that number of cases of sickness at £1 each, every fifth case on an average being that of an adult, entailing on an average a loss from disability for two and a-half weeks at £1 per week, making £1,875 per annum of expense for 1,000. Let us make a rough estimate of the immediate loss merely in money, apart from the suffering and misery resulting therefrom, caused by an excess of 10 per 1,000, the amount by which I maintain the present death rate could be diminished by good sanitation. For every 1,000 of the population, then, we have 10 unnecessary funerals at £5 each, or £50; for every average avoidable death, there will be, according to the experience of benefit societies, 20 cases of sickness, or 200 in all, at a cost of £1 each, or £200. Of these cases of sickness, according to the experience of friendly societies, about one-fifth will cause a loss of wages for two and a-half weeks on the average, or £2 10*s.* for 40 cases, therefore £100, making in all a total annual loss of unnecessary expenditure of £350 for each 1,000 inhabitants, or 7*s.* per inhabitant per annum. For the population of Manchester 148,000 in 1881, this amounts annually to £51,800, or, in other words, to the interest at five per cent. on more than a million of money."

* In 1882, it was 36·7 for 1,000 living in Manchester.

Now, this reasoning applied to London would shew an equally serious loss to the community, if the avoidable deaths and sickness of its slums were accurately ascertained. The low death rate of the Metropolis as a whole, and as at present ascertained, is not a correct estimate of the risks to life of its poorer inhabitants, and takes no heed of those who migrate to die in the places of their nativity, while they are replaced by others in the prime of health and life, until they in turn succumb to the lethal influences of the dens of darkness and impurity, in which they are compelled to live and work. This interchange of health and disease, life and death, is a constant current, the exact extent and influence of which has yet to be ascertained.

All this will doubtless be shewn when London at large is possessed of a government of its own, capable of dealing with the many problems underlying the exceptional conditions of life in this leviathan city; and, in the meantime, the economic problem of ascertaining the best means of securing early care in sickness to those who are too poor to pay for it, and consequent diminished death rates in hospitals, will, in my humble judgment, be best solved by the extension of the principle of the Poor Laws in the manner indicated above, with all requisite guarantees to prevent its abuse.

The Mortality of London Hospitals.

There are still some debateable and unsolved questions of primary importance with reference to the death rate in hospitals, which it is most necessary should be determined in a sound scientific manner. Although it is true, that in some few hospitals excellent records are now kept, little practical good will result until all such institutions are compelled to adopt an uniform system, to afford trustworthy data for the right understanding of the many factors needed to throw light upon the questions of morbidity, as well as of mortality, associated with the treatment of the sick and injured in public institutions. From such records all trifling and unimportant details should be rigorously excluded. It is manifest that all this requires the authority of a central body, armed with power to compel obedience to its mandates.

The most eminent and trustworthy authorities at present have widely divergent views, mainly from the absence of such data as those referred to.

Messrs. Bristow and Holmes in their excellent report on the hospitals of the United Kingdom,* which is a mine of wealth on the question, and a landmark in its history, arrived at the conclusion that the evidence then afforded by statistics, whether published by others, or gathered by themselves, were inadequate to settle any of the disputed points as to the size, situation, form of construction, and other cardinal conditions, having an influence in the healthiness or otherwise of hospitals, in town or country, double-storied or many-storied, medical, surgical, or obstetric, containing few or many sick. They rightly regarded some of the factors to be insusceptible of solution by figures, and believed that the significance of a death-rate was in itself of very small value as a sanitary test. They were unable to imagine on what data the proposition was founded, which

* *Sixth Report of the Medical Officer of the Privy Council*, pp. 483-743. London, 1864.

was supposed to be at the base of the pavilion plan of buildings, and which asserted that it was dangerous to place more than 100 patients under the same roof. This line of reasoning was not altogether justified, even at the time they wrote, and has been entirely discarded since, but it is still relied on by those who decline to quit the ancient ways, and who would sacrifice too much to mere administrative convenience and economy of supervision and management, in massing together great numbers of the sick under the same roof.

That a badly constructed, ill arranged, and objectionably situated hospital may be a fairly creditable institution under skilled and careful supervision, and minimise the evils inseparable from those conditions is as undoubted as that the best instruments may, and do fail in careless and incompetent hands. This is as true of small as it is of large hospitals, of country as of town, and so long as such institutions are private property, and subject to the fads and fancies of practically irresponsible government, it will continue to be so.

But as regards the question itself on its merits, independently of all such non-essentials, the causation of some of the most destructive diseases, and their mode of origin and spread, are much better understood now, than they were twenty years ago. The researches of Pasteur, Koch, and others, on the origin of germs and the important part they play in epidemics; the invaluable antiseptic surgery of Lister, and the successful labours of Tarnier, in diminishing, almost to extinction, the production of puerperal fever in the Maternity of Paris, are among the proofs of this altered state of our knowledge of disease.

And yet, in spite of all this, a new obstetric and gynæcological hospital has been built in Paris, very much on the old lines, as if the germ theory of disease were an unknown quantity; and the two largest and most costly palaces for the sick, of recent times, are from defects of construction and arrangement among the most unhealthy and least suited for their purposes of any such institutions, as if Hygiene were a retrograde science, or had not then been called into existence.

In 1861, a committee of inquiry published in the "Journal of the Statistical Society," of London, a memorandum on the "Statistics of Mortality in the General Hospitals" of that city. The hospitals referred to were fourteen in number. From this, it appeared that, including medical and surgical cases, both sexes, and all ages, there were in these institutions, 35,506 in-patients, of whom 3,131 had died, and 3,065 remained under treatment on the first day of the following year.

The medical cases numbered 13,346, of whom 1,710 died and 1,053 remained under treatment at the close of the year. In the surgical wards were 18,326 patients, of whom 1,030 succumbed, and 1,642 remained.

The mean average residence of all the cases was 31 days; of the medical cases, 28 days; and of surgical cases, 35 days. Two of the hospitals, Middlesex and Westminster, furnished no returns. The returns of King's College, Charing Cross, and the Great Northern Hospitals were deficient in some particulars.

The average rate of mortality of all cases was 9·5 per cent., of which 1·29 per cent. was from the medical, and 5·6 from the surgical wards.

In 1862, Dr. Guy, than whom we have no more scientific, conscientious, and accurate observer, read a paper to the Congrès de Bienfaisance, held in London in that year, on the same subject.

In this closely reasoned paper, he shewed that the mortality of a hospital depended so much on the nature and character of the cases treated in it, as to admit of no fixed basis of comparison between them—a heavy death-rate being in itself no indication of the greater unhealthiness of one hospital as compared with the other. Indeed, another distinguished authority, from an extended inquiry, arrives at the conclusion that a high death-rate was more indication of greater usefulness in the treatment of disease, than of any local or other condition of unhealthiness.

From the facts and figures collected by Dr. Guy, in relation to King's College Hospital, before and after reconstruction, when its hygienic conditions had been changed for the better, and by a comparison of the death rates of that institution with those of University College Hospital, a building of very much the same character, and answering the same purpose as the clinical auxiliary of a great school of medicine, as well as by an examination of dissimilar hospitals as respect size and site, with unequal combinations of different degress in the same great city, London —from all these factors—equal figures resulting from unequal and wholly dissimilar combinations of causes, extended over a considerable period of time—Dr. Guy inferred that hospital construction and arrangements had little apparent influence on death rates, and that the size of a hospital might exercise as little influence on its mortality as its site.

The subjoined table of figures, collected sixteen years subsequently to the enquiry of the Statistical Society in 1861, viz., in 1877, 1878, and 1879, seem to sustain Dr. Guy's contention in a remarkable manner.

London Hospitals.

Number of In-patients at the principal Hospitals in London, distinguishing the Patients in the Hospitals on the 1st January; received during the year; discharged cured, &c.; died; and remaining in Hospital on 31st December in each of the years 1877, 1878 and 1879.

Hospitals.	Remaining in Hospital on 1st January.			Received during the year.			Discharged cured, &c., during the year.			Died.			Remaining in Hospital on 31st December.			Ratio per cent. of deaths to Hospital population.		
	1877.	1878.	1879	1877.	1878.	1879.	1877.	1878.	1879.	1877.	1878.	1879.	1877.	1878.	1879.	1877.	1878.	1879.
Charing Cross	112	138	139	1,500	1,638	1,648	1,308	1,436	1,443	166	201	195	138	139	149	10·3	11·3	10·9
Consumption, Brompton	†159	194	194	1,063	‡896	847	891	792	750	137	104	106	194	194	185	11·2	9·5	10·1
Guy's	519	543	538	5,025	5,167	5,189	4,503	4,617	4,620	498	555	545	543	538	562	9·	9·7	9·5
King's College	156	162	187	1,682	1,978	1,885	1,503	1,732	1,657	173	221	252	162	187	163	9·4	10·3	12·1
Female Lock ‖	80	66	70	594	831	829	604	827	845	4	...	3	66	70	51	·6	...	·3
London	613	607	550	6,825	6,448	5,811	6,121	5,831	5,213	710	674	616	607	550	532	9·5	9·5	9·7
Do Fever	94	78	91	629	635	817	575	552	703	70	70	81	78	91	124	9·6	9·8	9·
Middlesex	236	239	257	2,222	2,040	2,636	1,953	1,786	2,343	265	236	297	240	257	253	10·8	10·4	10·3
St. Bartholomew's ...	428	410	494	4,797	5,243	5,820	4,259	4,632	5,252	521	527	586	445	494	476	9·97	9·3	9·3
St. George's	306	322	332	3,410	3,732	3,796	3,021	3,343	3,440	373	379	367	322	332	321	10·	9·3	8·8
St. Mary's, Paddington	168	186	178	2,064	2,036	2,164	1,818	1,812	1,902	228	232	241	186	178	199	10·2	10·4	10·3
St. Thomas's	340	340	386	3,419	3,387	3,317	3,009	2,942	3,004	410	399	356	340	386	343	10·9	10·7	9·6
Westminster*	133	97	136	846	1,666	1,713	809	1,480	1,580	73	147	133	97	136	136	7·5	8·3	7·2
Metropolitan Free ...	16	15	15	228	238	252	216	223	232	13	15	19	15	15	16	5·3	5·9	7·1
University College ...	129	100	138	1,997	2,188	1,784	1,768	1,918	1,577	258	232	188	100	138	157	12·4	10·1	9·8
City of London (Chest)	97	101	95	773	766	795	693	695	724	76	77	65	101	95	101	8·7	8·8	7·3
Royal (Chest)	12	24	18	153	227	249	123	201	210	18	32	32	24	18	25	10·9	12·7	11·9
Total	3,598	3,622	3,818	37,227	39,116	39,552	33,174	34,819	35,495	3,993	4,101	4,082	3,658	3,818	3,793	9·7	9·5	9·3

* Hospital closed for repairs from 24th May to 24th October 1877. † Part of this Hospital was closed in the early part of 1877 for alterations.

‡ Five houses previously used as part of the hospital were pulled down in 1878 to make room for the new extension buildings.

‖ The Female Lock Hospital might with advantage have been omitted from this table, as deaths directly due to syphilitic diseases are extremely rare, as this section shews.

But, do they warrant the conclusions deduced from them? In my opinion, these returns, although of considerable value in themselves, cannot be accepted as affording a sound basis for the determination of the question to which it refers, viz., the influence of site, surroundings, the structural and other relations of hospitals in their influence upon the risks to life of those admitted within their walls.

The reason of this will be found in pp. 24, 27, and 28 of Husson's "Etude sur les Hôpitaux," quoted and discussed in p. 17 of Part I of the present work. They are summed up in the conclusion that "these documents (hospital mortality returns), can be studied with profit only on the understanding that they contain general facts and summaries, from which the light of circumstantial details is absent."

In any case, the figures referred to above appear to establish 9 per cent., or 90 per 1,000, as the normal death rate of the hospitals of London. That this rate can be diminished by structural and other arrangements, I entertain no doubt whatever. General hospitals of recent construction, such as the Royal Infirmary of Edinburgh, and the Western Infirmary of Glasgow, which are similar in character, are attached to medical schools, admit all kinds of accidents and diseases, with the exception of infectious fevers, and dealing with large populations, of whom the lives of the poorer classes may be fairly compared with those of the same category in London, show a considerably lower death rate than the standard of the great London Hospitals.

Of the hospitals in Prussia in 1881 the following official statistics have been published.

The average duration of residence in hospitals of each of the sick, 293,203 in number, was 31·61 days, and in each 1,000 of the sick were enumerated the following diseases:—

585·77	Infectious or general diseases.
204·73	Diseases af the skin and its derivatives.
120·63	,, ,, respiratory organs.
106·12	Mechanical lesions.
76·72	Diseases of the digestive organs.
51·54	,, ,, locomotive organs.
47·88	,, ,, nervous system.
26·06	,, ,, generative system.
21·34	,, ,, circulating organs.
17·75	,, ,, eyes.
17·06	,, connected with the development of the body.
2·15	,, of the ear.
10·99	All other diseases.

The deaths among each 1,000 were as follows:—

30·28	Due to diseases of the organs of respiration.
23·94	,, infectious or general diseases.
6·13	,, diseases of the nervous system.
4·66	,, ,, connected with development of the body.
4·31	,, ,, genital organs.
4·27	,, ,, of the alimentary canal.
3·54	,, ,, organs of circulation,
3·54	,, ,, mechanical lesions.
1·56	,, ,, diseases of the organs of motion.
2·30	All other diseases.

The mortality rate was 88·8 per 1,000 in the hospitals. Of the numbers received in hospital from the general population, about 100 in every 10,000 died.

We have no statistics in England to compare with these. The population of Prussia in 1880 was 27,279,111 souls, whilst that of England and Wales in 1881 was 25,974,439, so that a tolerably close comparison could have been instituted, were we in possession of the necessary figures.

I omit in the estimate as respects England all reference to special hospitals, and the statistic of amputations and maternity, in which it has been well established that small are more healthy than large, and country than town hospitals. They do not cover the ground sufficiently, however, to be accepted as authoritative in the determination of the general question.

That even, in existing circumstances, the London hospital death rate can be materially reduced by the provision of more healthy dwellings for the poor, by securing the early treatment of acute disease in hospitals among the wage-earning classes in the prime of life, and by the habits of order, cleanliness, and morality that better surroundings would secure to the whole artizan and labouring classes, in all great cities, admits of no doubt, and needs no demonstration from figures, even were those figures in existence.

Dr. Steele, the medical superintendent of Guy's Hospital, notes as follows in his valuable essay* on the Mortality of Hospitals, General and Special:—

"The high and increasing hospital mortality of recent years, which has been felt in the chief Metropolitan institutions, will no doubt be attributed to the grave character of the maladies received, but it is gradually assuming proportions which deserve the most serious consideration. It is proverbially remarked that the hospital which confers the largest amount of benefit on the community is that in which the death-rate is found to be the highest; but such an admission, if true, and if acted upon to the extent of admitting none but critical and incurable affections, would rob the hospital of half its value and paralyse all efforts of medic skill in the shape of prevention. On the other hand, if the most pressing claims of the sick in an advanced stage of disease are disregarded, and preference is given to such as are recommended by supporters of the particular institution, who for the most part are strangers to the more urgent needs of the many, much injury may be inflicted on the sick poor and on the objects which the hospital was purposed to fulfil."

Mr. Lawson Tait, of Birmingham, after an exhaustive statistical inquiry, in an essay of equal value and authority, states that the whole of his statistics prove "that after the number of beds in a hospital exceeds 100, the risk to life become so much increased that it is questionable whether any hospital should be of larger size than this. If circumstances make it necessary that the hospital should be larger, most undoubtedly special arrangements and precautions should be taken to obviate the extra risk which is involved." He winds up his inquiry with recommending an exhaustive examination of the whole question by a competent and duly authorised body. †

In a return, published by Dr. Steele in his essay, the death rates in the general hospitals of London from 1872 to 1875 ranged from 7·20 per cent. in the Royal Free Hospital to 12·72 per cent. in King's College Hospital. If we possessed no other in-

* *Journal of the Statistical Society of London*, No. xl., 1877, p. 198.

† *Hospital Mortality*, by Lawson Tait, F.R.C.S. London, 1877.

formation than this on the subject, it would establish the absolute necessity of a searching public examination. There is every reason to believe that those serious disproportions of risk continue to exist.

In a valuable report on pyæmia, septicæmia, and purulent infections, drawn up by a Committee of the Pathological Society of London, and appended to the medical supplement of the Ninth Annual Report of the Local Government Board,* is the following tabular statement:—

TABLE II.—DECENNIAL RETURN OF DEATHS FROM PYÆMIA IN EIGHT LONDON HOSPITALS.

HOSPITAL.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	TOTAL.
St. Bartholomew's ...	10	9	10	8	4	8	9	8	3	9	78
St. George's	11	15	11	7	11	†8	8	5	5	4	85
Guy's	21	23	28	19	29	30	38	26	23	13	250
London	10	7	17	22	19	29	27	16	21	12	180
Middlesex	4	6	10	7	8	9	3	5	5	1	58
Seamen's	4	5	9	8	5	10	7	6	4	2	60
St. Thomas's	4	4	7	‡19	16	13	16	12	22	12	125
University	§—	§—	12	8	7	18	11	10	5	14	85
Totals	64	69	104	98	99	125	119	88	88	67	921

The most remarkable fact in this record is the place occupied by the new and very costly St. Thomas's Hospital, which bids fair to become the Lariboisière of London, as from the very commencement of its use it thus appears to have been afflicted by what eminent authorities consider, in the way of disease, to be the crucial test of an unhealthy hospital. It must not be overlooked that most of the cases above recorded originated in the surgical wards of the institutions mentioned, and in this unhappy family are the oldest and youngest members of the brotherhood. At St. Thomas's six cases only were admitted from without from its opening to 1878; the rest arose within the wards. In addition to the pyæmia there were, in the same hospital, from 1869—thus including three years prior to the opening of the new building—485 cases of erysipelas, of which 153 were admitted, and 332 originated in the wards.

It would be altogether out of place in this essay to attempt to explain these occurrences, of which the details are contained in the report above referred to. If such hospital opprobia are absent, as they are said to be, from smaller hospitals in better situations, and from those constructed more in consistence with the "new views," they point strongly to the urgency of due and proper investigation to set the question at rest.

Among the subsidiary matters connected with the organization of the medical relief of the sick poor in London, are—the relations of the medical schools to the hospitals associated with them, and the whole question of the clinical and practical portion of medical education; the scientific study of chemistry, physiology, therapeutics, and

* *Ninth Annual Report, Local Government Board*, 1879-80; Appendix B., No. 3, p. 208.

† Hospital closed for three months. ‡ First year in new buildings. § Returns not given.

pathology in their relations to practical medicine; the care and treatment of the sick poor in their own homes, when they are in such circumstances as neither to desire, to be able to bear, or to need removal to a hospital; and a well regulated ambulance system.

The two first questions are far too extensive to admit of proper treatment in this place, and involve so many issues foreign to it, as not to require it. It will be sufficient to state generally that all public institutions devoted to the healing of the sick should be instruments of instruction in their several degrees.

The dispensaries, in teaching the physiognomy of disease, a species of *visus eruditus*, which, with its twin brother, the *tactus eruditus*, cannot be acquired too early. With them would be associated the necessarily rapid and superficial examinations that can be given to the diagnosis and detection of, as well as the simple means required to deal efficiently with the minor and less important ailments, which fortunately include the bulk of the applications for out-door medical relief. This should form the first stage, and at this time, and in this manner a considerable and valuable amount of knowledge of the disorders of infancy and early childhood can be acquired, quite as well as in hospitals.

The general and special hospitals should supply the next step in the application of the principles taught in the schools, to the treatment of the ailments and injuries contained in the sick wards. In every such hospital should be found room for a sufficient number of clinical clerks and dressers to acquire a practical acquaintance with a more minute and careful examination of disease, as well as to study the effects of remedies, and the application of the appliances used in medicine and surgery. No other student should be permitted to frequent these wards, and the whole of the duties should be performed with the least possible distress and disturbance to the sick. The students selected for these offices should be sent from the schools in such manner as may be found to interfere least with their course of study, and at such stages of their *curricula* as will enable them to profit by an entry upon the practical duties of the profession in a responsible form. In these hospitals and at this time should be taught the application of chemistry and the microscope to the diagnosis of disease, and the use of such instruments as the stethoscope, the laryngoscope, the opthalmoscope, the electric current, etc.

This stage of clinical instruction would content a very large proportion of aspirants for degrees and diplomas—in fact, those who intend to enter upon general practice, and who do not aspire to the higher honours and offices of the profession.

The same class of hospitals should be used as training schools for nurses, after their period of probation in a clinical hospital. The number of the above classes should be restricted to the actual necessities of the institution to which they are appointed.

The last and highest stage of clinical instruction should be in the clinical wards of the great hospitals attached to the schools of medicine. The selection for the offices of clinical clerks and dressers, house surgeons, and house physicians, should be conducted in an entirely different manner from that in use amongst us. All such offices should be open to competition and concours among those who have gone through the training of the dispensaries and general and special hospitals, and there should be no other manner of appointment to them. The examinations should be severe and searching, and entirely

practical, so as to allow of no room for sham and cram—the bane of the educational system, created and fostered by the competitive plan of selection for public offices of other classes and kinds.

