THE UNIVERSITY OF ASTON IN BIRMINGHAM.

THE LIFE AND ARCHITECTURAL WORKS OF

WILLIAM HENMAN. F.R.I.B.A.

JOHN FRANCIS TOVEY.

M. Phil. 1982

SUMMARY.

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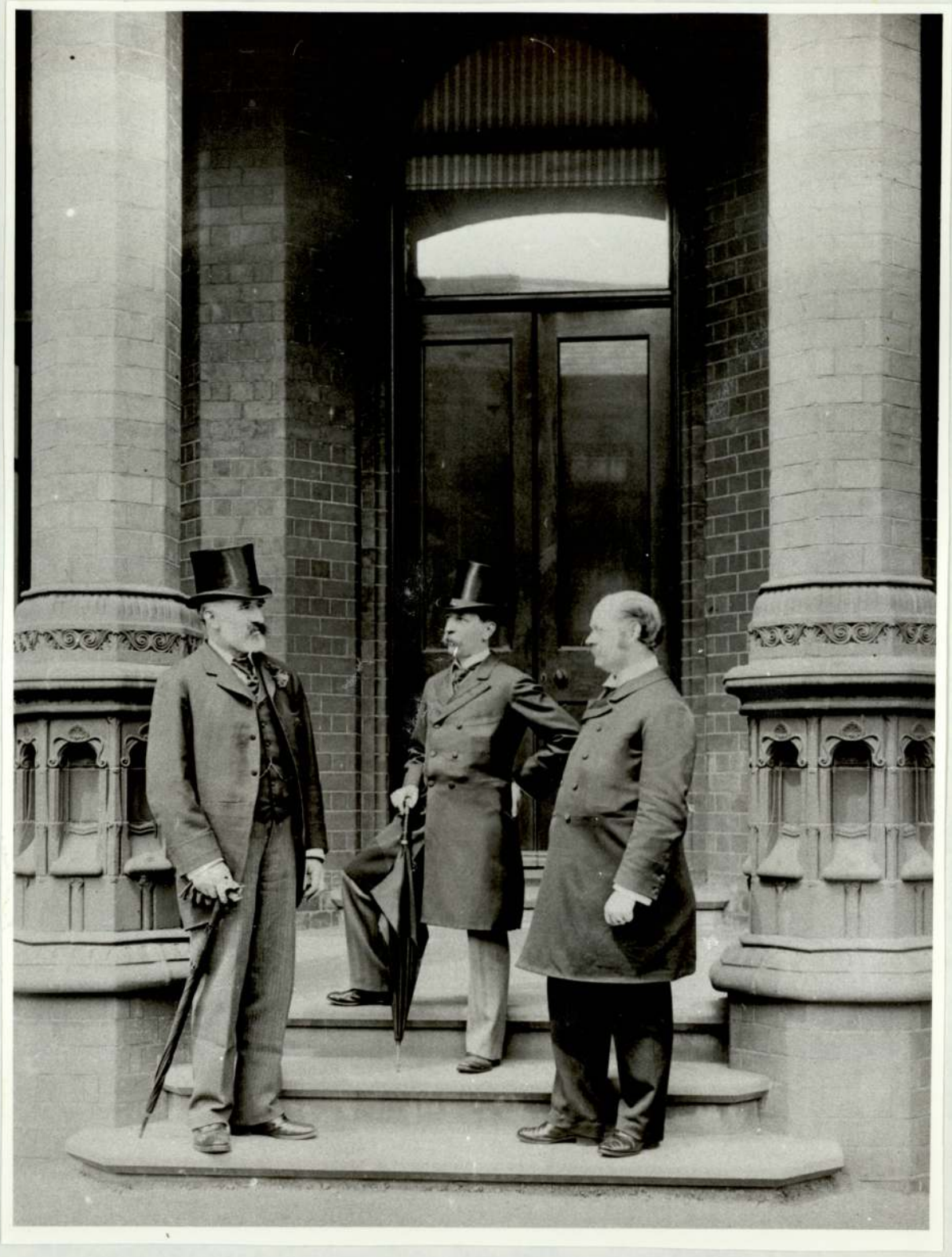
This thesis examines the career of the architect William Henman, F.R.I.B.A. (1846-1917) whose practice extended from 1871 until 1912. The introduction during this time of reinforced concrete and of mechanical services powered by electrical inventions made possible formal and stylistic changes in the design of large buildings. Henman's awareness of the potentiality of these innovations and his contribution as an inventor in these fields is demonstrated. His work as a pioneer architect, as designer of the Belfast Royal Victoria Hospital (1903) incorporating a controlled interior environment considered to be the first air-conditioned building to be constructed, is examined, together with the theories concerning ventilation and hospital design which moulded his design philosophy.

Henman's participation in contemporary social experiments such as the Garden City Movement, town-planning schemes, workmen's housing projects, and the Cottage Hospital Movement are included, and case studies of his principal civic buildings which reflect his practice methods and indicate stylistic changes during his career are added.

Architect
Hospitals
Ventilation
Inventions
Civic Buildings.

C O N T E N T S.

LIST OF ILLUSTRATIONS.



At the Birmingham General Hospital, 1897.

William Henman F.R.I.B.A.

The architect (centre) Sir John Holder, Building Committee Chairman (left) Howard J.Collins, House Governor (right).

P R E F A C E.

The achievements of provincially based architects during the Victorian and Edwardian years have tended to be overlooked. Accounts of changing architectural styles during those expansive years have concentrated largely on the famous names linked with London, where the concentration of wealth and patronage expressed in museums, monuments, government buildings and edifices of commercial aggrandisement provided the best opportunities for earning a national reputation. There were some notable exceptions such as Worthington of Manchester (1), Elmes of Liverpool (2) and Pilkington of Edinburgh (3), but the great names in architecture based in London tended to dominate the provincial field also. The spreading railway network carried them conveniently to the prosperous manufacturing centres keen to display evidence of commercial power by emulating the capital.

1. Thomas Worthington (1826-1909) Designer of Manchester Albert Memorial and Memorial Hall, 1864.
2. H. L. Elmes (1814-47) Architect of St. George's Hall, 1864.
3. F.T. Pilkington (1832-98) Designs for Churches in Edinburgh.

Well-known London practices were sometimes engaged in the supervision of a number of large buildings in various parts of the country at the same time. Sir George Gilbert Scott (4) for instance, whilst in the process of creating the Albert Memorial (1863-72) was supervising the completion of the Foreign Office in Whitehall, the designing of St. John's College Chapel, Cambridge, Leeds Infirmary, Glasgow University, the St. Pancras Hotel and St. Mary's Church Kensington. Other architects such as Alfred Waterhouse, having first achieved success in their home towns, proceeded then to enlarge their reputations and fortunes by gravitating to London. After designing the Assize Courts (1856) and Strangeways Gaol in Manchester (1866), Waterhouse transferred to Portland Place (5) from whence between 1867 and 1880 he designed such varied works as Balliol College, Oxford, Gonville and Caius College Cambridge, Owen's College, Manchester, Lime Street Station, Liverpool and town halls at Manchester, Reading and Knutsford and the Natural History Museum, London.