No other students should be permitted to crowd or walk the wards of clinical hospitals. In the clinical practice and teaching of this class of hospitals a great deal more direct responsibility should be allowed to the students in the care and management of the cases than is now the practice, but always under the direct and immediate supervision of the house surgeons and physicians. The greatest care should be taken to avoid unnecessary disturbance of the sick, and to minimise the risk of carrying infection to them.

That hospitals should also be the real training schools for nurses, into which no intrusion of extraneous elements of any kind or character should be permitted on any pretence whatever. The work is strictly secular and subordinate, and so it should be kept.

The details of the working of the scheme outlined above would of necessity need careful elaboration by the hospital authorities of the future, in the more close and extended guidance of the medical arrangements of the Metropolis that, it is to be hoped, will fall to them sooner or later.

As respects the scientific study of chemistry, physiology, therapeutics, and pathology, the departments assigned to them should find no place in the hospital buildings, nor should they be placed in such immediate proximity to the sick as to prove, in any circumstances, detrimental to them. They should be annexed to, but detached from the hospital buildings proper.

The whole of our medical organization must become far more complete and free from fads than it is at present—assimilated, in fact, to the system now well established and in thorough working order in Germany—before we can hope to attain or retain a foremost place in the advancement of medical science. Our medical schools and hospitals must likewise be placed on a different footing, if they are to keep pace with the methods of teaching practical medicine, as it now requires to be taught.

We must abandon, also, a good deal of our pretensions to regulate such matters in our several ways, and cease to regard and resent the interference of the State as an intolerable interference with private action. The State has already undertaken the management of primary education, with manifest advantage. The call for some control over education in Middle Class Schools is increasing in intensity. It has already interfered with the great Universities by legislative enactments, and no Colleges or Universities can be called into existence except under the stringent provisions of Royal Charters. Why, then, should medical education, and the care and treatment of the sick, be exempt from the general law? It cannot be because they do not need it, and can manage it better for themselues. Any argument based upon this contention is best met by the fact that we have failed to do so in the past, and there is no evidence of our will and power to do so in the future. The voluntary organization of schools and hospitals for any single and simple purpose, such as the keeping of records on a uniform plan; the preparation and publication of intelligible accounts; the adoption of similar methods for the admission of the sick, or any object whatever, is an idle dream and a delusion.

Organization, to be effective, must be compulsory, and the only compelling authority is the State, acting through and by the Legislature.

Mr. Goschen has recently discussed the doctrine and practice of *Laissez faire* in a sound and statesmanlike manner from the stand-point of public policy, and shewn clearly how in some circumstances, created by the altered conditions of modern life in association, the rules and practice of the past are no longer applicable to the present. The same reasoning, *mutatis mutandis*, fits strictly into the question now under consideration in all its bearings, from the direct aid of the State to the poor in sickness, to the pursuit of medical science and research, with advantage to the nation, in State endowed and State aided institutions.

As it is, the schools should not in any case be a tax upon the resources of the hospitals, and the interests of the sick should in no circumstances be sacrificed or subordinated to the education and training of the medical profession.

As respects the treatment of the sick poor in their own homes, provident dispensaries and sick clubs should be encouraged in every way, and where they fail to reach the classes immediately above the absolutely destitute, the relief can be afforded by similar agency to that now employed in the working of the Poor Laws, safeguarded by similar restrictions. Home treatment is already largely resorted to in puerperal practice, with vastly diminished risk to life; and, like it, may to the most advanced students in the schools, be rendered a valuable and inexpensive school of practical instruction.

Regarding ambulances, every great hospital should possess one or more, so regulated as to be immediately available to carry timely aid to the injured and suffering—very much as obtains in the extinction of fires. The police and all other authorities concerned should at all times be kept informed of the number of beds available for the injured and sick in the hospitals of their districts.

In a scheme of general organization, such as I contemplate and advocate, due provision for this should be made, as obtains in Paris. I have seen the plan in effective operation for street accidents in New York.

Suggestions.

From a careful review of the whole question, taking into account the vast proportions of the poor of London, the fact that the resources of the general hospitals—voluntary and endowed—are becoming dangerously strained; that from their quasi-eleemosynary character, and consequently conflicting regulations and interest, a large number of the really poor, for whose relief they are intended, are excluded from their benefits, whilst very many who can afford to pay for medical care and treatment, receive them gratuitously—a demoralizing proceeding tending to the prevention of the exercise of thrift, and destroying the principle of self-reliance in even a more objectionable manner than the present gross abuses of the out-door medical relief of the destitute, and, above all, seeing that the exertions of private charity are quite inadequate to meet the difficulty and to remedy the disorders of the hospital system in such an *Imperium in Imperio* as London has become, it is abundantly evident that the time has fully arrived for a reconsideration of the whole question.

General, and indeed all other, hospitals are public institutions of first necessity, and no personal or proprietary rights in relation to them should be permitted to interfere with their regulation in the interests of the public. This regulation can be so carried out as in no way to interfere with the maintenance of such control and management by the subscribers and supporters, as will not be inconsistent with that object.

As no one is permitted to engage in any trade or occupation which is of public importance, without some licence or authority for its proper conduct, so no hospital of any kind or for any purpose, should be allowed to be created or carried on without some similar means of securing that it is fit for its purpose, and that the funds raised for its maintenance are not devoted to any other object.

My conclusion then is that—

1. The sick and injured among the poor, who are unable to contribute towards their relief, should possess the right of admission to all general hospitals without being subjected to the penal consequences of the Poor Laws. The temporary destitution of the sick poor being due to other causes than those contemplated by the laws in question, and having always been rightly regarded as a fit subject for private charity and benevolence, subjecting its recipients to no loss of self-respect, this change of procedure would constitute merely the substitution of public for private charity, the former being constant, stable, and subject to control and regulation; the latter being capricious, unstable, and under no proper public or other control.

2. All general hospitals should thus be open to every class of destitute person, whether pauper or non-pauper, proper regulations being framed for the admission of all such poor persons, to prevent the abuses inseparable from its uncontrolled operation.

The immediate conversion of the existing Poor Law separate infirmaries and sick asylums in the Metropolitan area into general hospitals would at once provide an addition of several thousand beds for the poor generally of London, all aged, bed-ridden, and incurable paupers now contained in them, being transferred to the infirmaries within the workhouses, which are really intended for such cases.

3. A comparatively trifling extension of the Metropolitan poor rate to form a common sick fund would be sufficient to meet the additional expenditure required; a penny in the pound on the present rateable value of property in London, yielding an annual income of nearly £105,000.

It would not be difficult for a properly organized general government for London to effect savings in other directions in the rates, that would far more than cover the additional funds required.

4. An inquiry by a competent public authority, whether Royal Commission or other, as soon as the necessary legislative sanction can be obtained, should be instituted to determine how this system can best be harmonized with the action of the present endowed and voluntary hospitals, so as to secure to them such rights and privileges as can justly be allowed, consistently with the terms of their charters, or the conditions of their subscriptions or bequests, but always without detriment to their primary purpose, the relief of sickness among the poor.

The adoption of the fundamental principle of the French laws on the subject, with some slight modification, might probably furnish the soundest basis of regulation. The following are the rules on the subject :—

RULE 52.—"The admission to hospitals is either gratuitous or retributory. The creation in hospitals of special wards for paying patients is of real advantage in many points of view. But the essential purpose of hospital establishments is for gratuitous admissions, that is to say, for the indigent."

RULE 54.—"The admission of the indigent sick is regulated by one of the members of the Commission (d'Assistance Publique), specially appointed for the purpose, on the recommendation of a medical practitioner, and, except in urgent cases, one of destitution by the local authority of his domicile, and the other by the practitioner who has treated the sick person."

Should it be determined that all general and other hospitals shall be regarded and treated as public institutions, and thus be brought under the control of the State to the limited extent sanctioned by usage and legislation in this country, the following is an outline of the scheme which I venture to suggest for consideration, to organize the relief of the sick poor of London upon an entirely new and consistent basis.

It is obvious that in a fresh departure, dealing with overwhelming numbers, conflicting interests, time honoured abuses, deeply ingrafted prejudices, and life in association on a colossal scale, of the conditions underlying which little that is certain is known, it would be impossible even to attempt to work out any portion of it in detail. For such exhaustive treatment, the data now in existence, have not yet been collected and collated by any competent authority.

My plan then is to divide London into sections for hospital purposes, rendering each complete for those purposes, and governing the whole by a central body, representing each of its component parts in all particulars and interests, similar, in fact, to the London School Board.

HOSPITAL LONDON.

1. London, in the Metropolitan area to be divided into five hospital districts, corresponding to those of the Registrar General, and delineated in the accompanying Map.

The area embraced in each of these districts, the hospitals contained in, and the population inhabiting them are by no means those that would have been selected, or that may ultimately be finally adopted for the purposes above mentioned. The selection is compulsory, as they are the only areas of which the exact figures have been collected, and of which the exact boundaries have been defined.

2. Each hospital district to have a separate Board of Control to regulate all matters connected with the general management of these institutions, and the relief of the sick poor within the boundaries of the district, with full power to give effect to all existing and future laws and regulations regarding them.

This board to consist of members of the existing hospital authorities in each district, of a certain number of guardians of the poor of the parishes in those districts, and of ex-officio members appointed by some competent authority now existing, or to be created hereafter.

3. A General Hospital Board for the whole of the metropolis, to be created and selected by themselves from among the members of the district boards, to insure a fair representation of all the interests and localities concerned.

To this board should be entrusted the duty of harmonizing the action of the district boards, without interfering in matters of detail, or in the government of individual institutions.

It should prepare and print annually for submission to Parliament a detailed report of the hospital history of London for each year; and the report should be accompanied and illustrated every year by a carefully prepared map, shewing the exact incidence of sickness and death in every house and street of London, so as to indicate clearly where measures of sanitation were most urgently needed, either from over-crowding, defective housing, or any other remediable and ascertained cause of loss of health or life.

Such a record would be of infinite interest and importance in the future, both for purposes of legislation, and for the exercise of well regulated private charity, in mitigating individual miseries in the many forms which can only be efficiently dealt with by personal and untramelled agency.

4. Every hospital board (district and general) to appoint its own officers, and elect its own chairman.

5. The passing of an Act, similar in character to, but more extended in scope than the Metropolitan Poor Act of 1867, embodying the above provisions, in as much detail as can rightly be contained in a legislative enactment, in which the power to frame bye-laws dealing with all questions of detail should be included.

By the institution of some such form of general government for the hospitals of London, the subsidiary, collateral, and undetermined questions now urgently awaiting solution could best be dealt with, so as to secure the gradual introduction of all desirable or necessary changes, with as little interference as possible with existing principles and practice. All advances in administration, to be successful, must be gradual and deliberate, and nothing should be destroyed which cannot be more efficiently rebuilt and replaced, if changes are to be of a permanent character, and not the outcome of political passion, or of any of the many forms of perverted sentiment, which render England the paradise of enthusiasts, quacks, and impostors of all colours and complexions, and the abode of societies of anti-everything which can find dupes to believe in their advocacy.

Among the questions referred to are—A better distribution of the hospital accommodation of London with reference to the movements and present aggregation of its poorer population; a revision of the rules for the admission of the sick to hospitals, whether as gratuitous or paying patients of limited means; the proper regulation of the out-patient system and of the dispensaries, through which alone, except in cases of urgency, the sick should find admission to the hospitals; the affiliation of the special hospitals and dispensaries in each district to the leading general hospital of that district; the creation and development of a complete ambulance system for the whole of the metropolis; the relations of the medical schools to the hospitals, and the utilization of all classes of medical institutions for the education of the medical profession and for the unsectarian training of nurses, particularly for the sick poor; and the proper scrutiny of the budgets of the different hospitals with a view to the appropriation of such grants in aid from the common sick fund, as may be found necessary.

Should a Royal Commission be appointed to consider these matters, for that is the only authoritative agency which is almost universally deemed to be capable of dealing effectively with the whole question with a view to legislative action, that body would doubtless determine the nature and extent of the control which the State can rightly exercise, in the supervision of hospitals and kindred institutions. That this can be done without drying up the existing sources of private charity and personal benevolence, and without impairing the manly spirit of self-reliance and self-help, or insidiously superseding the self-government, which are considered the pride and the strength of our nation, I firmly believe. I am no partizan of any form of State Socialism in whatever guise it is presented, but I am convinced that in new conditions of life in association, of which the complicated relations and conflicting interests need regulation, the principle of *laissez faire* may be carried too far, and just so much control, supervision, and aid may and ought to be applied as will afford to the helpless and unprotected secure and timely succour in the hour of trial and danger, against which they are powerless to contend. Health and life are too sacred to be the sport of capricious charity, or of demoralizing doles. Moreover, the best and wisest direction in which private charity can be exercised in the matter is in helping the families of the bread winners to keep off the rates and retain their homes, when those bread winners are struck down by sickness, and compelled to resort to the hospital for treatment.

INDEX TO MAP.

Alphabetical List of the Metropolitan Hospitals in the WESTERN DISTRICT.

Hospital.	Parish.	No. of Parish on the Map.	No. of Hospital on the Map.
Belgrave Hospital for Children	St. George, Hanover Sq.	VI.	1
Cancer Hospital, Brompton	Chelsea	V.	1
Chelsea Infirmary, Cale Street, Chelsea ...	Do.	V.	6
Cheyne Hospital for Children...	Do.	V.	2
Epidemic Hospital (Small Pox)	Fulham	III.	
Fulham Union Infirmary...	Chelsea	V.	
French Hospital, Leicester Square	St. Anne, Soho	XIX.	1
Hospital for Children, Maida Vale	Paddington	IV.	3
Hospital for Consumption, Fulham Road ...	Kensington	II.	1
Hospital for Women, King's Road	Chelsea	V.	5
Hospital for Women, Soho Square	St. Anne, Soho	XIX.	2
Hospital for Women and Children	St. John, Westminster	VIII.	
Kensington Infirmary, Marloes Road	Kensington	II.	2
Lock Hospital for Men	St. Anne, Soho	XIX.	3
Lock Hospital for Women	Paddington	IV.	2
Marylebone Infirmary	Kensington	II.	3
National Hospital for Heart Disease	St. Anne, Soho	XIX.	4
Royal Orthopædic Hospital	St. George, Hanover Sq.	VI.	2
St. George's Hospital, Hyde Park Corner ...	Do. do. ...	VI.	3
St. George's Infirmary, Fulham Road	Chelsea	V.	7
St. John's Hospital for Skin Disease	St. Anne, Soho	XIX.	5
St. Mary's Hospital	Paddington	IV.	3
St. Raphael's Hospital for Men	Chelsea	V.	3
Throat Hosiptal	St. James, Westminster	VII.	
Victoria Hospital for Children	Chelsea	V.	4
West London Hospital	Hammersmith	I.	
Westminster Hospital	St. Margaret, Westminster	IX.	

CENTRAL DISTRICT.

Hospital.	Parish.	No. of Parish on the Map.	No. of Hospital on the Map.
Chest Disease, Hospital for	St. Luke's	XXII.	2
Children with Hip Disease, Hospital for ...	St. Andrew, Holborn ...	XX.	1
Fistula, St. Mark's Hospital for	St. Luke's	XXII.	3
Homœopathic Hospital, The London	St. Andrew, Holborn ...	XX.	4
Incurable Women, Home for	Do. do. ...	XX.	2
Lying-in Hospital, The City of London ...	St. Luke's	XXII.	1
Ophthalmic Hospital...	St. Stephen	XXIII. & XXIV.	1
Orthopædic Hospital, The City	Saffron Hill	XXI.	1
Paralysed and Epileptic, The National Hospital for	St. Andrew, Holborn ...	XX.	5
St. Bartholomew's Hospital	St. Bartholomew the Less	XXIII. & XXIV.	2
St. John's and St. Elizabeth's Hospital ...	St. Andrew, Holborn ...	XX.	6
St. Luke's Hospital for Lunatics	St. Luke's	XII.	4
Sick Children, Hospital for	St. Andrew, Holborn ...	XX.	3

SOUTHERN DISTRICT.

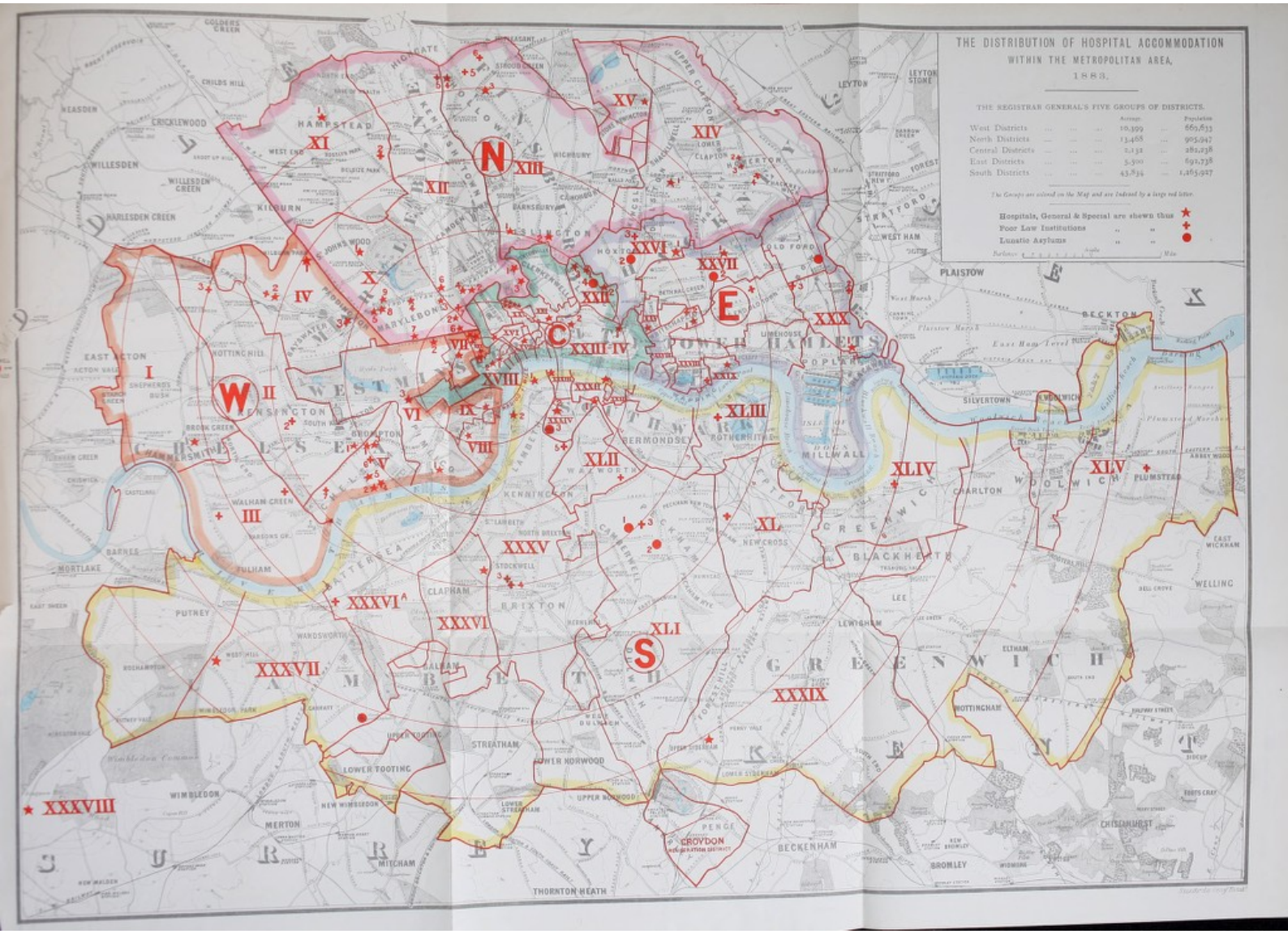
Hospital.	Parish.	No. of Parish on the Map.	No. of Hospital on the Map.
Bethlem Hospital for Lunatics	St. George the Martyr	XXXIV.	3
Camberwell House for Lunatics	Camberwell	XLI.	1
Camberwell Infirmary	Do.	XLI.	3
Evelina Hospital for Children	St. George the Martyr	XXXIV.	1
Greenwich Infirmary	Greenwich	XLIV.	
Guy's Hospital	St. Olave	XXXI.	
Do.	St. Saviour, Surrey ...	XXXII.	
Incurables, British Home for	Clapham	XXXVI.	
Do. Royal Hospital for	Wandsworth	XXXVII.	1
Lambeth Infirmary	Lambeth	XXXV.	5
Metropolitan Convalescent Institution... ...	Kingston	XXXVIII.	
Ophthalmic, Royal South London...	St. George the Martyr	XXXIV.	2
Peckham House for Lunatics	Camberwell	XLI.	2
St. Olave's Infirmary	Rotherhithe	XLIII.	
St. Saviour's Infirmary	Newington	XLII.	
St. Thomas's Hospital	Lambeth	XXXV.	2
Skin Disease, Hospital for	St.Saviour,Christchurch	XXXIII.	
Small Pox Hospital, Old Kent Road	Deptford	XL.	
Stockwell Fever	Lambeth	XXXV.	3
Do. Small Pox	Do.	XXXV.	4
Wandsworth and Clapham Infirmary	Battersea	XXXVIa.	
Do. Asylum for Lunatics	Wandsworth	XXXVII.	2
Women and Children, Hospital for	Lewisham	XXXIX.	
Do. Do. Royal Infirmary ...	Lambeth	XXXV.	1
Woolwich Infirmary	Plumstead	XLV.	