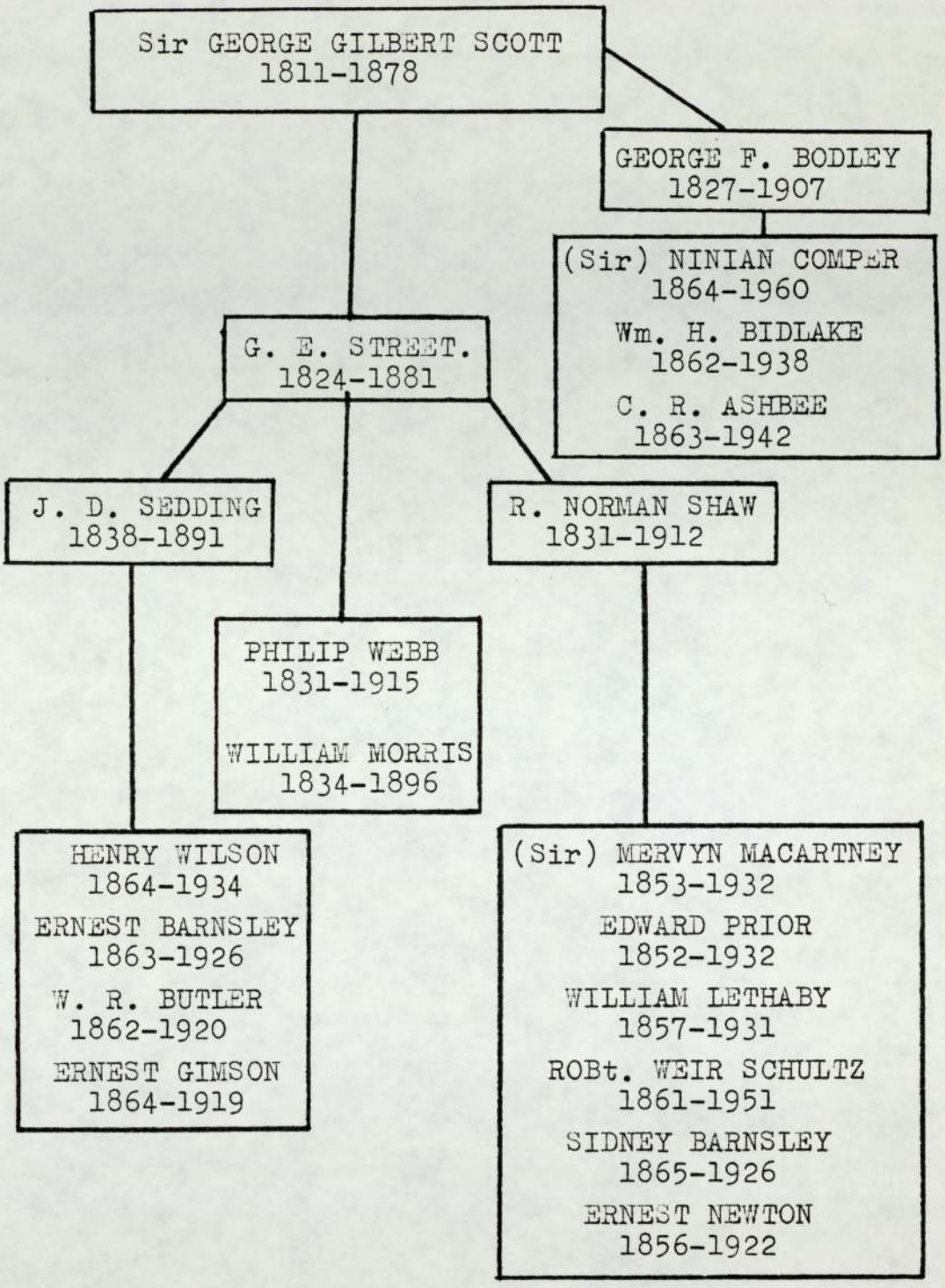
The dominance of London was also perpetuated by a system of architectural education based on private pupilage, sometimes following a family tradition, resulting in a London élite towards which young provincially-trained architects such as G. E. Street (6) from Winchester gravitated, who in turn attracted further talented assistants themselves. Street, having himself worked in the office of Sir G. G. Scott, was joined by (7) William Morris as a pupil and Philip Webb (8) as

4. Sir George Gilbert Scott (1811-78) R.I.B.A. President 1873-75. Knighted 1872.
5. No. 8 Cavendish Street, Portland Place.
6. G. E. Street (1824-81) R.I.B.A. President 1881 London Law Courts, 1877.
7. William Morris (1824-96) Founded the Kelmscott Press and Socialist League.
8. Philip Webb (1831-1915) Designed Red House for Morris 1859.

chief assistant, followed later by Norman Shaw (9). In this way, dynasties of talented designers, inspiring one another, emerged from focal London offices.

9. Richard Norman Shaw (1831-1912) Houses at Bedford Park 1877, New Scotland Yard, 1880.

An Architectural "Dynasty"



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These well-known names are representative of the stylistic stand points and changes taking place during those years : Gothicists followed by a generation of Arts and Crafts designers successfully liberating architecture from the artificialities they found deplorable in Victorian taste by the application of textures derived from the nature of local materials. At the same time that this pursuit of aesthetic satisfaction was in motion, other architects, at present lesser known, were involved in accepting the challenge offered by the technical resources then rapidly emerging.

William Henman F.R.I.B.A. was one such man, whose career is little known but whose achievements in the light of newly available evidence presented in this thesis may be regarded as a pioneer architect working within the contemporary surge of scientific development which led eventually to new constructional methods. These were governed by the introduction of mechanical services found necessary for the efficient functioning of large buildings, and which became architectural in the sense that the deployment of mechanical services such as heating, lighting, lifts and air-conditioning made possible new forms of buildings and gave rise to the Modern Movement in architecture (10).

From an examination of the career of William Henman evidence emerges that he may well have made a significant contribution to the development of heating and ventilating techniques, incorporating

10. As defined for instance in Pevsner's Pioneers of the Modern Movement.

them in the initial planning stage as an integral part of the design process in the creation of a building to fulfil specific human needs. The particular buildings to which he applied his philosophy of overall planning were large city hospitals, his greatest contribution being in one large project designed at the height of his maturity, having had during his early career considerable experience in the designing of smaller cottage hospitals in which the ancilliary services, where considered necessary, were added as an extra feature.

Henman moved against the accepted tide of professional ambition by leaving London, where his father had already established a successful practice, in order to pursue a career first in Middlesbrough (1871-79) and then for thirty three years in Birmingham (1879-1912). Perhaps this may have been a mistake. Certainly from a purely stylistic point of view it may appear that Henman's work no more deserves attention than the multiplicity of anonymous public buildings constructed in the manufacturing towns : that it may be placed only within the great quantity of city offices, hotels and warehouses which, nevertheless in the opinion of Sir John Summerson formed "the architecture of men who never came to much recognition as artists but who were, in fact, in the material sense, among the most effective practitioners of the time." (11)

Henman's effectiveness, which this thesis seeks to examine, emerges as his many-sided interests and abilities are revealed. As a student he won early

11. Summerson J. Victorian Architecture, Columbia, 1971, p.101.

recognition for his draughtsmanship, and in subsequent years his drawings were exhibited at the Royal Academy (12) yet these artistic merits were combined with an inventive mind which applied itself to engineering problems and to the invention of devices for reinforcing concrete during the introductory years of that material. His employment of cement and concrete strengthened by curved, light-weight metal armatures suggests that Henman was one of the earliest architects to demonstrate that concrete as a plastic material had aesthetic potentialities in addition to its structural value.

In posing the question of Henman's status as an innovatory architect in the widest sense, evidence also arises to show that his activities were not confirmed only to the practical aspects of his profession : that he was acutely aware of its social implications and that he deplored the segregation of architecture from the most pressing social problems of his day, namely better sanitation, the housing of low-wage workers in conditions of decency, land use in the confines of industrial cities, street planning with a regard for future development - all mundane problems which many of the architect - aestheticians considered beneath their attention. There is evidence to indicate from a detailed examination of Henman's public buildings still in constant use and serving the needs of large communities that his design philosophy was of a high order. His work displays his adherence to first principles; especially the principle that the basis of architectural design is the economical enclosure of space. Thus he became an expert on daily hospital

12. In particular his drawings of Birmingham General Hospital, 1897.

routine so as to exercise his ingenuity in devising plans for hospital wards to help doctors and nurses to perform their duties more efficiently and economically than before. His papers on hospital planning read to professional associations in London and many provincial centres indicate the thoroughness of his approach, and his hospital built at Belfast affords practical proof of his compact planning - so much so that after an interval of eighty years his controversial design rejected by many of his contemporaries has recently attracted a visit by the Department of Health and Social Security Low Energy Hospitals investigation team (13).

A scrutiny of the reports and correspondence indicating the strong opposition directed by established professional opinion at the time against Henman's initiative in the design and ventilating of hospitals poses the question of whether entrenched opinions, dismissing his ideas as unnecessary and expensive, were responsible for Henman's dismissal into comparative obscurity until recent years. Professor Reyner Banham's detailed appraisal of the Royal Victorial Hospital, Belfast (14) again raised the question of Henman's standing and competence - concerning which the present enquiry has provided evidence (15) to clarify the issue and to indicate that Henman's standpoint was not only justified but was remarkably forward looking. He anticipated many recent trends in hospital planning such as the need to allow for future expansion of

13. On 27th August, 1980.
14. Reyner Banham, The Architecture of the Well-tempered Environment, London, 1969.
15. Tovey J. Ventilating the Royal Victoria Hospital R.I.B.A. Journal, October, 1981

wards, flexibility of communication, reduction of staff walking distances and the combating of exterior pollution and noise.

Henman was born in 1846, during the height of Victorian faith in ordered progress. In the year that had seen the repeal of the Corn Laws, the first of a series of early Public Health Acts (16) destined to re-shape urban life and to provide opportunities for architects to improve it was passed. Within five years of his birth, the Great Exhibition had blazoned the age of iron and empire. This account will trace Henman's participation in the changing attitudes to architecture resulting from a vision of life enhanced by engineering inventiveness and how he applied his skills within the development of municipal administration from 1870 onwards in his designs for town halls, libraries, hospitals and schools.

In Portrait of an Age (17), G. M. Young declares "I had always been convinced that Victorianism was a myth, engendered by the long life of the sovereign and of her most illustrious subjects. I was continually told that Victorians did this, or Victorians thought that." Henman came from a middle class Victorian family and his career extended through Edwardian years which brought underlying shifts in opinions and architectural styles. He emerges as a thoughtful contemporary to all these, but to what extent he may have been capable, in some respects, of reaching

16. Baths and Washhouses Act, 1846
Town Improvements Clauses, 1847
Public Health Act, 1848.
17. Young G.M. Portrait of an Age, Oxford 1960, p.6.

beyond the accepted tenets of his day is a principal purpose of this enquiry. Discussion focusses on how the movement towards humanitarian principles gradually emerging during his career, absorbed his interest and directed his activities towards the Garden City and Cottage Hospital movements, to the detailed proposal of a self-help scheme for financing better working class housing offering to city artisans pride of personal ownership, and to an enlightened plan for a city scape in Birmingham by which, had he secured the political backing, the lives of its present day citizens might have been enhanced.

Failures came his way, and it is an essential element of this study to examine these in the light of the fiercely competitive nature of the architectural field which Henman entered in the provinces ; the opposition a newcomer needed to overcome both from the closely-guarded interests of locally established family practices and the power of the influential London firms. Under these circumstances, the anonymity of design authorship in architectural competitions was Henman's main protection. A review will also be made of Henman's family background, training, and his subsequent development as a practising architect, for he was, in Robert Kerr's terms, truly a "Latitudinarian" (18) and worked his way through a flux of styles which included a Gothic town hall, a terra-cotta hospital

18. Robert Kerr (1823-1904) presented a paper entitled "The Battle of the Styles" to the Architectural Association in 1860, in which he gave three categories of designers. Eclectic - the elder architects working in Neo-classical and Gothic, Ecclesiological - followers of Pugin, therefore Gothic, and Latitudinarian - the younger men who felt free to use any style.

with Renaissance features, several buildings in English Vernacular, and severely utilitarian structures such as the electric power station for Sir Alexander Kennedy (19).

A principal intention of this investigation is to establish that William Henman made an original and important contribution in the development of architectural design to accommodate the new methods of artificial ventilation entering into use after the introduction of the Plenum System by William Key (20) in 1889, from which modern systems of air-conditioning have developed. Henman was one of the small group of architects who valued the contribution of engineering expertise both to building construction and to the control of internal environment. Such partnership during a period of strongly authoritarian architects was a genuine departure. No ready-made statistics or tables of stress factors for concrete were available, whilst calculations concerning the ratios of air pressure to fan size and speed to provide the volume of air necessary for maintaining the health and well-being of hospital patients had to be made and carefully put to test.

A study of previous methods of heating and ventilation of large buildings has been thought necessary to the thesis in order to establish the starting points from which this departure took place, and to assess its significance. Henman's eight Patent Registrations (21), all of which are either applicable to mechanical or to sanitary engineering will also be examined, together with his design for a British

19. A principal figure in the early public electric supply schemes.
20. Glasgow engineer, inventor of the Plenum System of Ventilation.
21. See Chapter 6.

equivalent to the Eiffel Tower. An opportunity will be taken to show Henman's methods of working during his thirty three years in Birmingham. Unfortunately no records of Henman's practice survive and many of his plans for municipal buildings have been lost in local government re-organisation. Reliance has had to be placed on reports of committee meetings, newspaper accounts of official opening ceremonies, articles and correspondence in contemporary professional journals together with some recently discovered personal papers and extensive site visits with the object of examining design, structure and materials used.

Acknowledgements.

Some personal mementos in the form of private letters, apprenticeship and scholarship papers have been made available through the generous interest of Mr. Derek Wortley and the late Dr. Russell Wortley, grandsons of William Henman. Notebooks showing the working calculations done by Henry Lea C.E. at Belfast, owned by his grandson Mr. Donald Lea of Messrs Hoare, Lea and Partners, Consulting Engineers, were an essential source of information concerning the methods of working and the true authorship of the ventilation system. The honorary archivists at the Royal Victoria Hospital, Belfast and the General Hospital, Birmingham have provided valuable documentary evidence. Visits and enquiries have been allowed by hospital administrators, and by the chief librarians of the Birmingham Medical School, Middlesbrough, Stockton-on-Tees, and the Midland Libraries of Birmingham, Leamington, Redditch, Stratford-upon-Avon and Malvern.