EASTERN DISTRICT.

Hospital.	Parish.	No. of Parish on the Map.	No. of Hospital on the Map.
Bethnal Home for Lunatics	Bethnal Green	XXVII.	2
Chest Disease, City of London Hospital for	Do.	XXVII.	1
Children, North Eastern Hospital for	Shoreditch	XXVI.	1
City of London Infirmary	St. Leonard, Bromley...	XXX.	3
East London Hospital	Shadwell	XXIX.	
Grove Hall for Lunatics	Bow	XXX.	
Hoxton House for Lunatics	Shoreditch	XXVI.	2
London Hospital	Whitechapel	XXVIII.	
Metropolitan Free Hospital	Spitalfields	XXV.	
Mile End Old Town Infirmary	Mile End Old Town.		
Poplar and Stepney Sick Asylum	St. Leonard, Bromley...	XXX.	2
Poplar Hospital for Accidents	Do. do. ...	XXX.	1
St. George in the East Infirmary	St. George in the East	XXVIIIa.	
Shoreditch Infirmary	Shoreditch	XXVI.	3
Whitechapel Infirmary	Whitechapel	XXVIII.	2

NORTHERN DISTRICT.

Hospital.	Parish.	No. of Parish on the Map.	No. of Hospital on the Map.
Cancer, St. Saviour's Hospital for	St. Pancras	V.	1
Consumption Hospital, North London... ...	Hampstead	XI.	1
Epilepsy, Hospital for	St. Marylebone	X.	1
Eye Hospital, Western	Do.	X.	8
Fever Hospital, Hackney...	Hackney	XIV.	2
German Hospital	Do.	XIV.	1
Great Northern Hospital	Islington	XIII.	1
Hackney Infirmary	Hackney	XIV.	4
Holborn Infirmary	Islington	XIII.	5
Invalid Asylum, Stoke Newington	Stoke Newington	XV.	
Islington Infirmary	Islington	XIII.	6
London Fever Hospital	Do.	XIII.	2
Lying-in Hospital, Queen Charlotte's	St. Marylebone	X.	5
Lying-in Hospital, St. Saviour's	Islington	XIII.	3
Middlesex Hospital, The	St. Marylebone	X.	2
Ophthalmic Hospital, Western	Do.	X.	9
Orthopædic Hospital, National	Do.	X.	3
Royal Free Hospital	St. Pancras	XII.	3
Samaritan Hospital, Lower Seymour Street, W.	St. Marylebone	X.	7
Sick Asylum, Central London, Cleveland Street	St. Pancras	XII.	7
Sick Asylum, Highgate, N.	Do.	XII.	5
Small Pox Vaccination Hospital, Upper Holloway	Islington	XIII.	4
Small Pox Hospital, Hackney...	Hackney	XIV.	3
Small Pox Hospital, Hampstead	St. Pancras	XI.	2
Stone, St. Peter's Hospital for	St. Marylebone	X.	6
Temperance Hospital, London, Hampstead Rd.	St. Pancras	XII.	2
Throat Hospital, Central London	Do.	XII.	1
University College Hospital	Do.	XII.	4
Women, New Hospital for	St. Marylebone	X.	4


THE DISTRIBUTION OF HOSPITAL ACCOMMODATION
WITHIN THE METROPOLITAN AREA,
1883.
THE REGISTRAR GENERAL'S FIVE GROUPS OF DISTRICTS.
Average Population
West Districts ... ... 10,309 ... 669,633
North Districts ... ... 13,468 ... 905,947
Central Districts ... ... 2,132 ... 282,238
East Districts ... ... 5,500 ... 691,738
South Districts ... ... 43,834 ... 1,265,947
The Groups are coloured on the Map and are indexed by a large red letter.
Hospitals, General & Special are shewn thus ★
Poor Law Institutions .. ..
Lunatic Asylums .. ..
N
W
E
C
S
I II III IV V VI VII VIII IX X XI XII XIII XIV XV XVI XVII XVIII XXII XXIII-IV XXV XXVI XXVII XXX XXXI XXXII XXXIII XXXIV XXXV XXXVI XXXVI A XXXVII XXXVIII XXXIX XL XLI XLII XLIII XLIV XLIV
HAMPSTEAD
KENSINGTON
CHELSEA
WESTMINSTER
MARYLEBONE
ISLINGTON
HACKNEY
TOWER HAMLETS
LAMBETH
WANDSWORTH
CAMBERWELL
GREENWICH
LEWISHAM
CROYDON
SURREY
MIDDLESEX
KENT
HOLLOWAY
KENSINGTON
CHELSEA
BATTERSEA
BRIXTON
CLAPHAM
PUTNEY
FULHAM
BARNES
MORTLAKE
WALHAM GREEN
HAMMERSMITH
EAST ACTON
NOTTING HILL
BROOK GREEN
SHEPHERDS BUSH
WILLESDEN
CRICKLEWOOD
KILBURN
HARLESDEN
CHILDS HILL
GOLDERS GREEN
HENDON
HIGHGATE
WEST END
JOHN'S WOOD
BAYSWATER
PADDINGTON
CAMDEN TOWN
BARNSBURY
CANONBURY
HOXTON
CLERKENWELL
BETHNAL GREEN
OLD FORD
STRATFORD
WEST HAM
LEYTON
LEYTON STONE
UPPER CLAPTON
LOWER CLAPTON
HACKNEY
STAMFORD HILL
STOKE NEWINGTON
WICKSBURY
UPPER HOLLOWAY
HOLBORN
ST GILES
BLOOMSBURY
ST PANCRAS
EUSTON
REGENTS PARK
MARYLEBONE
PADDINGTON
BAYSWATER
NOTTING HILL
KENSINGTON
SOUTH KENSINGTON
BROMPTON
CHELSEA
PIMLICO
VICTORIA
WESTMINSTER
ST JAMES'S
WHITEHALL
CHARING CROSS
STRAND
COVENT GARDEN
HOLBORN
FINSBURY
CLERKENWELL
ST LUKE'S
SHOREDITCH
BISHOPSGATE
LIVERPOOL STREET
WHITECHAPEL
ST GEORGE'S-IN-THE-EAST
LIMEHOUSE
POPLAR
MILLWALL
ISLE OF DOGS
BLACKWALL
EAST INDIA DOCKS
LIMEHOUSE BASIN
RATCLIFF
STEPNEY
MILE END
BOW
BROMLEY
OLD FORD
BETHNAL GREEN
VICTORIA PARK
HACKNEY MARSH
HACKNEY
CLAPTON
STAMFORD HILL
STOKE NEWINGTON
NEWINGTON
WALWORTH
KENNINGTON
LAMBETH
VAUXHALL
NORTH BRIXTON
STOCKWELL
CLAPHAM
BRIXTON
STREATHAM
NORWOOD
UPPER NORWOOD
LOWER NORWOOD
WEST DULWICH
DULWICH
CAMBERWELL
PECKHAM
NEW CROSS
DEPTFORD
GREENWICH
BLACKHEATH
CHARLTON
WOOLWICH
KIDBROOKE
LEE
LEWISHAM
ELTHAM
WELLING
BELL GREEN
EAST WICKHAM
PLUMSTEAD
ABBEY WOOD
EASTERN
SILVERTOWN
CANNING TOWN
PLAISTOW
BECKTON
EAST HAM LEVEL
PLAISTOW MARSH
WEST HAM MARSH
WANDSWORTH
WEST HILL
PUTNEY
ROEHAMPTON
WIMBLEDON
WIMBLEDON COMMON
MERTON
MITCHAM
NEW MALDEN
NEW WIMBLEDON
LOWER TOOTING
STREATHAM
THORNTON HEATH
PENGE
BECKENHAM
BROMLEY
CHISLEHURST
SIDCUP
FOOTS CRAY
NOTTINGHAM
WORMWOOD SCRUBBS
WORMWOOD SCRUBBS PRISON
WEST LONDON
GREAT WESTERN
GREAT CENTRAL
METROPOLITAN
DISTRICT
NORTH LONDON
LONDON & SOUTH WESTERN
LONDON, BRIGHTON & SOUTH COAST
SOUTH EASTERN
LONDON, CHATHAM & DOVER
GREAT EASTERN
MIDLAND
LONDON & NORTH WESTERN
LONDON & SOUTH WESTERN
LONDON, TILBURY & SOUTHEND
LONDON, BRIGHTON & SOUTH COAST
SOUTH EASTERN
LONDON, CHATHAM & DOVER
GREAT EASTERN
MIDLAND
LONDON & NORTH WESTERN

CONCLUSION.

WE now present our work to the benevolent public, and to the professions most intimately associated with the relief of sickness and injuries in hospitals. We believe it to represent fairly the present state of the question in its medical and architectural aspects, without pretending to be exhaustive in either.

The progress of science is so rapid, the mechanical and other means of dealing with its discoveries are so numerous, and the views of the exponents of the one, and the active agents of the other are so constantly changing and advancing, as to render it well nigh impossible at any given time, to represent the actual state of either the science or the art of hospital construction and arrangements.

Among the criticisms of the first part of our work to which we have given attention, a request has been preferred, that we should formulate our own views and opinions on each of the questions treated, and draw up rules for the guidance of the authorities engaged in providing new, or re-modelling old institutions for the successful treatment of the sick and afflicted.

This would demand a more profound study of the whole question than the time at our disposal, at present, admits of. But, should the demand for the work in its complete form induce us to believe that an addition of this nature would increase its usefulness and value, we shall be happy to comply with the request in a supplement, reviewing the subject carefully in the sense desired.

In the meantime we trust that the index and illustrations will enable all inquirers easily to find the information they desire, on each of the details of hospital construction and management, which they are in search of.

The only classes of hospitals of which illustrations have not been given, are fever and convalescent hospitals. These are in a transition state, and the views regarding them are still to a great extent matters of speculation and discussion. We have, in consequence, had so much difficulty in fixing upon types that fulfil all the conditions required, as to induce us to leave them in abeyance for the present.

Should, however, another edition of the work be called for, we shall endeavour to supply the want as far as practicable.

APPENDIX.

CIRCULAR HOSPITAL WARDS.

[Excerpt from Vol. VII. of the Transactions of the Sanitary Institute of Great Britain.]

By H. Saxon Snell, F.R.I.B.A.,

Read September 24th 1885, at the Congress of the Institute, held at Leicester.

The proposition for constructing hospital sick wards upon what is known as the "Circular System," was first made in this country during the latter part of 1878, about the same time that the foundation-stone was being laid in Belgium of a hospital intended to be built upon this principle.

The design for this building, the Antwerp Civil Hospital, having received the approval of the Communal Administration of the town, was referred to the consideration of the Council of Public Hygeian at Brussels, but this body strongly condemned the erection of circular wards upon grounds which, now the building is erected, would appear to have been correct. Nevertheless, the work was proceeded with, and the building is now opened and may be inspected by those interested in the question.

No other Continental nation has, to my knowledge, considered this new system worthy of imitation, but in England many similar hospitals have been erected, and it is, I believe, in contemplation to erect others.

There is something very fascinating about the conception of a circular ward, and superficial consideration of the question would lead to a belief in the soundness of the arguments advanced in favour of the system; indeed, I was myself disposed, before critically examining the matter, to allow that its adoption might possibly be productive of some, if not all, the benefits promised by its advocates. This illusion was, however, dispelled when lately I had occasion to study the question in all its aspects for the purposes of a report to a public body prepared to erect this class of wards upon my recommendation, and I propose now to show the reasons that led me to the conclusion that parallelogram-shaped sick wards are in every respect much more economical, both in first cost and in management, and that no advantage is to be attained by the increased outlay consequent upon the erection of wards of circular shape.

My present remarks will be confined to a consideration of the erection of wards for general hospitals, and I do not propose in this paper to deal with the question in its application to fever or other wards for special cases. Nevertheless, I am equally convinced that the circular system as now advocated is wrong in any kind of hospital building, whatever be its special use or locality; but to deal with the question in its

application to other than ordinary hospitals would involve considerations which the time at my disposal on this occasion will not allow of being entered into.

It will be well to first consider what are the conditions necessary to be observed in the planning and construction of general hospital wards.

First, as to the number of patients. I have the authority of Miss Nightingale and of many hospital superintendents, for stating it to be essential that besides the ordinary nurses and attendants every ward should have the constant presence of one head nurse in the day time and of one nurse at night time, and that these head and night nurses could each properly overlook forty patients as a maximum; but taking into consideration all the essentials for proper discipline and facility of administration, the number of patients in any one ward should not exceed thirty-two or be less than twenty; also, that in all cases one, or at most two, separation wards—each for the accommodation of one, or at most two, patients—should be attached to the large ward, but not so as to communicate with it directly. All the wards should, however, adjoin the rooms occupied by the nurse having charge of the patients contained in them.

Except in the case of separation wards, wards of small size are decidedly objectionable, because they are (says Miss Nightingale), "unfavourable to discipline, inasmuch as a small number, when placed together in the same ward, more readily associate together for any breach of discipline than a larger number." * And it is also pointed out by her that one head nurse or one night nurse could not so efficiently superintend and overlook a number of small wards as one large one.

Each large sick ward, whether it contains ten or thirty patients, must have attached to it at least two w.c.'s and a slop sink, separated by cross ventilated lobbies. A bath-room should also adjoin each large ward. It is therefore clear that the fewer the patients in each ward the larger will be the total number of nurses required in the establishment, and the greater will be the multiplicity of nurses' rooms, water-closets, slop sinks, bath-rooms, and other sanitary offices.

Suppose a hospital to be designed for the reception of 576 patients, 540 of whom are to be placed in eighteen parallelogram-shaped wards containing thirty each, and the remaining thirty-six in smaller and adjoining separation wards. If the buildings are three stories in height there would be six pavilions, but if, as I shall show, twenty-two patients only can be placed in the large wards, because they are of circular shape, then eight pavilions would be required instead of six, and twenty-four wards instead of eighteen. In both cases these wards and pavilions are assumed to be of the same size.

It has been shown that the services of one head and one night nurse must be provided for each large ward, and it therefore follows that the adoption of this circular plan would involve the additional cost of twelve nurses for the six extra wards.

The two extra pavilions containing these six wards would also necessitate the additional services of one scrubber and one porter for carrying coals and meals and attending the fires, furnaces, &c., and the salaries, uniforms and maintenance of these 14

* *Notes on Hospitals*, by Florence Nightingale, 1863.

additional officers cannot be put at less, on the average, than £50 a year each, or a total of £700.

The additional cost of fuel for the warming and hot water supply to these two extra pavilions may be put at a minimum sum of £200 per annum, and the outlay for soap, soda, &c., for cleaning and the periodical whitewashing, painting, and repair cannot be put at a less sum than £100 per annum. Therefore, the total additional establishment charges consequent upon the adoption of the circular system would be £1,000, as follows, viz. :—

	£	s.	d.
12 extra Nurses 1 „ Scrubber 1 „ Porter } at £50 per annum each	700	0	0
Extra fuel	200	0	0
Soap, soda, &c., and repairs	100	0	0
Total	£1,000	0	0

This sum capitalised at 3 per cent. (33 years' purchase) would amount to £33,000, and this represents the additional cost of maintaining the 576 patients supposed to be housed in wards designed upon the circular system.

The additional cost per 1,000 patients would be £57,392, and this cannot be considered a large estimate, seeing that Miss Nightingale, in her work on hospitals, shows that where 9 patients only are contained in a ward, as against 32 patients in a ward, the additional capitalised outlay for nursing only would be £196,775.

Now, as to the relative cost of erecting the buildings—a question involving primarily a consideration of the requisite sizes for the wards.

There must be much diversity of opinion amongst medical men and other authorities upon this point if we are to judge from the dimensions of recently constructed hospitals.

Captain Douglas Galton considers that between 1,200 and 1,300 cubic feet of air space per bed is all-sufficient. Miss Florence Nightingale asks from 1,200 to 1,500 feet. Dr. Parkes, speaking of hospitals generally, says that the space should be from 1,500 to 2,000 feet (the latter quantity referring no doubt to fever and the former to general hospitals). Dr. de Chaumont, in his Report upon the Norfolk and Norwich hospitals, shows upon mathematical bases that where good ventilation exists no advantage is gained by making the air space of large wards greater than 1,200 feet per patient.

The report of the committee appointed to consider the cubic space of metropolitan workhouses and infirmaries states that the cubic space to be allotted to ordinary sick patients in large wards "should not be less than 850 feet"; but it is stipulated that no space above the height of 12 feet from the floor-line shall be included in the calculation. This committee consisted of the following eminent authorities, viz. :—Drs. Thomas Watson (chairman), Henry W. Acland, Francis Sibson, W. O. Markham, and John Randall, Captain Douglas Galton, Messrs. Uredale Corbett (Local Government Board Inspector), Timothy Holmes, F.R.C.S., and Charles Hawkins, F.R.C.S.

In my own practice I have erected four large parish infirmaries, holding in the aggregate upwards of 2,500 ordinary sick patients, with less than 950 cubic feet of space to

each, and the medical officers of these establishments have not found it necessary at any time to order the removal of any of the beds (as was contemplated), should one or more extraordinarily severe cases at any time be developed, and seem to call for increased space.

The Moabit Hospital at Berlin gives a space of only 864 cubic feet for each ordinary patient; but in this building one-fourth of the cases treated are stated to be of an acutely infectious character,* and we may presume that a larger space would be allotted for this class of patient. Yet the death rate at this establishment, I am assured by eminent men who have examined the returns, is not above the average of other German hospitals.

The proper size of hospital wards is not, however, to be determined by mere considerations of the greater or less quantity of air-space requisite for the well-being of a patient, for Dr. de Chaumont, in his report before referred to, has clearly shown that where by good ventilation a proper change of atmosphere is constantly effected, it matters not, within reasonable limits, what is the size of the ward. The question must be decided principally by consideration of floor space, and here again examples and opinions are sadly diverse.

The Moabit Hospital, and the four parish infirmaries previously alluded to, contain about 70 superficial feet of floor space per ordinary patient, and this is the quantity recommended by the before-mentioned committee of experts.

Captain Douglas Galton asks for from 90 to 112 feet, Miss Nightingale from 100 to 104 feet, and Dr. Parkes and Dr. de Chaumont from 100 to 120 feet. In each case these authorities seem to determine their maximum and minimum by the question of whether or no accommodation is to be provided around the bed for students, *i.e.*, whether the hospital is or is not to be designed for a medical school.

The disposition of the superficial space determined upon, whatever it may be, involves two important questions, viz., the width of the ward, and the distance apart of the beds. Twenty-four feet is conceded to be, for all purposes of administration, an all-sufficient width for any hospital ward, and inasmuch as it is of the highest importance that each bed should have the largest possible space surrounding it, this width would, I apprehend, never be exceeded, were it not for the desirability of reducing the length of a ward to within a limit not exceeding 120 feet.

In parish infirmaries the prescribed distance apart of the beds, *i.e.*, the bed space, is 6 feet; but 7 feet 6 inches or 8 feet is the width more generally adopted, and hence it comes about that the breadth of the wards is necessarily increased in some buildings to as much as 30 feet. And here I would point out that the advocates of the circular ward system invariably and wrongly use the term "wall space" as synonymous with "bed space," or the distance apart from centre to centre of the beds; and they often improperly calculate this distance apart of the beds by dividing the total length of the circumference of the circle by the number of beds, and so arrive at a deceptive result.

Take, for example, the description given in the *Builder* of May 9th 1885, of "A projected Military Hospital" designed upon the circular system. It is there stated that the wards

See page 205; Part II

are each to be 66 feet internal diameter, and that they are to hold 26 patients; thus, says the description, "each patient will have a wall space of 8 feet."

As a matter of fact, if this military hospital is ever erected, and 26 patients crowded into its wards, each will have a lineal wall space at the heads of their beds of 7 feet 4 inches, but the corresponding distance at the bottom of the beds will be but 6 feet 3 inches; that is to say (the beds being 3 feet wide), the distance apart of them will be 3 feet 3 inches only. And, therefore, if it is required to know what really will be the space given per bed in this proposed hospital, as compared with the quadrangular plan of ward, we must calculate the average distances apart as given above of the beds at the heads and at the feet, and, then, instead of the delusive 8 feet of wall space, we shall find that the actual *bed space* per patient in this proposed hospital would only be 6 feet 9½ inches.

The above results would be arrived at by deducting 6 feet 6 inches in width for each of the entrance lobbies and then planning out the feet of the beds at an equal distance apart, and radiating them towards the centre of the circle.

Then with regard to the height of hospital wards. It is only Professor de Chaumont who expresses any decided opinion upon this point, and the conclusion he arrived at that 12, or at most 13 feet, is all-sufficient, has since been confirmed by the results of experiments made by two eminent American physicians, Drs. Cowles and Wood,* who proved to their satisfaction that no benefit arises from making wards higher than 12 feet. It is also, no doubt, upon these conclusions that the recommendations of the cubic space committee before referred to were based.