The writer has a sincere obligation to place on record his thanks to Dr. Jennifer Tann who originated the lines of enquiry, provided essential academic guidance, and supervised with encouragement and understanding the various stages of the work.

CHAPTER 1.

a) Outline of Henman's Training.

b) Introductory Survey of his Professional Career.

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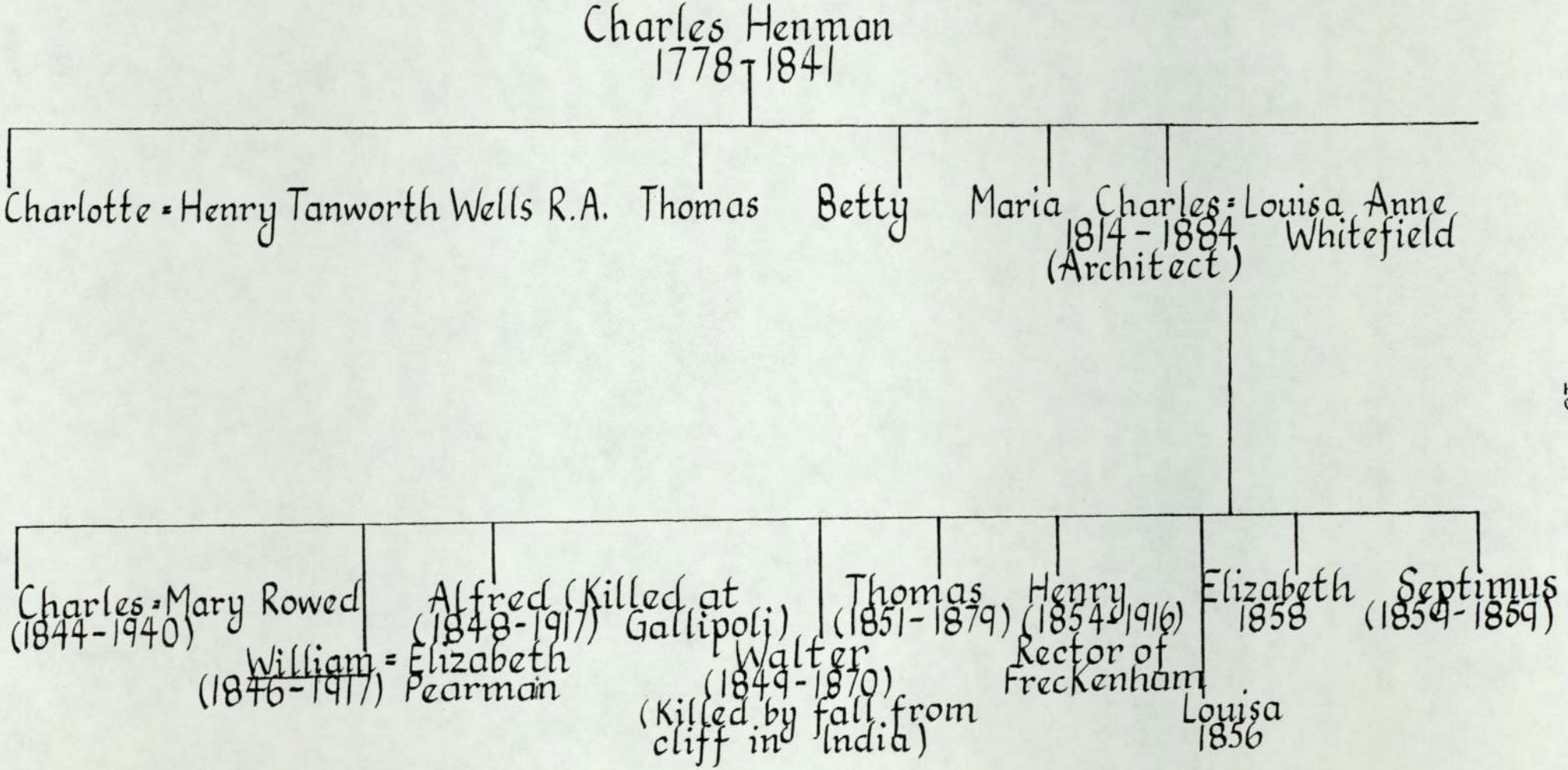
Charles Henman
1778 - 1841
Charlotte = Henry Tanworth Wells R.A.
Thomas
Betty
Maria
Charles = Louisa Anne Whitefield
1814 - 1884
(Architect)
Charles = Mary Rowed
(1844 - 1940)
William = Elizabeth Pearman
(1846 - 1917)
Alfred (Killed at Gallipoli)
(1848 - 1917)
Walter
(1849 - 1870)
(Killed by fall from cliff in India)
Thomas
(1851 - 1879)
Henry
(1854 - 1916)
Rector of Freckenham
Louisa
1856
Elizabeth
1858
Septimus
(1859 - 1859)

William Henman was born in Croydon on 29th August, 1846. He was a member of an old Kentish family from the neighbourhood of Biddenden, near Maidstone. His father, Charles Henman F.R.I.B.A. (1), a successful London architect, designed the Town Hall at Kingston-on-Thames (1840), prepared a design for the Embankment from London Bridge to Westminster, giving evidence to the Royal Commission on the subject, and was also one of the earliest architects accepted as associate of the R.I.B.A. after it received the Royal Charter in 1847. Charles Henman had seven sons and two daughters. His eldest son Charles trained as an architect in his father's office and in 1896 designed the Croydon Municipal Buildings, Law Courts and Library, eventually taking over his father's practice.

William Henman, the second son, began his apprenticeship to his father on 5th July, 1866, according to his Articles for training as "Civil Engineer, Surveyor and Architect". Both Charles and William won Pugin Travelling Scholarships awarded annually to students by the R.I.B.A. The Henman family had connections in contemporary artistic circles. A cousin of William Henman was the painter Henry Tanworth Wells, R.A. (2) whose sister was married to Henry Armstead R.A. (3), and whose daughter married Arthur Street (4).

For a period of seven years William Henman was a student at the Royal Academy of Art, receiving in

1. Ref. Biden W., History of Kingston, London 1852, p.65
2. Henry Tanworth Wells R.A. (1828-1903) until 1860 a miniature painter, then a successful portrait painter of distinguished Victorians.
3. Sculptor responsible for figures at the base of the Albert Memorial.
4. Arthur Edmund Street, (1855-1938) continued practice of his father G. E. Street.

1868 a certificate of proficiency in "Sculpture, Architecture, Anatomy and Perspective". By 1868 he had also won the Silver Medal of the R.I.B.A. for his set of drawings of the Church of St. Thomas, Winchelsea (5), submitted in open competition, and in the following year he gained valuable experience working in the office of F. Haytor Lewis F.S.A., Professor of Architecture at University College, London. On 21st February, 1871 Henman was elected Pugin Travelling Student for the year 1871 by the R.I.B.A. Council and used the opportunity to study ecclesiastical architecture (6), having been invited by Edmund Sharpe M.A. (7) to go to Lancaster and help to illustrate his books on Gothic Architecture, during which time Sharpe took him on architectural study excursions in England and France. Henman thus came under the influence of one of the principal Gothicists of the time. Edmund Sharpe (1809-1877) of Liverpool had been articled to Thomas Rickman (1776-1841) (8) who, in his Attempt to Discriminate the Styles of English Architecture, (1819) had introduced the terms "Early English", "Decorated" and "Perpendicular" to the vocabulary of architecture and had pioneered the use of iron in church structure and decoration. Edmund Sharpe's "Pot Churches" built in the Liverpool and Manchester area were noted for his use of terra-cotta decoration. The influence of Sharpe may be seen in Henman's early buildings, especially in the town hall at West Bromwich (1875) where his sensitive use of structural iron work and restrained application of terra-cotta decoration are

5. The auroral document signed by Seddon and Eastlake.
6. Henman W. Description of Pugin Tour, 1871 R.I.B.A. Library.
7. Edmund Sharpe (1809-77) Designer of terra-cotta "Pot Churches".
8. Thomas Rickman (1776-1841) Designer of "Commissioners' Churches".

particularly effective.

There is evidence to indicate that Sharpe was influential in arranging a professional opening for Henman in Middlesbrough which had experienced mushroom growth from a cluster of cottages in 1830 into a town of 40,000 sending its Member to Parliament in 1870. A letter from the architect's personal papers, written by Alfred Waterhouse discusses career prospects for Henman in partnership with J. W. Alexander of Stockton-on-Tees and Middlesbrough (9).

8, New Cavendish Street,
Portland Place. W.
9th February, 1871.

Dear Mr. Sharpe,

My acquaintance with Mr. Alexander is very slight, and of his business and professional skill I know absolutely nothing - certainly nothing in his disfavour.

I should suppose from what I have seen of Stockton and Middlesbrough that they were places so rapidly rising as to be good centres for enterprising young architects.

Hitherto I imagine one or two architects from Darlington have done far the greater part of the professional work there but Mr. Alexander informed me when he came the other day to ask my opinion of his commencing practice there that he had the promise of a house or two there, and if so I should imagine that he and W. Henman if they go into partnership have only to please their clients to get plenty more work.

Wishing them all success,

Alfred Waterhouse.

9. J. W. Alexander became an Associate of the R.I.B.A. in 1882.

Following the encouragement of two such well known men, the partnership then began at 96, High Street, Stockton-on-Tees. The Forster Education Act of 1870 establishing Board Schools provided opportunities for them to enter the competitive field to gain Local Authority commissions. By 1872 they had won the designing of Denmark Street School, Middlesbrough, though not before their original plans estimated at a cost of £7,000 had been modified to £5,000 for a school to accommodate a thousand children. In the same year they were successful and somewhat lucky, in winning the competition to design the Stockton Exchange Building (1873) to be situated in a prominent position in the High Street. The competition advertised in the Architectural Press (10), had a very limited response when the Stockton Exchange Company attempted to cover the Premium of £50 by charging the competitors ten shillings for each site plan copy. A substantial boycott to show professional displeasure left the field open for the enterprising local partnership. A second school, St. John's, Middlesbrough, followed in 1874 together with several commercial buildings in the area such as a large warehouse in Bishop Street, Stockton (1874), the restoration of churches at Norton, Yarm and Elton, a Savings Bank in Stockton and the new church of St. John at Stillington (1879).

The commission to restore Norton Church in 1876 which entailed the rebuilding of the aisles and nave, led to Henman's meeting with Thomas Wrightson of Norton Hall, who had begun his successful career as an engineer by apprenticeship in the Elswick works of

10. The Building News, 2nd August, 1872. p.10.

his cousin Lord Armstrong. Wrightson's firm specialised in bridges and piers, and was responsible for projects as far apart as Redcar Pier and the railway bridge over the Sutlej which is the subject of Kipling's story "The Bridge Builders" (11). Henman's interest in engineering was sharpened by this contact, and the first of his patent applications dates from 1876.

The Northern location did not deter the partnership from competing for work in more distant parts of the United Kingdom, public buildings and Board Schools being their main objectives. A degree of assistance was received from Charles Henman Senior; for an entry in The Builder announced that Messrs Alexander and Henman had been "appointed conjointly with Messrs Henman and Harrison of Bedford Row, London, to design and superintend the proposed school at Fratton Street, Portsmouth" (12), but during the following year Alexander and Henman secured for themselves the first premium to build two schools for the Llanelly School Board, at Aberdare and Brynmaur (1873) (13). The resolve to compete for work whatever the distance necessitated the removal of Henman to the more accessible centre of Birmingham in order to supervise projects. This was precipitated at an early stage in the partnership by a significant success in a Midlands competition, which led eventually to Henman's severance from J. W. Alexander and the establishment of a practice in Birmingham. First premium had been won for the design of the projected Town Hall at West Bromwich, adjudicated by Ewan Christian F.R.I.B.A. (1814-95) advisor to the Ecclesiastical Commission

11. Kipling R. Plain Tales from the Hills, London, 1888.
12. The Builder, 5th October, 1872 p.781
13. The Building News, 16th July, 1875 p.60

and R.I.B.A. President in 1884 (14). The design, in High Victorian Gothic Style, was by Henman alone and his presence became essential by 1872 when building began. He opened an office at 38, Bennetts Hill, Birmingham and although the partnership continued for a further seven years until 1879, the Midlands buildings were the sole responsibility of William Henman.

The Town Hall at West Bromwich took almost four years to complete from the tenders submitted in November, 1871 to the opening banquet in August 1875 given by Alderman Reuben Farley a Staffordshire Iron Master who was chairman of the Improvement Board. Although modest in scale, it provides a good example of restrained free treatment of the Gothic style, using pressed red bricks, terra-cotta and stone corner dressings. The interior makes ingenious use of cast iron to preserve lightness and space. It is here also that Henman's particular interest in the problem of heating and ventilation is demonstrated by rudimentary warm air ducting for short distances within the interior walls.

Henman's success at West Bromwich led to a commission to design the Local Board Offices and Public Library for the neighbouring authority of Handsworth. The appearance of this building is an indication of Henman's breadth of outlook in matters of design and his awareness of current trends in architectural movements emerging towards the end of the nineteenth century when, in an endeavour to find a new national style suitable for large public buildings, many younger architects were discarding Gothicism with its mediaeval overtones in favour of

14. Ewan Christian (1814-95) Designer of National Portrait Gallery, London.

experiments involving a mixture of English styles from Elizabethan to Queen Anne.

The Handsworth building is strongly Elizabethan, with balanced outline, a half-timbered clock tower, stone mullioned windows and tall Tudor chimneys. The layout proved practical and efficient : the library and board rooms occupying the two outer wings and administrative offices at the centre. The work was completed in 1878 and gave such satisfaction that the Handsworth Board later approached Henman to design a Technical School and an Electricity Power Station (15).

In the same year, the Local Board of Aston Manor, adjacent to Handsworth, initiated a competition, adjudicated by Waterhouse, for Public Offices and Library (16). Henman's winning design on this occasion further demonstrates his enthusiasm for essays in stylistic variation often emerging at that time from a re-appraisal of the great houses of Elizabethan and Jacobean times. In this instance, the proximity of the site to the Jacobean Aston Hall inspired Henman to design a successful blending of Baroque gables and Queen Anne fenestration within a neo-Jacobean outline (17).