Most other authorities regard the question of height as quite subsidiary to that of floor space, as decided by considering the width of the ward, and the distance apart from centre to centre of the beds.

I have been particular to cite the opinions of these great authorities as to the requisite dimensions of ordinary wards, because I am about to show that it is practically impossible to design a circular hospital ward within the limits they have laid down, without causing a useless multiplication of wards, ward offices, nurses, and domestics, resulting in an enormous and wasteful outlay, first in the erection of the buildings, and for all time in the annual establishment charges; and my argument would therefore admit of contention if it could be shown that in the illustration I am about to give I exceed these limits, for it will be seen hereafter that the smaller we take the units of space the greater will be the cost of the circular, as compared with the parallelogram-shaped ward; and I therefore propose to take for illustration a ward of dimensions which shall approach, as nearly as possible, the maximum quantities asked for by the before-mentioned experts.

A parallelogram-shaped ward (see Fig. 2), containing 30 beds, and being 28 feet wide, 120 feet long, and 14 feet high, will contain 1,568 cubic feet, and 112 feet of floor area per patient, whilst the bed space will be 8 lineal feet per patient.

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* *Report of State Board of Health of Massachusetts*, 1879.

A circular ward (see Fig. 1), of equal superficial floor space would be 65 feet 6 inches diameter, and if it is required (as for proper comparison it must be) to keep the beds the

PLAN OF A CIRCULAR-SHAPED HOSPITAL WARD.

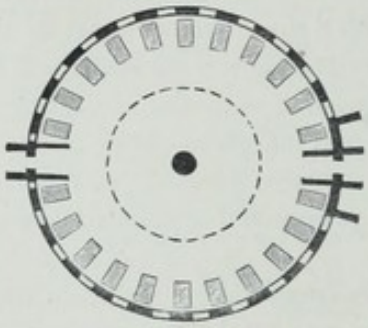


FIG. 1.

Dimensions—
65 feet 6 inches diameter.
206 feet circumference.
7 feet 8 inches average distance from centre to centre of beds.
Contains 22 beds

PLAN OF A PARALLELOGRAM-SHAPED HOSPITAL WARD OF EQUAL AREA TO FIG. 1.

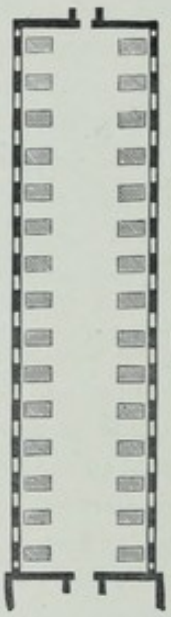


FIG. 2.

Dimensions—
120 feet long.
28 feet wide.
8 feet from centre to centre of beds.
Contains 30 beds.

same distance apart as in the parallelogram-shaped ward, this space would not contain so many even as 22 beds. For if we consider the feet of the beds to be 7 feet distant from the outer wall (6 feet 6 inches for the length of a bed and 6 inches space between it and the wall), and the width of the two lobbies as 13 feet, we find that if there are 22 beds, the lateral distance from centre to centre of the feet of each is 6 feet 9 inches, and the corresponding distance between the heads 8 feet 8 inches, thus giving an average distance of 7 feet 8 inches only as against the 8 feet space of the parallelogram-shaped ward. The result is that by the adoption of this circular plan we should have a ward containing less bed space and in round numbers respectively 41 superficial and 571 cubic feet per bed more than we started by admitting was necessary for the healthy condition of the patients.

The dotted line upon the plan (Fig. 2) encloses the central space thus wasted in each ward, amounting respectively to 896 superficial and 12,553 cubic feet.

Various ingenious suggestions have been made for the disposal of part of this space. One proposes to erect a staircase which, according to his plan, would occupy 250 superficial feet out of the 896, and at the Antwerp Hospital, a still less quantity is enclosed to form a room (ostensibly, but never, I believe, in reality) for the use of a nurse. But besides the practical inutility of adopting these expedients, it will be seen that any such obstruction would only augment the difficulties of cross ventilation already created by the necessity of having the windows between 60 and 70 feet apart.

What then is to be done with this superfluous space? It has to be built, to be kept clean, to be ventilated, to be heated, but, worst of all, it has to be paid for; and at what cost I will now consider.

The two additional pavilions previously shown to be necessary would cost, including heating, lifts and fittings, £26,800, and the outlay for the additional accommodation of twelve nurses, including furniture and accessories, would amount to about £700, or together to £27,500. It will be observed that I have not taken into account the fact that the six remaining wards being built upon the circular system must of necessity be of more costly construction than if they were built upon the parallelogram principle.

This sum of £27,500 represents the additional cost for 576 beds, and is at the rate of £47,743 per 1,000 patients. Adding to this the capitalised cost of nursing these 1,000 patients, previously shown to amount to £57,392, we find that if the circular system is to come into vogue, we must be prepared for indulgence in the luxury (if it is one) at the rate of £105,135 for every 1,000 patients.

Should it suggest itself to anyone to inquire how a circular would compare with a parallelogram-shaped ward if both were designed to contain 30 beds, an average distance of 8 feet apart, it would be found that the circular ward must be 87 feet 9 inches diameter, and consequently the waste or unnecessary space in the centre of it would amount to no less than 2,705 superficial feet. Moreover, it would be evident that the height of such a ward must be raised considerably if any sunlight at all is to approach the centre of it, and supposing this additional height to be, say 3 feet, the quantity of waste or unnecessary space in one ward alone would amount to 64,180 cubic feet. But this is not all, for it would follow that the adjoining offices, separation wards, nurses' room, staircase, &c., must also be raised.

It will hardly be necessary I think to trouble you with the figures which would show the additional cost of this plan to be even greater than has been proved to result from a comparison of two wards of equal area, but with fewer beds in the one of circular shape. Neither need I point out to you how much all the other difficulties of ventilation, lighting, heating, and want of cheerfulness would be enhanced.

Advocates of the system however say, "We have nothing to do with the cost; what we desire is to erect that description of building, whatever it may be, which best adapts itself to the cure of the patients to be contained in it," and within reasonable limits this view of the question is no doubt a right one.

But I have searched in vain for any substantial arguments showing that from this point of view the circular is any improvement upon the parallelogram shape of ward, and I have little doubt that no such arguments could exist unless it can be shown that in contravention of nature's laws air would as freely pass through a room from one side to another when the windows are 60 or 70 feet apart, as it would if those windows were from 24 to 30 feet apart. It would also have to be demonstrated that in defiance of all mathematical rules, when the sun was shining or the wind blowing against the straight wall of a parallelogram-shaped ward, less air and sun would penetrate through its window openings than would penetrate an *equal* number of window openings of the same size contained in the wall of a circular ward. And then, having proved this anomaly, it would be necessary to define the process by which as large a quantity of air and sun could be brought into the circular ward through its 22 windows as could be brought in through the 34 windows of the parallelogram-shaped ward.

This being made evident the contention must be upheld that a ward having the distance of its parts from the windows varying from 1 foot to 33 feet, is as cheerful as one of the parts which vary similarly from 1 foot to 14 feet only. And it must be shown that this cheerfulness will not be diminished by the height of the circular ward being $\frac{1}{3}$th only of its diameter as compared with the parallelogram-shaped ward, the height of which would be one-half its width.

But supposing all these difficulties to be surmounted, it will only have been shown that in the points referred to the circular is as good as the parallelogram system, and then what is left to compensate for the £105,000 outlay before referred to?

It cannot be contended that for the purposes of a medical school, where it is desirable the greatest space for students shall be given round and about the patient, that the constriction of the feet of the beds, consequent upon their radiation towards the centre of the circle, is an advantage. It cannot surely be argued that it is a desirable arrangement to place a nurse (as at the Antwerp Hospital) in the centre of a sick ward, breathing all day its more or less foul atmosphere, rather than that she should be assigned an adjoining room, having a window through which she could overlook the patients. Neither can it be said that if this central space is occupied by a staircase, that such staircase would not be better placed (as in the parallelogram system) away from the ward and adjoining and giving direct access to the nurses' rooms, separation wards, and other offices, and so avoiding the necessity of all persons and things passing through and disturbing the occupants of the large ward.

And if, then, these deviations from past practice cannot be shown to be improvements, what is left for those who would still be admirers of the new system to put forward as a claim for its superiority over the old one? I cannot say, neither can I imagine.

Captain Galton, C.B., F.R.S. (London), said he also had been struck with the radiation of the beds in the Antwerp Hospital. The central room for the nurse was an impediment both to the cheerfulness of the ward and the free circulation of the air, besides being an utterly useless place for anyone to live in permanently. The building was designed to be very largely artificially ventilated, but unfortunately the apparatus was not at work when he was there. He had had similar experience elsewhere, and although he had often wanted to examine the arrangements in artificially-ventilated hospitals, it had always happened that they were not in working order. He agreed entirely with the arguments which Mr. Snell had adduced, and wished the various hospital authorities contemplating the construction of circular hospitals would read his paper.

Professor de Chaumont, M.D., F.R.S. (Southampton), said he was at first attracted by the circular design, but he confessed the objections of Mr. Snell were very difficult to answer. The Antwerp Hospital was by no means attractive in appearance, and to place

a nurse in the cage in the centre would be simply monstrous. The adoption of this system would, he feared, not answer the expectations of its promoters. Yet the matter was one of great importance, seeing that it was now strongly advocated by the Director of Works at the War Office, and the proposal to build a hospital on this principle at Malta was now seriously entertained. He would take care that Mr. Snell's paper was brought before the notice of the War Office.

Mr. H. H. Collins (London) agreed with the views expressed by Mr. Snell. Circular hospitals were undesirable if on the score of expense alone. To construct a circular building was at least a third more costly than to build a parallelogram. At the same time, he admitted there might be some excuse for building a circular hospital in the case of a site which would ill adapt itself to any other form of construction.

Mr. E. C. Robins (London) thanked Mr. Snell for his paper, and was glad to know it would come under the notice of the War Office. He looked forward to the time when tents that could be taken down and destroyed when their purpose was fulfilled would supersede colossal hospitals, or better still, removable buildings on the Tollêt system. He felt he must concur with the views expressed by Mr. Snell, confirmed as they were by such high authorities as Professor de Chaumont and Captain Galton. He must confess, however, that he was much taken with the Antwerp Hospital on seeing it during its construction, and he thought it unwise to condemn beforehand the heating and ventilating processes so intelligently and scientifically designed and executed.

Mr. Gordon Smith (London) said he could not concur in all that had been said. He feared Mr. Snell had somewhat exaggerated his case, in addition to which there were some features about the circular ward system that demanded more attention than had been paid to them. For instance, the question of shape of site was of great importance. It was quite possible to have a site (upon which a hospital must be built) that would adapt itself to a circular building far better than to a rectangular one. A circular ward would stand less chance of interfering with a neighbour's rights of light and air, and would admit of freer ventilation. In aspect also, a circular building had advantages over an oblong one, while in regard to cost he had it on the authority of two architects who had actually built circular hospitals, that in some respects this form of building was really cheaper. He also urged that the circular ward affords advantages in administration in the way of facilitating control and minimising fatigue which are not possessed by the rectangular or oblong ward, and he considered the circular form of ward, notwithstanding what had been said against it, deserved careful attention.

Mr. H. Saxon Snell (London) in the course of his reply, contended that no hospital ought to be erected upon a site so confined in area that rights of light and air had to be considered; and he did not hesitate to say that wherever, upon this plea, circular wards had been built rectangular ones would have answered the purpose far better. He failed to see how circular wards could give greater facilities for ventilation than those of rectangular form. In the latter the foul emanations from the patients were removed by outlets into flues situated in the walls directly over the patients' heads. Surely this was a better plan than carrying the deleterious matter across the ward, a distance of 30 to 35 feet, into the central shaft, as recommended by the advocates of the circular system.

ANEMOMETERS.

[The following Paper was published in "The Engineer," June 23rd 1882.]

Account of Experiments to Test the Accuracy of Registering Anemometers.

By H. Saxon Snell, F.R.I.B.A.

The velocities of currents of air in mines and ventilating shafts are now almost universally determined by aid of the anemometers said to have been invented by Benjamin Biram. These instruments consist of series of light vanes which rotate by the action of air impinging against them, and the number of revolutions so made are, by the aid of suitable mechanism, recorded upon dials attached to the instruments. Each anemometer is differently affected as the forms and positions of the vanes and as the friction of the mechanism varies. It is, therefore, clear that this dial registration does not directly represent the actual velocity of the air, nor, indeed, the number of revolutions made by the vanes of the instruments, and, consequently, it becomes necessary to employ a formula for deducing the actual velocities from those recorded by the dials. It will also be obvious that for this purpose the instruments must be separately experimented upon in order that the values of the constants employed in the formula may be correctly determined in each particular case. In all such published experiments it has been found that if the actual and recorded velocities be graphically delineated the results give a straight line, or nearly so, and the formula for deducing the actual from the registered velocities is therefore of the form $V = m R + C$, where R is the velocity of the air as registered by the dial, V the actual velocity, and m and C constants to be found experimentally.

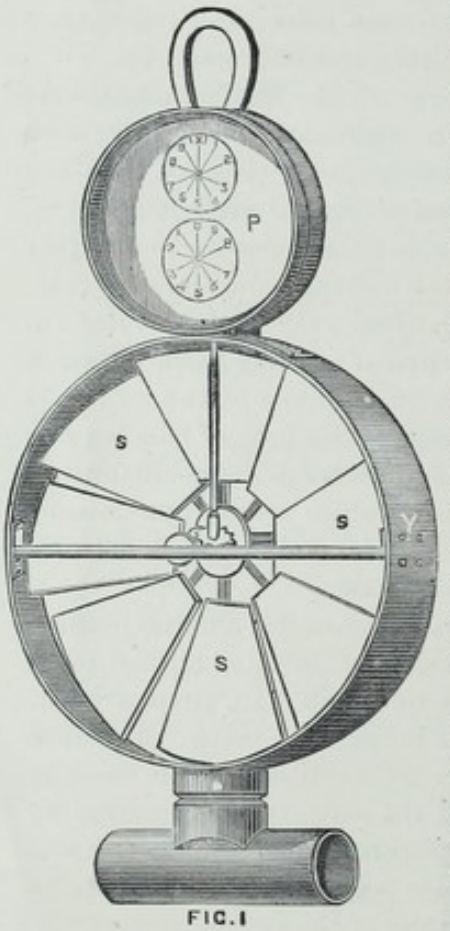


FIG. I

Fig. 1 represents a form of this anemometer commonly employed in English coal mines. It consists of a short cylinder of brass Y, through which the air passes, and impinging against the vanes S S S situated midway in the cylinder causes them to revolve, and the motion thus set up is transmitted by suitable clock-work arrangement to the cylindrical box P, on

the front of which are dials for recording data from which to calculate, as before described, the actual velocity of the air passing through the instrument. The position of the dials is not the same in all instruments, but is varied to suit particular circumstances. The method hitherto employed for ascertaining the actual velocity of air passing through one of these anemometers, as compared with its registered volocity, is to place the instrument upon one end of a bar about 8 feet in length made to revolve on its centre with any given speed, and to register, by the means of clockwork attached to the axis of the bar, the distance passed through by the anemometer in any given time. The face of the anemometer being placed parallel with the length of the bar, the vanes are supposed to encounter the resistance of the air through which they pass in a manner similar to that caused by moving air impinging against the vanes when the anemometer is stationary. It has been found, however, by experiments with these "Whirling machines," that when the arm upon which the anemometer is placed is varied in length, the results recorded by the dial for any given time and distance traversed are not similar, but that the greater the circumference of the circle formed by the anemometer in its passage through the air—*i.e.*, the greater the length of the arm upon which it is placed—the more slowly the vanes revolve.

It might well be conceived that this would be the case, not only because the air strikes the vanes in a direction different to what it would if the instrument were moving in a straight line, but by reason of the whirling bar and its adjuncts setting up in their rotary motion a number of eddies of air that in like manner alter the conditions under which the vanes of the anemometer are made to revolve, and such disturbing influences would necessarily become greater as the centre of revolution of the whirling machine was shortened. The variations in the readings of these anemometers resulting from this mode of testing have been found to be very perceptible when the difference in the length of the whirling arm is only a few feet, and therefore it may be assumed that the error would be very considerable when instruments adjusted by experiments made on a whirling machine of only 4 feet radius are used for measuring the velocity of air passing —as in a shaft or mine—in a straight line, or its equivalent the circumference of a circle of infinite radius. Nevertheless, it is with instruments so tested that a majority of the more recently recorded experiments on ventilation have been founded, and it would therefore appear desirable that a more reliable method of testing should, if possible, be resorted to. I am not prepared to say how this can always best be done, but having some few years since—1877—had occasion to test the accuracy of two of the smaller sizes of these instruments for the purposes of an extensive series of experiments on the movement of air in shafts of comparatively small diameter, it has occurred to me that the process adopted and its results might be usefully recorded.

The general form of the testing apparatus employed by me is shown on Fig. 2, and will be seen to consist of a large aspirator A, into which any known quantity of air could be drawn, but only after passing the vanes of an anemometer so constructed as to form part of the tube B, through which the air is admitted to the aspirator. The two anemometers tested by me were specially made for these experiments, and in one of them, shown at Fig. 2, the dial D was placed upon the exterior face of the brass tube

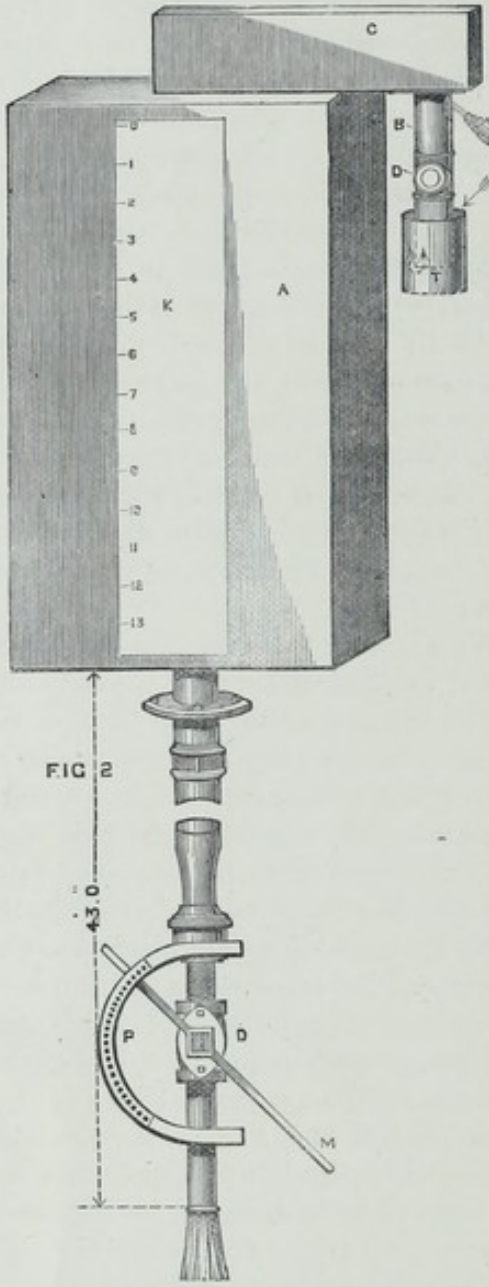


FIG 2

enclosing the vanes. This tube after having been tested by the makers, was elongated at either end in order that the air immediately before and after passing the vanes should have time to recover the disturbance caused by impingement against the sides of the orifices at either end. The lower end of this elongated tube was made to dip into a tin cup T, as it was found that without this a slight disturbance of the air in any part of the room, such, for instance, as would result from the movements of the operators, caused the instrument immediately to show an irregularity of measurement. The upper portion of the tube was attached to another and larger square horizontal iron tube C, through which the air was conveyed to the centre of the upper part of the aspirator placed in the topmost floor of the building in which the experiments were conducted. A plate of glass K was inserted in one side of the aspirator, so that the quantity of water displaced in any given time might be observed, and from the bottom of this vessel a cast-iron pipe 3 inches diameter was carried to the lower part of the building, and the passage of water there controlled by a cock D having a full circular way of 2 inches diameter. The turning of this cock was effected by a double lever M, the shorter arm of which passed through a slotted quadrant-shaped iron guide P, having holes with a moveable pin for regulating the quantity of water to be discharged at any stage of the experiments.

After the machine had been erected, a vessel so made as to very accurately measure one cubic foot of water was placed beneath the orifice of the cock, and as each cubic foot was drawn off a diamond cut was made on the glazed front of the aspirator for the purpose of marking the quantity of water displaced in the course of each experiment.

It was desirable that the speed of the air passing through the anemometer during each experiment should be as uniform as possible, but it will be obvious that the head of water, when the aspirator was full, would become less as it emptied. Consequently, the flow of air at the commencement of each experiment would gradually become less towards the end of it, and it was for the purpose of reducing this difference to

a minimum, as also for obtaining a greater velocity, that the apparatus was placed in as high a building as could be obtained.