During the progress of this work Henman severed his connection with J. W. Alexander (18) and on its completion was immediately engaged to design Gilstrap Library, Newark, Nottinghamshire (19), where once

15. Appendix 3.
16. Design illustrated in The Builder 4th October, 1879, but -
17. Financial restrictions caused considerable modification.
18. In 1888 J. W. Alexander emigrated to South Africa and joined the East Africa Exploration Syndicate, after which records at the British Architectural Library ceased.
19. In this project Henman was assisted by H. Beddoe of Birmingham.

again the site, on the Castle Green demanded sensitivity of treatment. The Library, standing close by the castle ruins, might have prompted a lesser architect to design in a Romantic manner, resulting in an architectural parody, but Henman's solution resulted in a sturdy, modest building in Elizabethan domestic style with just a hint of castellation over the main windows. The interior wall panelling and ceiling coffering in English Oak is well proportioned, and the library again indicates Henman's responsiveness to new trends in methods of heating and ventilation. In this case he chose the Gibb's system (20) of warm air supply through cast iron grills let into the wainscoting round the base of the walls.

Board School designing proceeded concurrently with Henman's work on civic buildings. A competition to build the Lower High Street School, Wednesbury (20), was won in 1879, and a second Board School in the High Street of Erdington, for Aston Manor School Board, adjudicated by E. R. Robson F.S.A. architect of the London School Board, was completed in 1884 (22).

An unusual commission occured in 1880 when John Corbett, the salt millionaire, of Chateau Impney, Worcestershire became interested in the prospect of developing the small town of Droitwich as a Midland Spa. He financed the building of the St. Andrew's Brine Baths designed by Henman as a focal point to the town. One large, heated saline pool and nine private bathrooms were accommodated in a single-storey half-timbered building to tone with the Tudor character of the town (23)

20. R. R. Gibbs, engineer of Liverpool, specialised particularly in steam pipe heating.
21. The Wednesbury Herald, 13th November, 1880.
22. The Builder, 10th May 1884 p.669.
23. The Builder, Obituary 4th May 1917. p.288.

An attempt to enter the field of ecclesiastical architecture in the Midlands was unsuccessful, although a design submitted by Henman and Beddoe published in The Builder on 7th July, 1883 was considered by professional opinion to have merited first premium (24). The competition was for "The Old Meeting Trust" Congregational Church, one of the Dissenters' churches in the line of descent from those destroyed by the mob during the Priestley Riots of 1791. Henman's solution, in the form of an octagonal nave with a centrally-placed pulpit was innovatory both from the point of view of his response to the requirements of congregational worship, and also for the advanced ventilation system which made ingenious use of the slender spire surmounting the octagonal base for the expulsion of foul air. Letters to the editor of The Builder (25) suggested that all had not been well concerning the adjudication. A church of Gothic character was chosen, and following this experience, apart from occasional church restoration Henman ceased to interest himself in this field of design.

Using the experience he had gained in constructing the Stockton Exchange Building, Henman naturally competed for opportunities to design for commercial sites in the centre of Birmingham. An ambitious scheme for a large Exchange Hall and complex of thirty shops to occupy an important site facing the Town Hall was submitted by Henman and Cooper in 1898. The design was published in The Builder of 25th June, but received second premium (26). The partnership was however successful in the designs for three large

24. See Chapter 8.
25. The Builder, 14th July 1883, p.63
26. The Builder, 29th Sept. 1900 p.270.
Essex, Nichol and Goodman won first premium.

city centre buildings : Nos. 85-87, Cornwall Street (1899), the Scottish Union and National Insurance Offices in Colmore Row (1902), and the Midland Hotel in New Street (1903) close to the railway station (27).

Henman's contact with projects in engineering, and in particular those connected with problems of ventilation and sanitation received national recognition when he was chosen to preside over the Architectural and Engineering Section of the Sanitary Congress in 1898 (28). In the same year, a further opportunity to exercise his understanding of engineering requirements occured when he was appointed to build an electric power station to provide power for domestic and street lighting in Handsworth (29). The engineering work was done by Sir Alexander Kennedy and Partner. Henman's effective planning for ease of fuel supply, compactness of boiler and generating rooms, and his provision for future expansion, indicated his grasp of the problems involved. Throughout his entire career Henman was working on various projects connected with some aspect of engineering applied to architecture, and a total of ten patent applications were made in his name between the years 1876 and 1911 (30).

No assessment of William Henman as a pioneer architect in the improvement of environmental control for large buildings can be made without reference to his work in hospital design. This led eventually to his employment of the Plenum System of ventilation and heating, as a result of which he was able to devise a new and more compact arrangement of the wards within a hospital lay-out to comply with the advantages offered by advances in environmental control.

27. Appendix 1.
28. The Architect 26th Aug. 1898 pp.25 and 234.
29. Plans of original building held at Birmingham Reference Library Local Studies Department.
30. Chapter 6.

Henman's vigorous pursuit at all times of competitive work early led him into the field of hospital design - an activity suited to his interest in the sanitory and engineering aspects of his profession, and one which continued across all the years of his career, his greatest achievement being the revolutionary design for the Royal Victoria Hospital at Belfast in 1903 (31). He gained his first experience in hospital work in the first year of his career when, as partner to J. W. Alexander, an enlargement of the Cottage Hospital at North Ormesby was undertaken - an important building in the history of the Cottage Hospital movement as it was only the second of its kind to be built in the Kingdom (32). Henman's subsequent contribution to the movement included designs for new cottage hospitals at Redditch (1893) Ramsey, Isle of Man (1905) and Malvern (1911), the latter containing in its construction concrete beams strengthened by expanded metal framework patented by Henman in 1906. A hospital commission followed soon after Henman's arrival in the Midlands when he competed successfully for the West Bromwich Infirmary, assessed by Yeoville Thomason (33) of Birmingham. This was a medium-sized hospital of 224 beds (34), which Henman designed on a "Pavilion Plan" layout of widely-spaced ward blocks. By the close of his career in 1912, he had made additions and alterations to eight hospitals (35), designed seven entirely new ones (36), had entered with merit competitions for several very large city hospitals including Manchester Royal Infirmary (1902, third premium) (37) and the

31. Chapter 5.
32. Chapter 2. The first Cottage Hospital was at Cranleigh, 1858.
33. Architect of Birmingham Council House, Museum and Art Gallery.
34. The Builder, 2nd April 1881 p.415.
35. } Detailed the chronological list of Henman's
36. } hospital works.
37. The Architect 6th July, 1902 p.31. Assessment by Burnett in The Builder 2nd April 1904 p.356.

Bristol Infirmary (1908, second premium) (38), had acted as assessor himself in hospital design competitions - for example, the Dental Hospital, Birmingham (1901) (39) and was chosen as assessor for the new buildings for the British Medical Association in the Strand, London (1907) (40).

Two large city-centre hospitals, at Birmingham and Belfast, stand as the essential achievement by which Henman's reputation in architectural history must be judged. At Birmingham in 1892 the competition was won when Henman was comparatively little known, but Waterhouse's assessment (41) praised the external appearance, the "very great knowledge and thought in respect of the sanitory details", and the effective layout, but there was nothing innovatory in this. The three three-storey ward blocks followed the generally accepted pavilion spacing to ensure as much "fresh" air as possible under city conditions. It was only after the competition had been won that the decision to incorporate William Key's Plenum Ventilation (42) was made. This created considerable problems of adaption for architect and engineer and it is clear from the difficulties encountered that Henman realised the importance of devising a new style of ward arrangement designed specifically for Plenum requirements.

His forward thinking was aided by the timely appearance of a letter to the editor of The Builder (43) entitled "On the Plan of Construction of Hospitals and Infirmaries" indicating that members of the

38.) Listed in the obituary, The Builder
39.} 4th May 1917 p.288.
40.)
41. The Architect, 11th March 1892 p.174
42. Chapter 4.
43. The Builder, 27th June, 1896, p.561.

medical profession were re-thinking the problem following the combined advantages of improvements in antiseptics and means of mechanical ventilation which could enable patients to be treated more safely in closer conditions of accommodation. The surgeon was arguing in favour of a return to the old "block" plan whereby rows of four or even six beds could be contained and thus the number of detached buildings be reduced.

Henman's reply, published within two weeks (44) dismissed any form of overcrowding in large wards, but advanced the alternative solution that normal wards could be placed side by side without need for open windows by utilising Plenum Ventilation, this reducing corridor communication and providing for patients' needs more efficiently. This letter was the source from which the new hospital at Belfast was derived. Henman's ideas were noted two years later by members of the hospital building committee whose experience of fan-assisted ventilation encountered in the construction of large ocean-going vessels, convinced them of the practical advantages, and Henman was invited to Belfast to demonstrate its feasibility (45). The hospital that resulted in 1903 takes its place as a pioneer building, not only in the sphere of hospital design but possibly as the inception of the first fully air-conditioned device in the world (46).

44. The Builder, 8th August, 1896 p.122.
45. Minutes of Royal Victoria Hospital Committee 29th November, 1898.
46. Reyner Banham. The Architecture of the well-tempered Environment London, 1969, p.82.

CHAPTER 2.

HENMAN'S WORK IN

THE COTTAGE HOSPITAL MOVEMENT.

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During the middle years of the nineteenth century there was a tendency to build hospitals with large long wards to fulfil the needs of nursing economy as advocated in Florence Nightingale's Notes on Hospitals 1863, (1), and also to provide thorough cross-ventilation from opposite windows in pavilion blocks - a trend fostered by Sir Douglas Galton's (2) widely read Healthy Hospitals, 1893, (3), and demonstrated visibly by Saxon Snell's (4) North Kensington Hospital (1879). Such ventures however were entirely the province of the larger cities and boroughs serving the needs of urban concentrations of patients, and possessing the necessary wealth and private philanthropy to provide them. In country areas, agricultural workers, when severely injured, or rural patients desperately ill, frequently died before reaching the nearest town infirmary or general hospital perhaps twenty miles away.

The Cottage Hospital Movement resulted from the combination of two important factors : urgent demand

1. Florence Nightingale. "A Sister can efficiently supervise, a night nurse can carefully watch, 32 beds in one ward; whereas with 32 beds in 4 wards this is impossible".
2. Douglas Strutt Galton 1822-1899. Born at Springhill, Birmingham. Engineered the raising of the Royal George, Spithead, 1842. Secretary of British Association for the Advancement of Science, 1871 to 1895. Knighted in the Queen's Jubilee honours of 1887.
3. Also, Galton D. Healthy Dwellings, Oxford, 1880.
4. Henry Saxon Snell (1830-1904) Assistant to Paxton and Tite.

which, for the first time, coincided with the presence in the countryside of a new generation of general practitioners trained in the large teaching hospitals, whose education was often equal to that of their colleagues in the towns. The First Medical Act (1858) had given doctors legal recognition and proper professional status, and the introduction of ether in 1846 followed by chloroform in 1847 had increased both the range and number of operations.

The first Cottage Hospital was the inspiration of a country G.P. Dr. Albert Napper of Cranleigh, Surrey (1858) (5). It was literally a cottage furnished with six beds "identical with the homes from which the patients are drawn, differing only in cleanliness, warmth, proper hygiene, and absence of overcrowding". The cottage hospital idea quickly spread as a result of magazine articles published in Good Words (6). The Builder (7) provided influential support and altered architectural attention.

Many cottage hospitals were small converted houses subsequently enlarged, but in the same year that Cranleigh was opened, the purpose-built North Ormesby Cottage Hospital, Middlesbrough, with twenty-eight beds was also built (8). The first of its kind in the North of England, it was this building, now well-known in medical history as the hospital where Sister Dora Pattison received her training before

5. MacCurrick H.J. Treatment of the Sick Poor in this Country. London, 1929. p.15.
6. Dr. Wynter wrote a series of articles for the magazine Good Wards, beginning 1st May, 1866.
7. Quoted Burdett H.C. Cottage Hospitals, London, 1896 p.11
8. Mauton J. Sister Dora, London 1977 p.163.

beginning her pioneering career at the cottage hospital in Walsall, that Alexander and Henman of Middlesbrough were engaged to enlarge in 1871.

Albert Napper founder of the movement, was a typical example of the new country practitioner. He had walked the wards of St. Thomas's, London before qualifying M.R.C.S., then spent a year at Edinburgh and also studied in Bonn (9). He moved to Cranleigh in 1854 where the vicar, the Rev. J. Sapte (10) saw him amputating a man's leg in a cottage with the help of the policeman and an old woman who promptly fainted. Napper discussed the project of a small hospital with the vicar, who gave an old cottage rent free which was adapted and extended for the cost of £50. The establishment consisted of a nurse, a cleaning woman and a local lady who "promised the benefit of her assistance in all special cases", one of the earliest being "a severe contusion of the thigh, having while intoxicated, fallen under the wheel of a wagon loaded with bricks". In 1864 Dr. Napper wrote a paper "On the Advantages of Cottage Hospitals to the Public and to the Profession" in which he analysed the first 500 cases treated at Cranleigh (11).

The advantages were greater than at first realised: patients were close to home and family, every doctor in the district had freedom of access to treat his patients when in hospital and to perform his own

9. McGonaghey R.M.S. Medical History, London 1967. p.131.
10. Obit. by Burdett in The Laucet, 1894, p.1153.
11. McGonaghey p.104.

operations - a service previously dominated by the hierarchy of consultants in the large city hospitals : the cottage hospitals were entirely the province of the local practitioners and were closely integrated with the community, supported by local subscribers, administered by committees of local gentry who made donations and left legacies. They improved the standards of treatment so that "the peasant's misfortune has been the means of saving the life of the squire" (12). The death rate in the cottage hospitals was proportionately lower than in the large London hospitals (13).

The North Ormesby Cottage Hospital originated from urgent necessity. In 1858, the boiler at a near-by iron works had exploded causing seventeen men and boys to be injured by blast and scalding steam. At that time Middlesbrough had no hospital and the nearest was at Newcastle 36 miles away. Help was sent for to Coatham, where a rich widow, Mrs. Theresa Newcomen had recently established an Anglican religious order for women inspired by the Oxford Movement, with herself in charge as "Mother Theresa" (14). At the convent was Sister Mary Jacques who, like Florence Nightingale, had spent several months in the Deaconess's Institution at Kaiserwerth near Dusseldorf. Arriving promptly at Middlesbrough, she tended the casualties in a hastily-rented cottage. The following year, Mother Theresa bought land in North Ormesby and provided funds for the building of the cottage hospital. The rate of

12. From a letter to The Times, 3rd January, 1866. Quoted by Burdett Cottage Hospitals, p.19
13. Pointer F. The Evolution of Hospitals in England, London 1964 p.218
14. Manton J. Sister Dora, p. 151

growth of Middlesbrough was so rapid that within ten years additions had been designed by Alexander and Henman (15).