In the experiments carried out by me the distance from the underside of the aspirator to the outlet of the draw-off pipe was 43 feet, with the result that the difference in the velocity of the air passing through the anemometer from the commencement to the end of any experiment was inappreciable, and considering that the difference that must have existed would be a uniform one, the results of the experiments may be considered in this respect satisfactory.

The object to be attained by the use of these anemometers is the measurement of the velocity existing in any particular current of air, but the necessary introduction of the instrument into the current to be measured must, by reason of the friction of the air against the sides and the opposition offered by the vanes, alter the condition under which the air would have been moving if the instrument were not so placed. It will therefore be apparent that although these anemometers as ordinarily tested may measure more or less correctly the velocity of air passing through them, they do not, as is required, indicate the velocity that would exist if the anemometer were removed. Although, as I shall have occasion to show hereafter, the errors arising from a neglect of this consideration must be so small that they may in the practical use of the instruments often be disregarded, yet it appeared to me that in an inquiry of this kind any such source of error should as far as possible be counteracted.

To this end I attached to the upper part of the anemometer tube what may be called a compensating valve—V, Fig. 2—capable of admitting, after adjustment, such an amount of air as should be found by experiment to have been retarded in its passage through the lower part of the instrument.

An enlarged section of this valve is shown on Fig. 3, and will be seen to consist of a small pipe E, for the admission of air to the upper part of the anemometer tube, the lower part of the pipe being made to dip into a brass cup F in a manner similar to the lower part of the anemometer tube. This cup was so screwed on as to enable the lower orifice of the pipe to be entirely closed or to be opened by it to any required distance. The clamping screw H was provided for the purpose of permanently fixing the position of the cup after the opening of the valve had been adjusted.

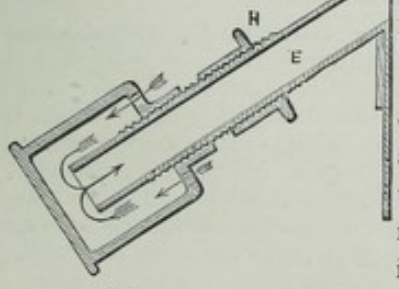


FIG. 3

The distance to which the valve should be opened was determined in the following manner. The anemometer and tube were removed from the aspirator, the cock was then turned on to various distances marked by the movable pin and quadrant arm M, and the time occupied in emptying the cistern noted in each case. The anemometer was then again attached, and the cock being turned on to the same distances as before, the compensating valve was opened more and more, until the relative times occupied in emptying the cistern were found to correspond with those when the anemometer was removed.

It is important to observe that it was found sufficient that the tube of this compensating valve should be but $\frac{3}{8}$ inches diameter, and that therefore the area of section of any column of air passing through it could not exceed ·11 square inches, while the sectional areas of the tubes of the anemometers tested were 5·725 inches. Now, as the quantities of air admitted through the anemometer and the compensating valve would be directly as their areas, it follows that the amount of air retarded by these instruments could not—even if the valves were fully opened—have exceeded $\frac{\cdot 11}{5\cdot 725}$ or $\frac{1}{52}$ of the quantity to be measured.

When in ordinary use, part only of the air passes through the instrument and part is deflected by it, as shown by the accompanying sketch, where the dotted lines indicate the boundary between the part which flows inside and the part which flows outside.*

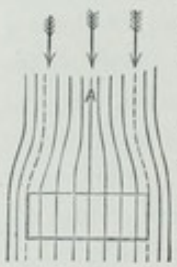


FIG. 6

In ordinary use the velocity of the air is computed from the sectional area of the anemometer tube, but to be correct it should be computed from the sectional area contained between the dotted lines at the point A in the sketch. The difference in these two areas would be found to be that of the sectional area of the compensating valve in the testing apparatus before described. In the one case the force of the resistances of the instrument to the flow of air is employed in deflecting the filaments of air towards the outside of it, and in the other these resistances exert themselves in retarding the flow of water in the cistern.

When the apparatus had been put together it was thought desirable to test its air-tightness. and for this purpose the compensating valve was closed and the aspirator nearly emptied of water. The cup into which the anemometer tube dipped was partly filled with water, and the draw-off cock then turned sufficiently to cause the water to rise from the cup to some distance up the lower portion of the anemometer tube, and as it was found to remain for some considerable time without alteration of level, I was satisfied that the apparatus had been so carefully made that during the experiments no appreciable quantity of air could enter the aspirator that had not passed through the anemometer.

The internal diameter of the tubes of the anemometers tested was 2·7 inches, their area 5·725 inches, consequently the displacement of one cubic foot of water from the aspirator would cause air to flow through the instruments in a stream $\frac{144}{5\cdot 725} = 25\cdot 15$ feet in length. The actual velocity per second V of air passing through the instruments

* I am indebted to Professor G. G. Stokes for the following lucid statement of the action of these instruments:—"In the actual use of the instrument a portion of the air passes through it, and a portion is deflected by it. If the vanes were away and the cylinder of brass were infinitely thin and smooth, the velocity of the air passing through it would be the velocity we wanted to measure; in this case there would be no lateral deflection of the filaments of air produced by the instrument. On the other hand, if the vanes were replaced by a disc closing the cylinder, no air would get through, all the filaments would be deflected to the one side or the other. In the actual case the condition is intermediate, the vanes oppose a certain amount of resistance to the passage of the air through this cylinder, and therefore there is a certain amount of lateral deflection. I have endeavoured to represent rudely the course of the lines of motion of the air flowing partly past and partly through the anemometer (*see* Fig. 6). The dotted lines represent the boundary between the part which flows inside and the part that flows outside."

during any given time t would therefore be remembered by the formula $V = \frac{25{\cdot}15}{t}$ and the corresponding registered velocity R as indicated by the readings r of the dials by $R = \frac{r}{t}$.

In the following experiments the draw-off cock was in each instance opened three times to the same extent and the average results calculated. The time was noted by means of a chronograph. Many preliminary trials were made and noted, but as it was desirable that the final experiments as given in the table below should be taken when the temperature of the atmosphere was as nearly as possible equal, it is unnecessary to record here the results of the previous trials.

No. of hole at which-ever was stopped	Seconds occupied in emptying 10 cubic feet of water.	Average time occupied in emptying one cubic foot of water.	Velocity registered by anemometer dials for 10 cubic feet of water emptied.	Average registered velocity r for one cubic foot of water.	Registered velocity in ft. per sec. from formula $R = \frac{r}{t}$	Actual Velocity in ft. per sec. from formula $V = \frac{25{\cdot}15}{t}$
1	16·5		286			
,,	16·5	1·65	290	28·8	17·454	15·242
,,	16·5		288			
2	18·3		290			
,,	18·3	1·83	290	29·0	15·846	13·743
,,	18·3		290			
3	21·1		288			
,,	21·1	2.11	293	29·366	13·917	11·919
,,	21·1		300			
4	26·1		291			
,,	26·4	2·62	293	28·966	11·055	9·599
,,	26·1		285			
5	34·0		300			
,,	34·0	3·4	294	29·666	8·725	7·397
,,	34·0		296			
6	45·0		290			
,,	45·0	4·513	283	28·7	6·359	5·572
,,	45·4		228			
7	64·3		296			
,,	63·4	6·363	294	29·233	4·594	3·952
,,	63·2		287			
8	100·2		288			
,,	100·6	10·046	280	28·433	2·830	2·503
,,	100·6		285			
9	147·4		291			
,,	146·8	14·723	286	28·833	1·958	1·708
,,	147·5		288			
10	235·8		273			
,,	234·2	23·500	268	26·966	1·147	1·070
,,	235·0		268			

The results shown in the last two columns of the foregoing table are represented by the diagram Fig. 4, where the numerical values of the registered velocities R, and of the actual velocities V, are respectively the abscissæ and ordinates of the several points referred to a pair of co-ordinate axes O X and O Y. Through the mean position of these points passes the straight line B C, giving rise to the formula V = ·8524 R + ·0718, which it will be seen is of similar form to that mentioned in the earlier part of this paper as resulting from previously published experiments with these instruments.

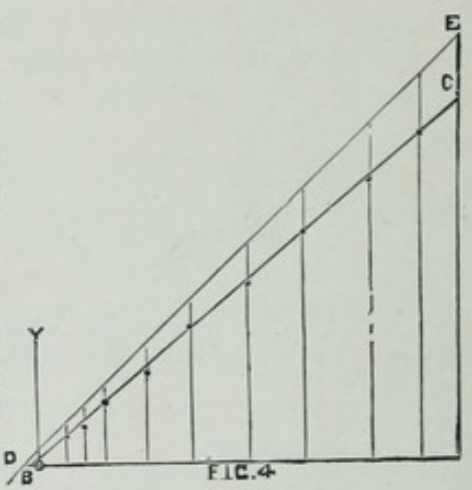


FIG. 4

No. of hole.	Velocity (R) registered by anemometer	Actual velocity=V.	Velocity calculated from formula, V=·8524 R + ·0718.	Differs from actual velocity.	Velocity calculated from the instrument makers' formula, V=R + ·5	Differs from actual velocity.
1	17·454	15·242	14·949	$-\frac{1}{52\cdot02}$	17·954	$+\frac{1}{5\cdot6}$
2	15·846	13·743	13·579	$-\frac{1}{83\cdot80}$	16·346	$+\frac{1}{5\cdot3}$
3	13·917	11·919	11·935	$+\frac{1}{744\cdot94}$	14·417	$+\frac{1}{4\cdot7}$
4	11·055	9·599	9·495	$-\frac{1}{92\cdot3}$	11.555	$+\frac{1}{4\cdot9}$
5	8·725	7·397	7·509	$+\frac{1}{66\cdot04}$	9·225	$+\frac{1}{4}$
6	6·359	5·572	5·492	$-\frac{1}{69\cdot65}$	6·859	$+\frac{1}{4\cdot3}$
7	4·594	3·952	3·988	$+\frac{1}{109\cdot78}$	5·094	$+\frac{1}{3\cdot4}$
8	2·830	2·503	2·484	$-\frac{1}{131.74}$	3·330	$+\frac{1}{3}$
9	1 958	1·708	1·741	$+\frac{1}{52\cdot23}$	2·458	$+\frac{1}{2\cdot3}$
10	1·147	1·070	1·05	$-\frac{1}{52\cdot20}$	1·547	$+\frac{1}{1\cdot8}$

The anemometers and their tubes employed in these experiments were specially made for me by one of the most eminent makers of this class of instrument, with full knowledge of the use to which they were to be put, and that the results in all probability would be published. It may therefore be presumed that more than ordinary care was taken, not only in manufacturing, but in testing the instruments before they were placed in my hands. The formula resulting from the makers' tests of the instrument last described as given to me was V = R + ·5, an equation of the same form as before, but with the constant *m* equal in this case to unity. The application of this formula to the diagram Fig. 4 produces the straight line D E, and it will be seen that this differs considerably both in p sition and direction from the line B C resulting from my own experiments. The preceding table shows this difference numerically.

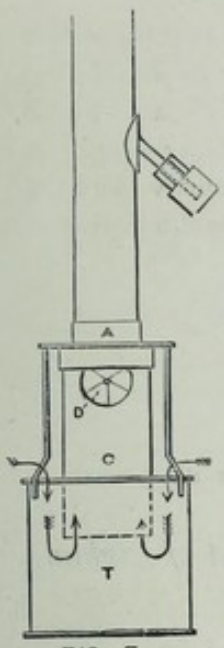


FIG. 5

The next anemometer tested was of different construction to the last. The vanes were fixed within the tube at A—Fig. 5—the dial D occupying a position beneath them, and the whole of this lower portion was enclosed by a glass tube open only at its lower end, and dipping as before into a tin cup T. The actual velocities of various streams of air passing through this anemometer, and the corresponding velocities registered by the instrument having been noted in the same manner as described in the previous experiments, the following formula for calculation was arrived at :—

$$V = \cdot 8182\ R + \cdot 0767.$$

The formula given by the makers of the instrument was as before :—

$$V = R + \cdot 5.$$

The difference between the working out of the two formulæ when applied to the last-mentioned experiments, and the actual corresponding velocities known to have existed, is shown in the following table :—

No. of hole	Velocity (R.) registered by anemometer.	Actual velocity = V.	Velocity calculated from formula, V=·8182 R + ·0767.	Differs from actual velocity.	Velocity calculated from instrument makers' formula V=R + ·5	Differs from actual velocity.
1	18·446	15·429	15.170	- $\frac{1}{59\cdot57}$	18·946	+ $\frac{1}{19\cdot446}$
2	16·771	13·926	13·799	— $\frac{1}{109\cdot65}$	17·271	+ $\frac{1}{17\cdot771}$
3	14·524	11·976	11·960	— $\frac{1}{748\cdot50}$	15·024	+ $\frac{1}{15\cdot524}$
4	11·935	9·801	9·842	+ $\frac{1}{233\cdot36}$	12·435	+ $\frac{1}{12\cdot935}$
5	9·145	7·591	7·560	— $\frac{1}{244\cdot87}$	9·645	+ $\frac{1}{10\cdot145}$
6	6·726	5·589	5·580	— $\frac{1}{621\cdot00}$	7·226	+ $\frac{1}{7\cdot726}$
7	4·820	3·988	4·020	+ $\frac{1}{124\cdot63}$	5·320	+ $\frac{1}{5\cdot820}$
8	2·987	2·479	2·521	+ $\frac{1}{59\cdot02}$	3·487	+ $\frac{1}{3\cdot487}$
9	1·969	1 689	1·688	— $\frac{1}{1689\cdot00}$	2·469	+ $\frac{1}{2\cdot969}$
10	1·168	1·050	1·032	— $\frac{1}{58\cdot333}$	1·668	+ $\frac{1}{2\cdot168}$

The results of this inquiry prove that *the registering dials of the anemometers in question, as corrected by the instrument makers' formula, were perfectly unreliable*, and it may, therefore, be very fairly assumed that *the deductions hitherto arrived at and published by the numerous eminent experimenters using this description of instrument for testing the velocities of air in ventilating shafts and mines are similarly unreliable.*

It will be remembered that some time since the Sanitary Institute of Great Britain delegated a Committee to carry out a series of experiments for the purpose of ascertaining the efficacy of various patterned cowls placed upon upright ventilating tubes as compared

with the same tubes opening into the air without covering of any kind, and that the results arrived at not being considered satisfactory, further tests were determined upon. Understanding that Biram's anemometers—or "Lownes," which are similar—were used by the committee in the first experiments, I communicated to it the results of my inquiry as detailed above, and I have reason to believe that, in consequence, an exhaustive series of somewhat similar tests are being carried out by this committee. It will be interesting to learn how far the results obtained by them will accord with mine.

GAS v. ELECTRIC LIGHTING.

[The following Account was published in "The Engineer," July 21st 1882.]

Result of an Enquiry by H. Saxon Snell *into the respective Cost of Lighting a London Infirmary by Electricity and by Gas.*

Many hundreds of thousands of pounds have lately been invested in electric light companies upon the faith of statements made in the prospectus that the mode of lighting is as cheap, if not cheaper, than that by gas. As to public buildings, we are told that "the difference between the cost of gas and electricity, light for light, is largely in favour of electric light, as proved by the Brush arc system at South Kensington—a saving of £325 16*s.* 4*d.* having been effected during nine months as compared with the cost of gas." Then, Sir William Thompson is stated to have "had his house fitted with incandescent lamps from cellar to attic, to the entire banishment of gas, and the cost of internal wires for electric lamps is less than the cost of fittings in connection with gas pipes." Lastly, we have the statement of Mr. William Crookes, F.R.S., and director of the Gulcher Electric Light Company, that he has fitted up two rooms in his private house with electric lamps, and has effected a saving of £4 17*s.* 6*d.* per annum as compared with gas-lights.

No wonder, then, that one of my clients—a public Board—deemed it its duty to ascertain the cost of lighting by electricity one of the large institutions under its control. It instructed me to obtain estimates, and accordingly I applied to three of the most important electric light companies for specifications and tenders for lighting the building in question, merely stipulating that the work should be executed under the same general conditions as those employed in the contract for the supply of gas pipes and fittings.

In the result three tenders were received for the execution of the works, amounting, respectively, to £5,500, £4,345, and £3,143.

It then became my duty to make an estimate of what would be the annual cost of lighting the building supposing one or the other of these tenders to be accepted, and I did so as follows, from one furnished me by one of the companies in question, though

I thought it my duty to inform my client that I considered many of these items to be considerably underrated :—

	No. 1.	No. 2.	No. 3.
	£ s. d.	£ s. d.	£ s. d.
Interest on first outlay at 5 per cent.	275 0 0	217 5 0	157 3 0
Depreciation of plant and general repairs at 10 per cent.	550 0 0	434 10 0	314 6 0
Coals, say 2 tons per day at 20*s.* per ton delivered ...	730 0 0	730 0 0	730 0 0
Oil, waste, &c.	52 0 0	52 0 0	52 0 0
Wages two engineers at £2 per week	208 0 0	208 0 0	208 0 0
Wages two stokers or attendants at 30*s.*...	156 0 0	156 0 0	156 0 0
Renewal of lamps after first year, not including accidental breakage, but assuming the average life of a lamp to be 1,000 hours and that the average time of lighting would be 5½ hours daily	475 0 0	475 0 0	475 0 0
Total	£2,446 0 0	£2,272 15 0	£2,092 9 0

As I was anxious that my report should, as far as possible, be incapable of question, I sent a copy of each of these estimates to the respective companies, with a request that they would point out any errors they might conceive to exist, and in reply they sent me their revisals, which resulted in the following estimates for the annual expense, viz. :— £2,394, £1,905, and £2,000, as against my own of £2,446, £2,272, and £2,092 respectively. These reductions were made in various ways, some conceiving 4 per cent. for interest on outlay, and an average of 5 per cent. only for depreciation and repairs, to be a sufficient allowance.

It now became necessary to calculate the corresponding cost of gas lighting. The total outlay for fitting up the building in question with gas pipes, burners, meters, and all other appliances had been £906. The annual cost of gas consumed, exclusive of that used in a cooking apparatus, was £738 ; but more than one manufacturer has offered to supply regulators—there are none at present—and to guarantee a reduction in the consumption of 20 per cent., failing which no claim would be allowed for payment. Moreover I have lately had the meters, from the records of which the above amount is computed, tested by a Government official, and he reports as to three out of four of them that they register 3 and 4 per cent. more than the actual consumption. But neglecting these important considerations, and assuming the consumption to continue now as in the past, we find the annual cost of the gas lighting to be as follows :—

	£ s. d.
Interest as before on first outlay (£906) at 5 per cent.	45 6 0
Depreciation of plant and general repairs as before at 10 per cent.	90 12 0
Annual cost of gas actually used in the past	738 0 0
Total	£873 18 0

Now observe how the matter would stand supposing that the lowest tender, No. 3—£3,143—for the electric lighting appliances were accepted, and that in the execution of the works no extra expenses were found to be necessary; assume also that the

corresponding estimate, £2,000, made by the company itself for the annual cost of lighting to be the right one, and we have:—

	Gas Lighting.	Electric Lighting.
	£	£
Cost of all appliances	906	3,143
Annual cost of lighting	874	2,000

These estimates ignore the fact that even though the electric light were adopted, it would still be necessary to retain and use the present gas fittings, because the majority of the rooms and corridors of the institution in question from the nature of their use require to be lighted with a subdued light during the whole of the night. It would clearly not be fair to calculate that the electric light machinery would be working all the time to supply this comparatively small demand. Neither does it take into consideration the very important fact that the gas-burners give greatly increased warmth to the rooms in which they are placed, and that, therefore, in the absence of these appliances a much larger consumption of coals for heating purposes would necessarily result.

This inquiry was entered into by me without the slightest prejudice in favour of either system, and in entire ignorance of their relative monetary values, but the information I have gathered during the course of my investigation results in a strong conviction that if the statements before referred to as to the economy of electric lighting in private houses were submitted to similar impartial tests they would be shown to be fallacious. Further, I have no hesitation in saying that if only a tithe of the scientific labour now devoted to the improvement of electric lighting apparatus were expended upon discovering methods for improving the construction of gas lamps in closed rooms, the superiority of gas as a lighting agent in such situations would soon be shown to be paramount. I do not hazard an opinion as to the relative advantages of the two systems when employed to light railway stations or other such-like open spaces.

Mr. Crookes says that with the use of gas "the ceilings get blackened, the curtains are soiled with soot and smoke, the decorative paintwork is destroyed, the gilding tarnished, the bindings of the books rotted, and the air of the room is not cool and fresh, but vitiated by the hot fumes from burnt or semi-burnt gas;" but surely he must be aware that these ills do not attain where proper apparatus, such as Rickett's ventilating gas globe lights, Siemens' regenerative gas burners, or the ordinary sunlights are employed for lighting up rooms. These appliances when in use carry off into the outer air not only the products of combustion, but they also act as powerful ventilators by drawing away foul air from the upper parts of the rooms in which they are placed—air which would stagnate were these lamps to be replaced by electric lights, and it is therefore to the improvement of this class of apparatus, so as to moderate their present prices, that I would, as a corollary to my investigation, commend the attention of our scientists and mechanicians.

GENERAL INDEX.

The Roman figures i, ii, iii, *refer to the various Sections into which the Book is divided.*

ABBATOIRS used as Hs., i, 35.
Accident Hs. in London, Number of beds in, iii, 12.
Accommodation in various Hs., ii, 5, 13, 18, 26, 36, 45, 54, 59, 78, 83, 93, 103, 117, 125, 126, 127, 128, 130, 132, 138, 143, 164, 170, 177, 183, 188, 193, 199, 201, 207, 214, 221, 233, 237, 242, 250, 259, 272.
,, in Hs. in England and Wales, iii, 5, 6.
,, Insufficiency of, in London Hs., iii, 14.
,, required in London Hs., iii, 15.
,, Dr. Buckle on, iii, 15.
,, Dr. Oppert on, iii, 15.
Accounts and Finance, iii, 22.
Administrative Departments, i, 41, 48, 54, 56, 57; ii, 4, 12, 17, 25, 34, 44, 53, 59, 60, 82, 91, 101, 116, 125, 126, 127, 128, 137, 142, 162, 168, 174, 177, 182, 187, 191, 199, 200, 206, 213, 222, 232, 238, 248, 258, 267, 271.
Admission, French rules for, iii, 39.
Aëration, Dr. Layet on Co-efficients of, i, 25, 78.
,, Table of Co-efficients of, i, 26, 78.
,, Zone of, i, 21, 23.
Aggregation of Patients, Danger of to Neighbourhood, i, 36.
,, ,, Sir Wm. Blizard and Dr. Rumsey on, i, 36.
,, ,, limit of, i, 33, 36.
,, ,, Trélat on, i, 33.
Air, Contamination of, by one person, i, 25, 28.
,, horizontal currents of, i, 21.
,, purification of, by earth containing organic matter, i, 30.
,, ratio of contamination of to number of people, i, 25, 28.
Air space required for each patient, i, 36; ii, 175.
Airing Yards, ii, 75.
Alteration of Old Hs. (*see* Old Hs.).
American Hs. (*see* Johns Hopkins H. and New York H.).
Amersfoort H., Holland, general description, ii, 200.
,, ,, ,, the sick wards and their offices, ii, 201, 202, 204.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, elevation (*plate*), ii, 200.
,, ,, ,, plans and sections (*plate*), ii, 202.
Anatomical Institute, ii, 213.
Anatomical Museum, ii, 213, 232.
Annular Wards, ii, 87, 275.
,, ,, proposed by Burdon Sanderson, ii, 87, 274.
Ante Room, ii, 218.
Antwerp Civil H., general description, i, 55; ii 79.
,, ,, the sick wards and their offices, ii, 84.
,, ,, Commission and Report on, i, 57; ii, 80.
,, ,, Professor Marshall on, i, 56.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, elevations (*plate*), ii, 79.
,, ,, plans and sections (*plate*), ii, 82.
Apothecaries H., Rome, ii, 230.
Area covered by H. buildings, ii, 6, 13, 18, 27, 37, 46, 54, 61, 83, 94, 104, 119, 125, 126, 127, 128, 138, 139, 140, 144, 150, 164, 171, 174, 178, 183, 188, 193, 201, 207, 214, 223, 233, 238, 250, 260.
,, of Pavilions, ii, 10, 15, 21, 32, 41, 48, 57, 68, 86, 98, 111, 112, 114, 121, 124, 135, 140, 144, 149, 167, 173, 180, 185, 190, 195, 204, 209, 217, 218, 219, 227, 235, 240, 243, 255, 263, 273.
,, of London Registration Districts, Table of, iii, 11.
,, of London Parishes, Table, iii, 9.
,, of Site, i, 41, 55, 78; ii, 3, 12, 16, 25, 33, 44, 53, 58, 78, 82, 91, 101, 115, 125, 126, 127, 128, 129, 137, 142, 162, 168, 176, 182, 187, 191, 198, 200, 206, 210, 220, 231, 238, 241, 248, 258, 271.
,, of Site, Summary of, ii, 278.
Arrangement of Buildings (*see* General Arrangement).
Artificial ventilation, i, 29, 41; ii, 85, 95, 107, 112, 131, 133, 138, 145, 172, 189, 202, 215, 218, 234, 239, 253.
Aspect of Principal Wards (*see* Wards, aspect of).
Asylums, Poor Law in London, Number of beds in, iii, 14.
Attendants' Dining hall, ii, 268.
,, Rooms, ii, 21, 112, 212.
Aural Wards, ii, 212.

BAKER'S H., Rome, ii, 230.
Baltimore, U.S. (*see* Johns Hopkins Hospital).
Basement Arrangements, i, 51, 57; ii, 200, 210.
Basements under sick wards, ii, 10, 13, 15, 21, 32, 41, 48, 67, 86, 97, 111, 112, 114, 121, 123, 135, 149, 167, 173, 180, 185, 190, 195, 217, 218, 219, 235, 240, 255, 273.
,, ,, Precautions as to, ii, 185.
Bathing Departments, i, 45; ii, 26, 78, 102, 143, 169, 177, 192.
Baths, Necessity of, i, 31.
,, and w.c.'s, i, 50; ii, 5, 9, 15, 20, 30, 40, 45, 47, 56, 66, 74, 75, 78, 85, 96, 120, 122, 130, 134, 139, 143, 148, 166, 172, 179, 184, 190, 194, 203, 208, 216, 218, 219, 224, 234, 239, 243, 255, 262, 268, 269, 272.

Beaujon H., Paris, Number of beds in the, iii, 5.
Bed Clothes Beating Shed, ii, 269.
Bed or Wall Space (*see* Wards, size of).
,, Cubic contents per (*see* Wards, size of).
,, Floor space per (*see* Wards, size of).
,, Pavilions, area of per (*see* "area covered").
,, Cost of buildings per (*see* "cost").
,, Sites covered per (*see* "area covered").
,, Window glass per (*see* windows).
,, Window ventilation per (*see* windows).
Beds at various Hs, Summary of No. of, ii, 278, 279.
,, in Hs. in London parishes, Table of, iii, 9.
,, Number of, in London Hs., Summary of, iii, 14.
,, Ratio of, in Hs. to the population, Table of, iii, 9.
,, Ratio of, to population in London, iii, 9, 10, 11.
,, Total of in Hs., &c., in London, iii, 9, 14.
,, Total number of, in Hs. in England and Wales outside the Metropolis, iii, 14.
Belgian Hs. (*see* Antwerp Civil H. and Mons Civil H.)
Bellevue H., N.Y., Sturges Pavilion of the, i, 55.
Berlin Civil H., general description, i, 40, 63; ii. 100.
,, ,, the sick wards and their offices, i, 41; ii, 104, 111, 112.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, View (*plate*), ii, 100.
,, ,, isolation pavilion, plan (*plate*) ii, 113.
,, ,, plan and sections (*plate*), i, 42; ii, 102.
Berlin Military H., general description, ii, 115.
,, ,, the sick wards and their offices, ii, 120, 121, 124.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, elevations and plans (*plate*), ii, 115.
,, ,, staircase (*plate*), ii, 123.
,, ,, Ice House, elevation and plan (*plate*), ii, 128.
Berlin Moabite Barrack H. (*see* Moabite H.)
Bhavnagar H. (*see* Takhtsingji H.)
Bicêtre Asylum for Lunatics, Paris, Number of beds in, iii, 5.
Bichât H., Paris, general description, ii, 181.
,, ,, the sick wards and their offices, ii, 183.
,, ,, Summary of, ii, 278, 279.
,, ,, plan and elevations (*plate*) ii, 181.
Billings, Dr. John, on Dr. Sanderson's scheme, ii, 277.
,, ,, on Warming and Ventilation, ii, 250, 252.
Blackburn Infirmary, general description, ii, 11.
,, ,, the sick wards and their offices, ii, 13.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, front view (*plate*), ii, 11.
,, ,, plan (*plate*), ii, 12, 14.
Blizard, Sir Wm., and Dr. Rumsey on Aggregation of Patients, i, 36.
Board of Management for Hs., iii, 39.
Boston City H., Pavilions at, i, 55.
Bourges Military H., France, general description, ii, 186.
,, ,, ,, the sick wards and their offices, ii, 189.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, Dr. Ch. Sarazin, on, ii, 186, 189.
,, ,, ,, plan and elevation (*plate*), ii, 186.
Bridges (*see* connecting bridges).
Bristow and Holmes on H. statistics, iii, 28.
Brocklesby, Dr., on Military Hs., i, 36.
Brussels International Congress on Lying-in Hs., i, 66.
Buckle, Dr., on H. accommodation, iii, 15.
Buildings, cost of, per bed (*see* cost).
Burdon Sanderson on Annular Wards, ii, 87, 275.
,, ,, ,, plan section, ii, 274.
,, ,, Evidence of, before Commission on Fever Hs., ii, 274.
Buxton, Sir T. Fowell, on H. management, iii, 21.

CALCUTTA H., nursing in, i, 13.
Cancer Hs. in London, Number of beds in, iii, 12.
Cardorcet, Marquis de, on M. Tenon's proposed H., ii, 264.
Ceilings (*see* Floors, &c.).
Chadwick, Edwin, on cost of sickness in Manchester, iii, 27.
Chapels, i, 45, 48, 57; ii, 5, 12, 18, 26, 35, 54, 59, 82, 93, 102, 103, 116, 121, 143, 163, 169, 170, 177, 187, 192, 213, 221, 232, 249, 259.
Charité H., Paris, Number of beds in, iii, 5.
,, ,, Patients in, ii, 102.
Chaumont, F. de (*see* de Chaumont).
Cheadle Convalescent Home, i, 77.
Chest Affections, Hs. in London for, Number of beds in, iii, 12.
Children's Diseases, Hs. for, in London, Number of beds in, iii, 13.
,, The Sick, H., Paris, Number of beds in, iii, 5.
Children's Ward, i, 52; ii, 211, 259.
Circular H., Antwerp (*see* Antwerp Civil H.).
Clark's, Dr., system for softening water, i, 31; ii, 6.
Classes and Schools in H., i, 60.
Classification of Hs., i, 59.
Classified List of London Hs., iii, 12.
Clinical Hs., Requirements and arrangements of, i, 60.
Clinique d'Accouchements H., i, 69.
Clothing Stores, i, 45, 48, 53; ii, 92, 111, 163, 169, 177, 185, 201, 221, 232, 255, 268.
,, ,, Requirements of, ii, 268.
Co-efficients of Aëration, Table of, i, 26, 78.
Commission on Small Pox and Fever Hs., Evidence of Dr. J. Burdon Sanderson before, ii, 274.
Committee of Management, Constitution of, i, 10, 22.

Committee of Management, Executive, i, 11.
,, ,, for Districts, iii, 39.
,, ,, Ladies on, i, 10.
,, ,, Medical Men on, i, 10.
Connecting Bridges, i, 54; ii, 78, 84, 257, 259.
Conseil Supérieur d'Hygiène Publique, Brussels, report on circular wards, &c., ii, 80.
Construction and Arrangements, General, i, 18.
Construction, Early works on, i, 18, 19.
,, Leon Lefort on, i, 20.
,, Philibert, De Lorme, on, i, 20.
,, Sarazin, Dr., on, i, 72.
,, Surgical Society of Paris on, i, 21.
,, Tollet, C., on, i, 20; ii, 196.
Consumption, Hs. for, in London, Number of beds in, iii, 12.
Contagious Matter, Destruction of, ii, 274.
Contaminated Air, Purification of, by Fire, ii, 274.
Contamination of Air by one person, i, 25, 28.
,, ,, Ratio of, to number of people, i, 25, 28.
Continental Hs., proportion of to population, iii, 5.
Control of Hs. by State, i, 9; iii, 20, 36.
,, Executive, i, 11.
,, of Nurses, i, 13.
Convalescent Home, Cheadle, i, 77.
,, Hs., i, 77.
Convalescent, Hs. for, in London, Number of beds in, iii, 12.
,, Home for paying Patients, ii, 232.
,, Rooms, i, 54; ii, 35, 142, 192, 195.
Cool Air, Effect on the Lungs, ii, 251.
Corridors, i, 64; ii, 5, 13, 18, 26, 36, 54, 61, 78, 83, 93, 103, 117, 121, 138, 143, 164, 170, 178, 183, 188, 201, 222, 233, 238, 250, 272, Summary of, 278.
Corridor and Pavilion system combined, Hs. built on, Rudolf-Stiftung, i, 40; Glasgow Western Infirmary, i, 49; ii, 42.
Corridor System, suitability for cold climates, ii, 88.
Cost of various Hs., i, 40, 42, 54; ii, 6, 13, 18, 28, 37, 46, 54, 61, 78, 83, 94, 104, 125, 126, 127, 132, 138, 144, 150, 164, 171, 178, 183, 188, 193, 201, 207, 214, 223, 233, 238, 241, 250, 260.
,, ,, Summary of, ii, 278.
,, ,, Altering and Improving less than new building (*see* Old Hs.)
Cottage Hs., i, 76.
,, in England, Accommodation in, Table, iii, 6.
,, in England and Wales, Total number of beds in, iii, 5, 6, 14.
Crèches, ii, 142, 174.
Crimean War, Mortality in, i, 15.
Cubic contents per bed (*see* Wards, size of).
Cüstrin Military H., general description, ii, 128.
,, ,, the sick wards and their offices, ii, 128.
Cüstrin Military H., Summary of, ii, 278.
,, ,, plan (*plate*) ii, 128.
DAY ROOMS, ii, 10, 15, 21, 31, 35, 40, 48, 67, 97, 110, 112, 114, 122, 139, 140, 149, 167, 173, 180, 184, 190, 194, 199, 227, 234, 239, 255, 262, 270.
,, ,, Summary of, area per bed, ii, 280.
Dead House (*see* Mortuary).
,, ,, Ventilation of, ii, 74.
Death Chamber, ii, 235.
Death Rate, Modes of calculating, i, 35.
,, ,, Dr. Farr on, i, 34.
,, ,, from Puerperal Fever, i, 67.
,, ,, in Lying-in Hs., i, 66, 69, 70.
,, ,, in Paris Hs., i, 35, 66, 69, 70.
,, ,, in various Hs., i, 50.
,, ,, in Workhouse, Lying-in Wards, i, 67.
,, ,, in Vesinet H., i, 77.
,, ,, in London Hs., iii, 28, 31.
,, ,, and Disease, Statistics of, in Prussian Hs., iii, 32.
,, ,, in London Hs., Reduction of, iii, 33.
,, ,, Manchester, iii, 27.
Deaths from Pyæmia in London Hs., Table of, iii, 34.
De Chaumont on Heights of Wards, ii, 195.
,, on nursing, i, 14.
,, on overcrowding, ii, 151.
,, on ventilation, ii, 51.
,, on warming, ii, 55.
Decline of H. funds, iii, 18.
Deformities of the Limbs, Hs. for, in London, number of beds in, iii, 12.
De Lorme Philibert on construction, i, 20.
Desgadets' Radiating H., i, 18.
Destitution and Sickness, Separation of, i, 8; iii, 16, 26, 38.
Dimension and distribution of buildings, i, 22, 32.
Disinfecting Chambers, ii, 52, 169, 182, 192, 207, 222, 249, 268, 276.
Dispensary, i, 23; ii, 248, 269; iii, 7.
Dispensaries, Poor Law, iii, 25.
,, Table of, in England and Wales, iii, 6.
Drainage, i, 22, 31, 32; ii, 6, 13, 18, 27, 36, 46, 52, 54, 61, 74, 83, 94, 104, 117, 118, 125, 128, 138, 143, 164, 170, 178, 201, 214, 222, 233, 243, 262.
,, Calculations for, ii, 118.
,, on Dry System, i, 32.
,, Precautions as to, i, 32.
,, and removal of waste matters, i, 22.
Drains, Ventilation of, i, 32.
Dresden Public H., general description, ii, 129.
,, ,, The Mutterhaus, ii, 130.
,, ,, The sick wards and their offices, ii, 132.
,, ,, Pay wards, ii, 130.
,, ,, Summary of, ii, 278, 279.
,, ,, Plan of Mutterhaus (*plate*), ii, 131.

Dresden Public H., plan of pavilions (*plate*), ii., 133.
,, ,, ,, elevations and sections (*plates*), ii, 134, 135.
,, ,, plan of additions (*plate*), ii, 130.
Druggists' H., Rome, ii, 230.
Drunkard's Room, ii, 268.
Dry system of Drainage, i, 32.
Düsseldorf Military H., general description, ii, 126.
,, ,, Summary of, ii, 278.
,, ,, Plan (*plate*), ii, 128.
Dust shoots, ii, 112.
Dutch Hs. (*see* Amersfoort M. H., and Utrecht H.)
Duty Rooms, ii, 10, 15, 21, 31, 35, 41, 48, 56, 67, 86, 97, 110, 120, 123, 135, 139, 140, 149, 167, 173, 180, 184, 190, 194, 204, 208, 216, 218, 219, 227, 235, 240, 243, 255, 262.
Duvoir-Leblanc system of heating and ventilation, ii, 145.

EAR and Throat Hs. in London, Number of beds in, iii, 13.
Economy in the Treatment of Disease, iii, 22.
Edinburgh, Royal Infirmary (*see* Royal Infirmary, Edinburgh).
Education and Examination of Students, i, 61.
Ehrenbreitstein Military H., general description, ii, 127.
,, ,, Summary of, ii, 278.
,, ,, plan (*plate*), ii, 128.
Elevators, Steam, i, 52.
England and Wales, H. accommodation in, iii, 5, 6.
,, ,, Table of Hs. in, iii, 6.
,, ,, Total number of beds in Hs. in, outside the Metropolis, iii, 5, 6, 14.
English Hs. (*see* Blackburn Infirmary, Herbert Military H., Hull General Infirmary, Leeds General Infirmary, Norfolk and Norwich H., St. George's Union Infirmary, St. Marylebone Infirmary, St. Thomas' H.)
Enlargement of Old Hs. (*see* Old Hs.)
Epilepsy, Hs. for in London, Number of beds in, iii, 12.
Erection of various Hs., Dates of, Summary of, ii, 278.
Erysipelas Wards, ii, 43, 45.
Esse, Dr. C. H., on pavilion principle, i, 40.
Executive control, i, 11.
Extension of Existing Buildings (*see* Old Hs.)
Eye (*see* Ophthalmic).

FAN for ventilation, ii, 131, 275.
Farr, Dr., Table of death-rate, i, 34.
Fawcett on Poor Law Relief, iii, 26.
Fever Patients, space required, ii, 70.
Fever and Small-pox Hs., Requirements and general arrangements for, i, 70; ii, 70.
Fever Hs. in England and Wales, Accommodation in, Table iii, 6.
Fever Hs. in England and Wales, Total number of beds in, iii, 5, 6, 14.
,, in London, Number of beds in, iii, 12.
Finance and Accounts, iii, 22.
Fires (*see* Warming, also Thermhydric Grates).
Fistula, Hs. for, in London, Number of beds in, iii, 12.
Floor space per bed (*see* Wards, Size of).
Fittings for Workhouse Hs., ii, 75.
Floors, Fireproof, ii, 8, 30, 108, 112, 139, 166, 172, 179, 234, 255.
Floors, Walls, and Ceilings, Construction of, i, 43; ii, 8, 14, 20, 30, 39, 47, 52, 56, 66, 75, 85, 96, 108, 112, 114, 120, 122, 134, 139, 148, 166, 172, 179, 190, 203, 208, 216, 218, 224, 234, 239, 243, 255, 261, 262, 272.
Floors, Warming of, i, 29; ii, 109.
Foundation, Table of date of, of Hs., i, 1.
Foundling H., Paris, Number of beds in the, iii, 5.
French Hs. (*see* Bourges Military H., and St. Eloi H., Montpellier), *see* also Paris Hs.
,, ,, Regulations for, i, 63
,, Lying-in Hs., Death-rate in, i, 66, 69, 70.
,, rules for admission, iii, 39.
Funds, Decline of H., iii, 18.
,, Mode of raising, iii, 23.
Furniture and Fittings of wards, i, 22, 37.
,, for Workhouse Hs., ii, 75.

GALTON, Captain Douglas, on ventilation, ii, 71.
,, ,, on warming, ii, 55.
,, ,, on Norfolk and Norwich H., ii, 49.
General Arrangement of Buildings, i, 18, 63; ii, 4, 12, 17, 25, 44, 53, 59, 74, 82, 91, 101, 115, 137, 142, 162, 168, 176, 182, 187, 191, 199, 200, 206, 210, 220, 232, 238, 248, 258, 271.
General Hs., Requirements and arrangements of, i, 62.
,, ,, Table of, in England and Wales, i, 34; iii, 6.
,, ,, in England and Wales, Total number of beds in, iii, 5, 6, 14.
,, ,, in London, Number of beds in, iii, 12.
Genoa (*see* St. Andrew the Apostle H.)
German Hs. (*see* Berlin Civil H., Berlin Military H., Cüstrin Military H., Dresden Public H., Düsseldorf Military H., Ehrenbreitstein Military H., Halle University H., Heidelberg University H., Königsberg Military H., The Moabite Barrack H., Strasburg University H.
Glasgow Western Infirmary, general description, ii. 42.
,, ,, ,, the sick wards and their offices, ii, 46.
,, ,, ,, average number of patients and time of residence, i, 50.
,, ,, ,, nursing arrangements, i, 15.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, view (*plate*), ii, 42.
,, ,, ,, plan (*plate*), ii, 44.

Gordon Smith on Heidelberg H., ii, 91.
Government Inspection of Hs., iii, 20.
Governmental Management, i. 8, 9.
Grassi, M., on ventilation, ii, 147.
Grigurn, Report of J., on Russian Hs., ii, 236.
Grouvelle's, M., system of heating and ventilation, ii, 145.
Guy, Dr., on H. mortality, iii, 30.

HALLE University H., Germany, general description, ii, 210.
,, ,, the sick wards and their offices, ii, 215.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, view and plan (*plate*), ii, 210.
,, ,, plans and sections of wards (*plate*), ii, 216.
Hard Water, Modes of softening, i, 31 ; ii, 6.
Healthiness, Ratio of, to space, i, 24.
Heart Diseases, Hs. for, in London, Number of beds in, iii, 12.
Heating (*see* Warming).
Herries', Mr., account of Hs. in Rome, ii, 228.
Heidelberg University H., general description, ii, 88.
,, ,, the sick wards and their offices, ii, 94.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, Gordon Smith on, ii, 91.
,, ,, general view (*plate*), ii, 88.
,, ,, plan (*plate*), ii, 92.
,, ,, plan of pavilions (*plate*), ii, 98, 99.
Herbert H., Woolwich, general description, ii, 3.
,, ,, the sick wards and their offices, ii, 7.
,, ,, Summary of, ii, 278, 279.
,, ,, general view (*plate*), ii, 3.
,, ,, plan and section (*plate*), ii, 4.
Holland, Hs. in (*see* Amersfoort Military H. and Utrecht H.).
Holmes and Bristow on H. statistics, iii, 28.
Holy Trinity, Convalescent H. of, Rome, ii, 229.
Hope Infirmary, Manchester, i, 63.
Hot air, and Hot water, Warming by (*see* Warming).
,, ,, advantages of, ii, 105.
Hôtel Dieu, Paris, general description, i, 18; ii, 151.
,, ,, the sick wards and their offices, ii, 165.
,, ,, Mortality at, ii, 266.
,, ,, Number of beds in, iii, 5.
,, ,, Patients in one bed, ii, 151, 265.
,, ,, Objections to, i, 18, 32, 39.
,, ,, Overcrowding at, ii, 151, 265.
,, ,, Report of Commission on plans and mode of construction, ii, 152.
,, ,, Report of Special Commission of the "Lancet" on the building, ii, 161.
,, ,, Summary of, ii, 278, 279, 280.
Hôtel Dieu, view (*plate*), ii, 151.
,, plan (*plate*), ii, 162.
Hull General Infirmary, general description, ii, 256.
,, ,, the sick wards and their offices, ii, 260.
,, ,, plans for enlargements, ii, 257.
,, ,, Sanitary arrangements at, ii, 257.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, plans and elevation (*plate*), ii, 256.
,, ,, plans and details (*plate*), ii, 260.
Husson on management, i, 7.
,, on overcrowding, ii, 151.
,, on records, i, 17.
,, on religious control in Hs., i, 14.
,, on ventilation, ii, 147.
Hut Hs., ii, 94, 241 (*see* also Tent Hs.).
,, Advantage of, i, 18, 74.
,, for military use, i, 73.
Hydropathic Department, ii, 192.

ICE HOUSE, i, 41, 42 ; ii, 92, 102, 116, 125, 126, 128, 206, 207, 213, 238.
,, Elevation and plan (*plate*), ii, 128.
Improvement of old Hs. (*see* Old Hs.).
Income of London Hs., iii, 15.
,, Sources of, iii, 18.
Incurables, H. for, in London, Number of beds in, iii, 12.
Indian Hs. (*see* Takhtsingji H.)
Infectious Wards, ii, 70, 103, 112, 117, 170, 201 ; iii, 15.
Infirmaries, Poor Law, iii, 25, 26.
,, (*see* Workhouse Infirmaries).
Inspection of Hs. by Government, iii, 20.
Interior Courts, Objections to, ii, 81.
Invalids, Hs. for, in London, Number of beds in, iii, 13.
Isolation and Itch Wards, i, 41, 43, 52, 53, 56; ii, 5, 56, 73, 92, 124, 213, 218, 249.
Italian Hs. (*see* St. Andrew the Apostle H.; *see also* Rome, Hs. at).
Italy, Number of Hs. in, ii, 228.
Itch Wards (*see* Isolation Wards).

JOHNS HOPKINS H., Baltimore, U.S., general description, i, 55; ii, 244.
,, ,, the sick wards and their offices, ii, 250.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, plans and sections (*plate*), ii, 244.

KITCHENS, i, 45, 51, 53, 54, 56, 57; ii, 4, 17, 25, 32, 35, 44, 53, 54, 59, 82, 92, 102, 116, 142, 163, 169, 177, 182, 187, 192, 199, 200, 206, 213, 219, 221, 232, 238, 249, 259, 269, 272.
Kitchen and Laundry, Separation of (*see* Laundry).

Königsberg Military H., general description, ii, 125.
,, ,, the sick wards and their offices, ii, 125.
,, ,, Summary of, ii, 278.
,, ,, plan of site (*plate*), ii, 128.

LABORATORY, ii, 26, 35, 91, 116, 169, 182, 192, 199, 213, 232, 249, 269.
Ladies on General Committee, i, 10.
Land and Buildings, cost of, per bed (*see* Cost).
Lariboisière H., Paris, general description, i, 69; ii, 141.
,, ,, the sick wards and their offices, ii, 144.
,, ,, Number of beds in, iii, 5.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, Overcrowding at, ii, 143.
,, ,, elevations and sections plan (*plate*), ii, 141.
,, ,, plan of pavilion (*plate*), ii, 144.
,, ,, puerperal fever wards, plan and sections (*plate*) ii, 148.
Larnure H., Paris, number of beds in the, iii, 5.
Laundry and Kitchen, Separation of, i, 33, 54; ii, 17, 43, 52, 102, 221.
,, and Wash-house, i, 48, 50, 51, 53, 54, 56, 58; ii, 5, 17, 34, 36, 43, 45, 54, 59, 78, 82, 92, 101, 102, 116, 125, 126, 127, 128, 129, 142, 177, 192, 207, 213, 221, 232, 238, 249, 259, 268, 270, 272.
Lavatories, ii, 9, 15, 20, 31, 40, 47, 56, 67, 86, 96, 109, 120, 122, 139, 140, 166, 194, 204, 234, 255, 262, 270, 273.
Lawson Tait on H. Gangrene, i, 39.
,, on H. mortality, i, 15, 34; iii, 33.
,, on H. records, i, 18.
Layet, Dr., on the Co-efficients of Aëration, i, 25, 78.
Lecture Rooms, i, 50; ii, 35, 45, 93, 103, 143, 199, 211, 212, 232, 249.
Leeds General Infirmary, general description, ii, 16.
,, ,, the sick wards and their offices, ii, 18.
,, ,, Summary of, ii, 278, 279.
,, ,, elevation (*plate*), ii, 16.
,, ,, plans and sections (*plate*) ii, 18.
Leforte Leon on construction, i, 20.
Leoping, i, 30.
Library, ii, 4, 5, 53, 59, 92, 162, 168, 187, 191, 192, 211, 232, 248, 249.
Lifts, i, 52; ii, 10, 21, 31, 41, 48, 57, 67, 86, 139, 167, 173, 227, 235, 255, 263, 273.
Lighting, warming, and ventilation (*see* Warming).
Linen Shoots, ii, 86, 112
Linen Stores (*see* Clothing Stores).
Lister, Prof., on superposed wards, i, 36.
Local Government Board Arrangements as to Workhouse Infirmaries, ii, 68.
Lock Hs. in London, Number of beds in, iii, 13.
London Hs. (*see* St. George's Union Infirmary, St. Marylebone Infirmary, St. Thomas's H.)
,, Classified list of, iii, 12.
,, Deaths from Pyæmia in, Table of, iii, 34.
,, Death rate, Reduction of, iii, 33.
,, Income of, iii, 15.
,, Insufficiency of accommodation in, iii, 14.
,, Mortality of, iii, 28.
,, Patients in, discharged, cured, died, &c., Table, iii, 31.
,, Total number of beds in, iii, 14.
London Districts, Table of H. Accommodation in, iii, 10.
London Parishes, Areas of, Table, iii, 9.
,, ,, Number of Hs. and beds in, Table of, iii, 9.
,, ,, Number of persons per acre, Tabl of, iii, 9.
,, ,, Ratio of beds in Hs. to the population, Table of, iii, 9.
,, ,, Table of area, population and Hs. in, iii, 9.
,, ,, Table of population of, in 1881, iii, 9.
London, Population of, iii, 3.
,, Rateable value of, iii, 19, 38.
,, Registration Districts (*see* Registration Districts in London).
London, Poor Law Asylum, Number of beds in, iii, 19.
,, Small-pox Hs. in, i, 71; iii, 13, 15.
Lumber Room, ii, 193, 209.
Lunatic Asylums in London, Number of beds in, iii, 13.
Lying-in Hs., i, 65, 69; ii, 230 (*see* also Maternities).
,, Brussels, Congress on, i, 66.
,, Death-rate in, i, 66, 69, 70.
,, in London, Number of beds in, iii, 12.
,, Requirements and arrangements of, i, 65.
Lying-in Wards, i, 43, 56, 69; ii, 73, 142, 148, 173, 176, 192, 199, 212, 238.
,, Advantages of space in, ii, 69.
,, first opened in England, i, 65.
,, Precautions to be observed, i, 68.
,, Surgical Society of Paris on, i, 68.
,, Cubic space in, i, 67.

MAINTENANCE, Ratio of cost, iii, 21.
Maison Dubois H., The, Paris, Number of beds in, iii, 5.
Management, Constitution of Committee of, for Hs., i, 10, 11, 22; iii, 39.
Management of Hs., i, 7, 50.
,, ,, by Government, i, 8, 9; iii, 20.
,, ,, Husson on, i, 7.
,, ,, in Paris, i, 8.
,, ,, objections to French system, i, 21.

Management of Hs., Ratio of cost, iii, 21.
,, ,, Suggestions by Dr. Mouat for, iii, 39.
,, ,, Sir T. Fowell Buxton on, iii, 21.
,, ,, Tenon on, i, 8.
Manchester, Cost of sickness in, iii, 27.
,, Death rate, iii, 27.
,, Hope Infirmary, i, 63.
Marshall, Prof. John, on circular wards, i, 56.
Marylebone Infirmary (*see* St. Marylebone).
Massachusetts General H., Pavilions at, i, 55.
Maternities, i, 48, 69.
,, at Paris, i, 69, iii, 5.
,, Number of beds in, iii, 5.
,, at Antwerp, i, 56.
Maternity, Tenon H., i, 43; ii, 173.
,, ,, plan and section (*plate*), ii, 148.
,, (*see* also Lying-in H.'s and Wards).
Matron, Authority of, i, 12.
,, Necessity for, i, 12.
Medical Appliances for Workhouse Hs., ii, 76.
,, Men on General Committee, i, 10.
,, Schools in connection with Hs., iii, 34, 37.
Medical Superintendent, i, 11.
Menilmontant H. (*see* Tenon H.)
Metropolitan Separate Workhouse Infirmaries, Number of beds in, iii, 14.
Military Hs., (*see* Amersfoort, Berlin, Bourges, Cüstrin, Düsseldorf, Ehrenbreitstein, Königsberg and Woolwich).
Military Hs., Dr. Brocklesby on, i, 36.
Moabite Barrack H., Berlin, general description, ii, 205.
,, ,, ,, the sick wards and their offices, ii, 207.
,, ,, ,, Summary of, ii, 278, 279.
,, ,, ,, tabulated statement of classes of diseases treated, ii, 205.
,, ,, ,, plan (*plate*), ii, 205.
Mons Civil H., general description, i, 57; ii, 77.
,, the sick wards and their offices, i, 58; ii, 78.
,, Summary of, ii, 278.
,, view and plan (*plate*), ii, 77.
Montpelliier (*see* St. Éloi H.)
Morin, General, on Hs., i, 63.
,, ,, on ventilation, ii, 254.
Mortality in Crimean War, i, 16.
,, Dr. Guy on H., iii, 30.
,, at Hôtel Dieu, ii, 266.
,, in relation to number of inmates, table of, i, 34.
,, Lawson Tait on, i, 15, 33; iii, 33.
Dr. Steele on, iii, 33.
,, of London Hs., iii, 28.
,, Statistics as to, in London Hs., iii, 29.
Mortuary, i, 42, 45, 51, 56, 58; ii, 5, 17, 26, 36, 45, 54, 59, 68, 74, 82, 93, 102, 116, 125, 126, 127, 128, 130, 143, 163, 170, 177, 182, 188, 192, 199, 201, 207, 221, 232, 238, 249, 259, 268, 272.
NATIVITY H., St. Petersburg, general description, ii, 241.
,, ,, the sick wards and their offices, ii, 242.
,, ,, Summary of, ii, 278, 279.
,, ,, plan, elevation and section (*plate*), ii, 241.
Necker H., The, Paris, Number of beds in, iii, 5.
Nervous Disorders, Hs. for, in London, Number of beds in, iii, 12.
New York H., general description, i, 51.
,, ,, the sick wards and their offices, i, 53.
,, ,, view (*plate*) i, 52.
Norfolk and Norwich H., general description, ii, 49.
,, ,, ,, the sick wards and their offices, ii, 55.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, Capt. Douglas Galton on, ii, 49.
,, ,, ,, plan (*plate*), ii, 54.
,, ,, ,, view (*plate*), ii, 49.
Number of Hs. in England and Wales, iii, 7.
Number of Patients in one H., i, 21, 33, 36; ii, 265; iii, 33.
Nurses' Apartments, Necessity for separating from Sick Wards, ii, 257.
,, Control of, i, 13.
,, Home, ii, 59, 249, 259.
,, Rooms, i, 18, 43, 50, 53, 56; ii, 10, 12, 21, 31, 41, 45, 48, 57, 59, 82, 92, 103, 110, 121, 123, 139, 140, 149, 162, 163, 167, 173, 180, 184, 190, 194, 204, 208, 217, 218, 219, 235, 240, 243, 249.
,, Training of, i, 14.
Nursing, i, 12, 15, 50.
,, Arrangements at Glasgow Western Infirmary, i, 15.
,, De Chaumont on, i, 14.
OBSTETRIC Wards, &c. (*see* Maternity also Lying-in).
Officers' Quarters, necessity for separating from sick wards, ii, 257.
,, Mode of appointment of, iii, 35.
Old Hs. badly planned, capable of improvement, ii, 256.
,, injudicious alterations, example of, ii, 256.
,, description of alterations to Hull General Infirmary, ii, 257.
,, modernized at less than half the cost of new buildings, Example of, ii, 260.
One-storied Pavilions, Advantages of and objections to, ii, 94.
Open Fires (*see* Warming also Thermhydric Grates).
Open Stoves (*see* Warming also Thermhydric Grates)

Operating Rooms, i, 57; ii, 26, 78, 82, 103, 110, 116, 130, 192, 194, 199, 232, 243, 249, 269, 272.
,, Wards, ii, 5, 187.
,, Theatres, i, 50, 53, 56; ii, 5, 17, 26, 35, 53, 92, 99, 162, 169, 210, 212, 259.
Oppert, Dr., on Special Hs., i, 75
,, on H. accommodation, iii, 15.
Ophthalmic Hs. in London, Number of beds in, iii, 12.
,, Wards, i, 4; ii, 17, 25, 93, 96, 164, 212, 230.
Oratory, ii, 269.
Outdoor Medical Relief in London, iii, 8.
Out-patients Departments, i, 51; ii, 12, 17, 25, 48, 54, 162, 168, 191, 199, 211, 232, 249, 258; iii, 25.
,, Home treatment of, iii, 37.
,, Rooms, Ventilation of, ii, 52.
,, system, Evils of, iii, 24.
,, suggested improvements, iii, 25.
Overcrowding, i, 21, 33, 36; ii, 143, 170, 265; iii, 4, 33.
,, de Chaumont on, ii, 151.
,, at Hôtel Dieu, ii, 151, 265.
,, Sir Wm. Blizard and Dr. Rumsey on, i, 36.
,, Husson on, ii, 151.
,, at Lariboisière H., ii, 143.
,, in London, Lord Salisbury on, iii, 4.
,, Result of, i, 24.

PARIS Hs. (*see* Hôtel Dieu, Lariboisière H., Tenon H., Bichât H., St. Anne H., St. Louis Bicêtre Asylum for Lunatics, Pitié, Foundling, Larnure, St. Antoine, Children's Sick H., Charité, Beaujon, Necker, Maison Dubois, St. Eloi H., St. Denis H., M. Tenon's proposed H.)
,, Death rate in, i, 35, 66, 69, 70.
,, Maternities at, i, 69; iii, 5.
Paris Surgical Society on construction and Position, i, 21.
Parishes (*see* Londo parishes).
Parkes Museum, i, 38.
Pasteur, Professor, on organic impurities, i, 29.
Pathological Department, i, 50, 53; ii, 34, 36, 45, 163, 249.
,, Institute, ii, 93, 199, 213.
,, Society's report on Pyæmia, iii, 34.
Patients in London Hs. discharged, cured, died, &c. table, iii, 31.
,, limit of number in one H., i, 21, 33, 36; iii, 33.
,, number in each ward, i, 22, 40, 64.
,, payments by, iii, 26, 27.
Pavilions, Area of (*see* Area of Pavilions).
,, One storied, advantages of and objections to, ii, 94.
,, Relative positions of, ii, 7, 18, 29, 37, 62, 84, 104, 111, 113, 124, 132, 144, 165, 171, 184, 189, 193, 202, 207, 215, 217, 223, 233, 238, 250.
Pavilion System, Advantages of, i, 35; ii, 94.
,, ,, Dr. C. H. Esse on, i, 40.
Pavilion System, first established in France, ii, 141.
Pavilion and Corridor System (*see* Corridor System).
Pay wards, ii, 24, 89, 130, 192, 199.
,, Regulations for, ii, 24, 90.
Periodical evacuation of wards, i, 22; ii, 52.
Philadelphia Presbyterian H. collecting committee, iii, 23.
,, ,, One-storied pavilion at, i, 55.
Physiological Institute, ii, 213.
Pitié H., Paris, Number of beds in, iii, 5.
Poor Law Asylums in London, Number of beds in, iii., 13.
,, Board Committee Report, ii, 68.
,, Infirmaries and Dispensaries, iii, 25, 26.
,, Relief, Fawcett on, iii, 26.
Poor Priests, H. for, at Rome, ii, 230.
Population of London, Classification of, iii, 3.
,, ,, parishes in 1881, Table of, iii, 9.
,, ,, Districts, iii, 10.
,, ,, Registration District in 1881, Table of, iii, 11.
,, Proportion of Hs. to, on the Continent, iii, 5.
Porous Walls, Disadvantages of, i, 30.
Porter-Clark's process for softening water, i, 31; ii, 6.
Post Mortem Rooms, i, 51; ii, 5, 17, 26, 54, 59, 82, 116, 163, 170, 177, 182, 192, 213, 221, 232, 249, 259.
Power, Dr., on Small-pox Hs., i, 71.
Presbyterian H., Philadelphia (*see* Philadelphia).
Prince Torlonia's Room for Eye Diseases, Rome, ii, 230.
Private Charity in London, iii, 16.
Prussian Hs., Statistics of disease and death in, iii, 32 (*see* also German Hs.)
Puerperal Fever, Death rate from, i, 67.
,, ,, Thevenot, M., on, i, 68.
,, ,, Tollet, M., on, ii, 149.
,, ,, Wards, ii, 149.
Purification of air by earth containing organic matter, in India, i, 30.
Pyæmia, Deaths from, in London Hs., Table of, iii, 34.

RADIATING H., by Desgadets, i, 18, 38.
Rateable value of London, iii, 19, 38.
Reception Room, ii, 249.
Receiving Ward, ii, 110, 232, 267.
Records of Hs., i, 15.
,, Husson on, i, 17.
,, Imperfect Nature of, i, 16, 17.
,, Lawson Tait on, i, 16.
,, should contain, i, 16.
,, Value of, i, 17.
Registration Districts in London, H. accommodation in, Table of, iii, 11.
,, ,, in London area, and number of persons in, Table of, iii, 11.

Registration Districts in London, Number of Hs. and beds in each district, Table of, iii, 11.
,, ,, in London, Population in 1881, Table of, iii, 11.
,, ,, in London, Ratio of beds to population, Table of, iii, 11.
,, ,, Table of H. accommodation in, iii, 11.
Relief of sickness by State aid, iii, 19.
Religious organization and teaching, i, 1, 13.
Religious control in Hs., Husson on, i, 14.
Richardson, Dr. B. W., on purification of contaminated air, ii, 274.
Riga Town H., Russia, general description, ii, 236,
,, ,, the sick wards and their offices, ii, 238.
,, ,, Regulations and list of, ii, 236, 237.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, elevation, plan, and section (*plate*) ii, 236.
Rome, Hs. at (*see* S. Spirito in Sassia, SS. Mo Salvatore ad Sancta Sanctorium, St. James in Augusta, S. Maria in Portico, S. Maria delle Granzie, S. Maria and S. Gallicano, S. Maria della Consolazione, S. Rocco, St. John Calibita, Poor Priests (H. for), S. Francesca Romana, Druggists' H., Bakers' H., Prince Torlonia's Room for Eye Diseases, and the Spanish H.)
,, Proposed new H. at, ii, 230.
Room for Drunkards, ii, 268.
Rotunda H., Dublin, i, 65.
,, ,, table of cases, i, 65.
Royal Infirmary, Edinburgh, general description, i, 50; ii, 34.
,, ,, ,, the sick wards and their offices, ii, 37.
,, ,, ,, Number of patients and deaths in, i, 50.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, plan and section (*plate*) ii, 34.
,, ,, ,, view (*plate*) ii, 33.
Rudolf-Stiftung H., general description, i, 40.
Rumsey, Dr., and Sir William Blizard on Overcrowding, i, 36.
Russia, Regulations of Hs. in, ii, 236.
Russian Hs. (*see* Nativity H., St. Petersburg, and Riga Town H.)

ST. ANDREW THE APOSTLE, H. of, Genoa, Italy, general description, ii, 228.
,, the sick wards and their offices, ii, 233.
,, Summary of, ii, 278, 279, 280.
,, view (*plate*), ii, 228.
,, plan and section (*plate*), ii, 233.
St. Anne H., Paris, Number of beds in, iii, 5.
St. Antoine H., Paris, Number of beds in, iii, 5.
St. Denis H., France, general description, ii, 175.
,, ,, the sick wards and their offices, ii, 178.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, plan and section (*plate*), ii, 175.
St. Eloi H., Montpellier, general description, i, 45, ii, 191.
,, ,, the sick wards and their offices, i, 48; ii, 193.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, Perspective view (*plate*), i, 46.
,, ,, plans, sections, and elevation (*plate*), ii, 191.
St. Francesca Romana H., ii, 230,
St. George's Union Infirmary, general description, ii, 220.
,, ,, ,, the sick wards and their offices, ii, 223.
,, ,, ,, Summary of, ii, 278, 279, 280.
,, ,, ,, elevation, plan, and section (*plate*), ii, 220.
St. James in Augusta H., ii, 229.
St. John Calibita H., ii, 230.
St. Louis H., Paris, Number of beds in, iii, 5.
S. Maria and S. Gallicano H., ii, 229.
S. Maria in Portico, S. Maria delle Granzie, and S. Maria della Consolazione united H., ii, 229.
St. Marylebone Infirmary, general description, i, 63; ii, 58.
,, ,, the sick wards and their offices, ii, 61.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, perspective view (*plate*), ii, 58.
,, ,, plan and section (*plate*), ii, 60.
St. Petersburg (*see* Nativity H.)
S. Spirito in Sassia, H. of, Rome, ii, 228.
S. Rocco Lying-in H., Rome, ii, 230.
St. Thomas's H., general description, ii, 22.
,, ,, the sick wards and their offices, ii, 29.
,, ,, Building Committee, ii, 23.
,, ,, Cost of furuiture, ii, 28.
,, ,, Estimates for building, ii, 27.
,, ,, failure in construction, i, 19, 32.
,, ,, Negotiations for new site, ii, 22.
,, ,, Nursing in, i, 14.
,, ,, Objections to, i, 39.
,, ,, Pay Wards, ii, 24.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, general view and plan (*plate*), ii, 22.
,, ,, plan (*plate*), ii, 26.
Salisbury, Lord, on overcrowding in London, iii, 4.
Sanderson, Dr. Burdon, proposed H. ward, ii, 274.
,, ,, on ventilation of wards, ii, 274.

Sanderson, Dr. Burdon, Evidence of, before Commission on Fever Hs., ii, 274.
Sanitary arrangements, Supervision of, ii, 52.
SS. Mo Salvatore ad Sancta Sanctorium H. of Rome, ii, 229.
Sarazin, Dr. Ch., on Bourges Military H., ii, 186, 188, 189.
,, ,, on H. construction, i, 72.
,, ,, on temporary Hs., i, 39.
Schools and classes in H., i, 60.
Scotch Hs. (*see* Glasgow Western Infirmary and Royal Infirmary, Edinburgh).
Separation, Advantage of, i, 25.
,, Wards, i, 50, 58; ii, 15, 31, 41, 48, 56, 67, 69, 86, 97, 110, 112, 117, 122, 135, 139, 140, 149, 167, 173, 176, 190, 195, 204, 216, 219, 226, 235, 239, 249, 255, 262, 273.
,, Wards, Summary of area and contents per bed, ii, 280.
Sickness and Destitution, Separation of, i, 8; iii, 16.
Site, Selection of, i, 21, 22, 63.
,, Area of, per bed, Summary of, ii, 278 (*see* also Area of Site).
,, covered per bed, Summary of, ii, 278 (*see* also Area covered).
Skin Diseases, Hs. for, in London, Number of Beds in, iii, 13.
Slop Sinks, ii, 9, 15, 20, 31, 40, 47, 67, 86, 96, 109, 166, 226, 234, 262, 269.
Small Pox Hs., in London, i, 71.
,, ,, in London, Number of Beds in, iii, 13.
,, ,, Dr. Power on, i, 71.
,, ,, Dr. Thorne on, i, 71.
,, Pavilion, i, 43, 45.
,, and Fever Hs., Evidence of Dr. J. Burdon Sanderson before Commission on, ii, 274.
,, ,, ,, Requirements, and general arrangements for, i, 70; ii, 70.
Soldiers' Home at Washington, i, 54.
Sources of Income, Decline of, iii, 18.
Space required in Wards, Report of Government Committee on, ii, 68.
Space surrounding H., i, 21, 22, 23.
Spanish H., Rome, ii, 230.
Special Hs., Requirements and general arrangements for, i, 75.
,, Dr. Oppert on, i, 75.
Staff, Superintendence and control of, i, 11.
Staircases, i, 43, 53; ii, 10, 15, 21, 32, 41, 48, 57, 67, 75, 86, 111, 121, 123, 139, 140, 149, 167, 173, 185, 227, 235, 255, 263, 269, 272, 273.
State Control of Hs., i, 9; iii, 20, 36.
State relief of sickness, iii, 19.
Statistics, Bristow and Holmes on, iii, 28.
,, of disease and death in Prussian Hs., iii, 32.
,, as to patients and mortality in London Hs., iii, 29.
Steam Elevators, i, 52.
Steam Pipes, Heating by, ii, 145, 171, 208, 215, 218.
Steele, Dr., on H. mortality, iii, 33.
Stone and Urinary Disorders, Hs. for, in London, number of beds in, iii, 13.
Stores, i, 43, 45, 48, 51, 52, 53; ii, 4, 17, 25, 35, 44, 45, 53, 59, 82, 92, 101, 125, 143, 162, 163, 169, 177, 182, 187, 188, 195, 199, 200, 201, 212, 221, 232, 249, 259, 270, 272.
Strasburg University H., general description, ii, 137.
,, ,, the sick wards and their offices, ii, 138, 139.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, plan and section (*plate*), ii, 137.
Sturges Pavilion, Bellevue H., N.Y., i, 55.
Subsoil, ii, 4, 12, 16, 25, 34, 44, 53, 59, 91, 101, 115, 142, 162, 168, 176, 187, 199, 200, 206, 210, 220, 231, 248.
Summary of Construction of various Hs., ii, 278, 279, 280.
Summer Sick Pavilions, ii, 201.
Superficial or floor space (*see* Wards, size of).
Supervision of sanitary arrangements, ii, 52.
Surgical Society of Paris, on construction and position, i, 21.
Surgical Wards, Limit of patients in each, i, 37.
Swedish plan of payments from patients, iii, 26.
Syphilitic Hs. in London, Number of beds in, iii, 13.
,, wards, ii, 35, 73, 92, 211, 238.

TABLE of Co-efficients of Aëration, i, 26, 27, 28, 78.
,, Date of erection, size, and general arrangement of buildings, ii, 278.
,, Date of foundation of Hs., i, 1.
,, Death rate, Farr and Lawson Tait on, i, 34.
,, Diseases treated at Moabite Barrack H., ii, 205.
,, Mortality in relation to number of inmates, i, 34.
,, Deaths from Pyæmia in London Hs., iii, 34.
,, Area, population and H. accommodation in London Districts, iii, 10.
,, H. Accommodation in London Parishes, iii, 9.
,, Hs. in England and Wales, iii, 6.
,, Mortality in Lying-in Wards at Rotunda, H., i, 65.
,, Number of beds in various H., classified, iii, 12, 13, 14.
,, Patients in London Hs. discharged, cured, died, &c., Table iii, 31.
,, Rate of air contamination, ii. 51.
,, Relative mortality in Hs., 34.
,, Space required in wards, ii, 73.
,, Summary of construction of various Hs., ii, 278, 279, 280.
,, Lighting and ventilation of wards, ii, 279, 280.
,, Tenders for St. Thomas's H., ii, 27.

Tait, Lawson, on H. mortality, i, 15, 34; iii, 33.
,, table of death rate, i, 34.
Takhtsingji H., general description, ii, 271.
,, the sick wards and their offices, ii, 272.
,, view (*plate*), ii, 271.
,, plans (*plate*), ii, 272.
Temperature of wards and offices, ii, 106, 251.
Temporary Hs., i, 39, 73 (*see* also Hut Hs.).
,, Dr. Sarazin on, i, 39.
,, materials in construction desirable, i, 39.
Tenon H., Menilmontant, Paris, general description, i, 43; ii, 168.
,, ,, the sick wards and their offices, i, 43; ii, 171.
,, ,, the Maternity, i, 43; ii, 173.
,, ,, Overcrowding at, ii, 170.
,, ,, Summary of, ii, 278, 279, 280.
,, ,, plan (*plate*), i, 44; ii, 148, 170.
,, ,, view (*plate*), ii, 168.
Tenon on management, i, 8.
,, on Hs., ii, 264.
,, proposed H., general description, ii, 264.
,, ,, the sick wards and their offices, ii, 269.
,, ,, M. de Cardocet on, ii, 264.
,, ,, plan (*plate*), ii, 264.
Tent Hs. i, 71, 74 (*see* also Hut Hs.).
Theatres, i, 50; ii, 35, 36, 45, 192 (*see* also Operating Theatres).
Thermhydric Hot-water Grates, ii, 55, 62, 224, 261.
,, ,, ,, description and plans of (*plates*), ii, 62, 64, 65.
Thevenot, M., on Puerperal Fever, i, 68.
Thomas and Laurens' System of Ventilating and Heating, ii, 145.
Thorne, Dr., on Small Pox Hs., i, 71.
Throat and Ear Hs. in London, Number of beds in, iii, 13.
Tollet's, M., System, Hs. built on (*see* St. Éloi H. Montpellier, H. Bichât, St. Denis H., Bourges Military H.).
,, Letter from, on his System, ii, 196.
,, on construction, i, 20, ii, 196.
,, System, i, 20, 47, 49, 72; ii, 175, 181, 186.
,, Puerperal Fever Wards, ii, 149.
Training Kitchen, ii, 249.
Training of Nurses, i, 54.
Trélat on aggregation of patients, i, 33.
Tyndall, Professor, on dust, i, 29.

UNIVERSITY College H., Objections to i, 39.
Urinals, ii, 9, 20, 30, 47, 86, 109, 120, 194, 216, 234, 255, 269.
Urinary Diseases, Hs. for, in London, Number of beds in, iii, 13.
Utrecht H., Holland, general description, ii, 198.
Utrecht H, Holland, the sick wards and their offices, ii, 199.
,, ,, summary of, ii, 278.
,, ,, elevation and plan (*plate*), ii, 198.

VAN HECKE'S system of ventilation, ii, 147.
Vaulting under Hs., Objections to, ii, 217.
Ventilating Shaft, Danger of, i, 31, 45.
,, fan, ii, 131, 275.
Ventilation, lighting and warming (*see* Warming).
,, Amount of power required for, ii, 253.
,, Artificial (*see* Artificial Ventilation).
,, Amount required for each adult, i, 28.
,, and warming, Dr. Billings on, ii, 250, 252.
,, Dr. Burdon Sanderson on, ii, 274.
,, by Capt. Douglas Galton's stoves, ii, 8.
,, by Thermhydric Hot-water Grates, ii, 55, 62, 64, 65, 224, 261.
,, by windows (*see* Window Ventilation).
,, Captain Douglas Galton on, ii, 55, 71.
,, Conditions of, i, 29, 48; ii, 108, 253.
,, Cost of Duvoir-Leblanc system, ii, 146.
,, Cost of Thomas and Laurens' system, ii, 146.
,, Dr. C. Waldhauer on, ii, 239.
,, General Morin on, ii, 254.
,, Husson on, ii, 147.
,, in Circular Wards, i, 56.
,, M. Grassi on, ii, 147.
,, of Drains, i, 32.
,, Prof. de Chaumont on, ii, 51, 55.
,, Thomas and Laurens' system of, ii, 145.
,, to gas burners, ii, 71.
,, Van Hecke's system, ii, 147.
,, window (*see* Windows).
,, with reference to size of room, &c., i, 25.
Venereal Wards, ii, 35, 73, 92, 211, 238.
Verandahs, ii, 31, 41, 56, 97, 110, 135, 180, 184, 194 216, 218, 219, 239, 273.
Vesinet Convalescent H., Death rate in, i, 78.
Vincennes and Vesinet Convalescent Hs., i, 77.
Vivisection Room, ii, 213.

WALDHAUER, Dr. C., on ventilation, ii, 239.
Walls, Floors and Ceilings (*see* Floors).
Wall or bed space (*see* Wards, size of).
Wards, Aspect of, i, 58, 64; ii, 7, 14, 16, 29, 37, 46, 55 61, 95, 104, 120, 121, 125, 126, 127, 132, 138, 139, 144, 165, 171, 178, 183, 189, 193, 202, 215, 217, 219, 223, 233, 238, 250, 260, 272.
,, Summary of, Aspect of, ii, 278.
,, Annular, ii, 87, 275.
,, Aural, ii, 212.
,, Children's, i, 52 ii, 211, 259.
,, Circular, i, 56; ii, 80.
,, infectious, Destruction of contagious matter in, ii, 274.

Wards, Furniture of, i, 22.
,, Lying-in, i, 43, 56, 69; ii, 73, 142, 148, 173, 176, 192, 199, 212, 238.
,, Limit of patients in, i, 22, 40, 64.
,, Isolation (*see* Isolation).
,, Operation (*see* Operation).
,, Ophthalmic (*see* Ophthalmic).
,, Periodical evacuation of, i, 22; ii, 52.
,, Receiving, ii, 110, 232.
,, Separation (*see* Separation).
,, Separation of cases in, ii, 72, 266.
,, Size of, i, 7, 14, 19, 32, 41, 58; ii, 7, 14, 19, 29, 37, 46, 50, 55, 62, 73, 84, 95, 98, 105, 120, 121, 132, 138, 140, 142, 144, 165, 171, 175, 178, 184, 189, 193, 202, 207, 215, 217, 219, 223, 233, 239, 242, 250, 252, 260, 265, 269, 272.
,, Summary of size of, 280.
,, Small Pox, ii, 238.
,, space required, ii, 73; Report on, ii, 68.
,, Summer and Winter, ii, 201, 204.
,, Temperature of, ii, 106, 196, 251.
,, Syphilitic and Venereal (*see* Syphilitic).
,, Warming, lighting and ventilation of (*see* Warming).
Warming, lighting, and ventilation, i, 24; ii, 7, 8, 14, 19, 29, 38, 47, 51, 55, 62, 78, 85, 95, 105, 114, 120, 122, 130, 132, 138, 140, 145, 165, 171, 178, 184, 189, 202, 208, 215, 224, 234, 239, 242, 243, 250, 252, 261, 272.
,, Burdon Sanderson on, ii, 276.
,, de Chaumont on, ii, 55.
,, Duvoir-Leblanc System of, ii, 145.
,, Captain Douglas Galton on, ii, 8, 55.
,, Grouvelle's, M., system of, ii, 145.
,, by hot air, ii, 85, 95, 138, 165, 171, 202, 234.
,, by hot water, ii, 47, 62, 105, 130, 145, 178, 184, 224, 234, 239, 242, 250, 261, 276.
,, Experiments on, ii, 105, 145.
,, Advantages of and objections to, ii, 105, 251.
,, by open fires, ii, 7, 14, 19, 29, 38, 47, 62, 85, 179, 184, 189, 224, 261.
,, Advantages of and objections to, ii, 105, 251.
,, by steam pipes, ii, 145, 171, 208, 215, 218.
,, Experiments on, ii, 105, 145.
,, by close stoves, ii, 78, 122, 189, 202.
by Thermhydric Grates, ii, 55, 62, 224, 261.
Warming Stoves, Comparison of, ii, 64.
,, and Ventilation, Thomas and Laurens' system of, ii, 145.
,, ,, Dr. Billings on, ii, 250, 252.
,, ,, Tollet on, i, 47.
Wash-house and laundry (*see* Laundry).
Washington, Soldiers' Home at, i, 54.
Water closets and baths (*see* Baths and w.c.'s.).
Water closet ventilating lids (*plate*), ii, 225.
Water supply, i, 31; ii, 6, 13, 18, 27, 36, 45, 54, 61, 83, 93, 103, 117, 125, 128, 143, 164, 170, 178, 188, 201, 207, 214, 222, 233, 238, 243, 269.
,, Modes of softening, i, 31; ii, 6.
,, Precautions as to, i, 32.
Westminster H., Objections to, i, 39.
Windows, Size and amount of light and ventilation of, i, 43, 50; ii, 7, 14, 19, 29, 38, 46, 55, 62, 74, 84, 95, 98, 105, 122, 133, 145, 165, 171, 178, 184, 189, 194, 202, 208, 215, 217, 219, 223, 233, 242, 250, 260, 272.
,, Summary of, ii, 279.
,, sashes, Special recommendations as to, ii, 62, 224, 260.
Winter sick wards, ii, 204.
Women, Hs. for, in London, Number of beds in, iii, 13.
Woolwich (*see* Herbert H.).
Workhouse Hs., Furniture and fittings for, i, 22; ii, 75.
,, infirmaries, ii, 58; iii, 17.
,, ,, fittings and medical appliances, ii, 75.
,, ,, Infectious diseases in, ii, 70.
,, ,, Local Government Board Regulations as to, ii, 68.
,, ,, Metropolitan, Separate number of beds in, iii, 13.
Workhouse Hs. and Infirmaries, List of Plates—
St. Marylebone Infirmary, view, ii, 58.
,, ,, plans and section, ii, 60.
,, ,, Thermhydric Stoves, ii, 62, 64, 65.
St. George's Union ,, plans, elevation and section, ii, 220.
,, ,, Construction of w.c.'s, ii, 225, 226.
Workhouse lying-in wards, Cubic space in, i, 67.
,, ,, Death rate in, i, 67.
Women, Hs. for, i, 64.

ZONE of Aëration, i, 21, 23.

ERRATA.

SECTION II.

Page 144, three bottom lines, for "3,695, 62,815, 59,030, 1,963, 1,845" read respectively "3,699, 62,886, 59,186, 1,965, 1,850."

,, 145, top line, for "eight feet" read "7 feet 10 inches."

,, 165, lines 20 and 21, for "57,866, 54,108, 53,357, 2,223" read respectively "57,854, 54,098, 53,346, 2,222."

,, 167, line 7, for "13½" read "21."

,, 176, line 27, for "7" read "28."

,, 178, lines 15 and 29, for "1,271, 1" read respectively "1,245, 2."

,, 184, line 10, for 52,974, 2,207" read respectively "52,916, 2,205."

,, 187, line 21, for "59,800, 17, 277" read respectively "537,920, 16, 2,490."

,, 189, lines 25 and 26, for "89, 47,678, 1,703" read respectively "85, 47,405, 1,693."

,, 193, lines 16, 18, and 42, for "372, 114, 65, 118" read respectively "371, 113, 65, 184."

,, 194, line 7, for "16¼" read "16½."

,, 199, lines 1 and 2 for "35,080, 133" read respectively "341,129, 1,292."

,, 202, the divisions of the scale on plate beneath the "transverse section" are drawn twice the proper size.

,, 206, line 26, for "800,670, 8, 10" read respectively "800,672, 18, 20."

,, 214, line 2, for "494" read "496."

,, 215, lines 2 and 3, for "334, 44, 378" read respectively "333, 41, 374."

,, 217, line 10 from bottom, for "3,368, 142, 53,046, 2,210" read "3,363, 140, 52,967, 2,207."

,, 223, line 7 from bottom, for "177" read "354."

,, 239, line 9 from bottom, for "13" read "12¾."

,, 248, line 21, for "14 acres" read "13 acres, 3 roods, 26 perches," and for "1,689" read "1,679."

,, 250, line 27, for "104" read "105."

,, 260, lines 2, 21, 22, 24, and 25, for "128, 562, 18⅝, 20½, 669, about 22¼, 22⅜" read respectively "129, 529, 17·63, 19·7, 633, 21·1, 21½."