By 1865 there were eighteen cottage hospitals (16). In the Midlands, the large house at Leamington (17) which Henman converted, adding a new ward, was typical of the better accommodation increasingly bequeathed by will as the movement gathered momentum. In 1859 the Borough of Walsall sent a donation to the support of the Birmingham General Hospital (18) : an annual sum which appears not to have been very substantial, for the Secretary responded, "The hospital authorities would thank the people of Walsall to send more money and less patients" (19). This goaded Walsall "to open our own hospital and shun Birmingham". On 12th October, 1863 the cottage hospital was opened (20) - with four beds to deal entirely with the numerous accidents of a busy mining and manufacturing town. The following year Sister Dora Pattison, who devoted her short eventful nursing career to the service of the Walsall poor, arrived from North Ormesby. A purpose-built hospital was eventually envisaged and she attracted public interest and donations by arranging an exhibition of the plans drawn by Charles Henman (21), father of William.

15. Annual Report 1875-76 North Ormesby Hospital. A new ward called the Alexander Brodie Cochrane Ward and other departments were added "through public liberality".
16. By 1880 the number had increased to 180 (Burdett p.17).
17. Royal Midland Home, Leamington
18. Williams F.W. History of Walsall, Walsall 1887 p.429.
19. Ibid. p. 430.
20. Accidents to a little girl with legs fractured in a coal mine, and a boy of 12 whose arm was torn off accelerated the decision. Ibid. p.429.
21. Charles Henman modestly described his plans as "of the Brick-o-logical Order" and was surprised at the response. (Walsall Cottage Hospital Building Committee Reports 1876-77 held by Walsall Group Hospital Management Committee Wednesbury Road, Walsall).

Funding the cottage hospitals so that properly trained nurses could receive adequate renumeration was partly solved by Napper's scheme to involve patients in contributing towards their own treatment. Paupers were admitted free, as at the town infirmaries : other patients were taken on payment of a weekly sum dependent on their circumstances. Thus Napper claimed that he "secured justice for the medical profession, and for the first time in England, put the hospital patient in the position of having the privilege of being able to pay something, however small, according to his means, for treatment he receives" (22).

22. Burdett H.C. Op. Cit. p.56.

THE MIDLAND HOME FOR INCURABLES.

Within the cottage hospital orbit but serving a different need was the house at Leamington which Henman, working in collaboration a colleague W. Hawley Lloyd, who was Secretary of the Birmingham Architectural Association, converted for use as a hospital for 26 patients in 1884 (23).

A spacious house called The Arboretum was bought for £6,950 as"a hospital specially set apart for the treatment of chronic and incurable diseased" available to patients from the surrounding Midland area (24).

Surgeon-General Ranking, formerly Chief Inspector of Government Hospitals in India took control of the medical side, and General Radcliffe much of the administration. Miss A. Ryland a wealthy patroness from Barford contributed £4000 (25), thus providing for the Ryland Ward added by the architects. When, in 1906 a further wing, the Radcliffe Ward was opened by Princess Louise, the title of the hospital was changed to The Royal Midland Home (26)

Although Hawley Lloyd was appointed honorary architect and served the hospital until 1923, Henman's friendly contact with General Radcliffe, whose work for the Cottage Hospital Movement in Warwickshire

23. Leamington Spa Courier, 8th June, 1898.
24. Leamington Week by Week, Magazine, 5th Jan.1885.
25. Typescript: A History of Royal Midland Home, A. J. Wilkins. (No date) property of Warwickshire Area Health Authority. Records Office,Stratford.
26. Ibid. p.3.

extended over more than twenty years, was maintained. A letter in the architect's personal collection (27) indicates that ten years after the Midland Home conversion Henman's services on the occasion of the official opening of the Birmingham General Hospital by Princess Christian, were appreciated.

Grafton House,
Milverton,
Leamington.

Dear Mr. Henman,

As General Radcliffe and I were unable to find you after leaving the Pavilion at the opening of the new General Hospital last Wednesday, I think I ought to write you a few lines to thank you for enabling us to get such a good view of the ceremony.

After seeing what the Birmingham people have done, I do not think we need despair of their some day realising the claims of the Home for Incurables on their generosity.

Again thanking you and congratulating you on your share in the day's success.

Yours very truly,

P. H. Tonchman (Hon. Sec.)

The comment was prompted by the fact that Birmingham patients were costing the Home £300 to £400 per year, whereas Birmingham subscriptions totalled only £80; a situation General Radcliffe was anxious to rectify (28).

27. The property of Mr. Derek Wortley, a grandson of Henman.
28. Wilkins op. cit. p.4

REDDITCH COTTAGE HOSPITAL.

Dr. Andrew Wynter, in his Village Hospitals serialised in Good Words mentions, "Redditch, Worcestershire, Cottage Hospital is in course of formation" (29) but although William Avery had put forward the idea in a letter to the Redditch Indicator in 1865 (30), the hospital was not built until much later. Even in 1887 when a public meeting called to mark the celebrations for Queen Victoria's Jubilee decided that "a Cottage Hospital would form a fitting permanent memorial" (31), the funds were still lacking until Edmund Smallwood, a wealthy needle manufacturer bequeathed £5,000 "for the building and endowing of a Cottage Hospital in Redditch" (32).

Subsequently his brother William Smallwood added a further £15,000 for a purpose-built hospital (33). In February 1893 The Architect announced, "Mr. William Henman has been successful in the competition for the Smallwood Hospital" (34).

A site was chosen in the centre of the town where some dilapidated cottages were demolished (35), but Henman's strongly vernacular design in red brick with

29. H. Page, A Record of Smallwood Hospital, Redditch p.2 located at Redditch Reference Library.
30. Redditch Indicator, 7th October, 1865.
31. The Needle District Almanack & Trades Directory, 1895. p.33. Redditch Reference Library Local Coll 362.11.
32. Ibid. p.33.
33. Redditch Indicator, 23rd July, 1892.
34. The Architect, 14th February, 1893 p.318.
35. The site selected on 22nd November, 1893 was at Church Green West.

stone copings and dressings still tones well with what now remains of the original Worcestershire town. Provision was made for 28 beds and space for enlargement - a characteristic feature of Henman's approach to hospital planning. Ventilation of the wards was provided by "the introduction of warmed fresh air, discharged over the fireplace, on the Galton principle, into the centre of the ward, and the extraction of the vitiated air is provided by the adjustment of special openings over every window" (36).

The opening ceremony, described in the Birmingham Daily Gazette of 28th May, 1895 reflects the pride of the needle town and also its macabre choice of music. "An occasion of popular rejoicing in the town. Choir boys sang the hymn 'Thou to Whom the Sick and Dying' while Mr. W. Henman handed Lady Windsor a suitably inscribed key with which her Ladyship opened the principal door of the hospital" (37). Austin Chamberlain M.P. was present and Lord and Lady Windsor were met by a procession consisting of the town band, management committee, friendly societies carrying banners and local cycling clubs.

36. The Needle District Almanack, 1895 p.2
37. See also Dr. Page's "Record of the Smallwood Hospital". The Redditch Indicator, 16th November, 1895.

MALVERN COTTAGE HOSPITAL.

Opened on 29th May, 1911, (38) Henman's design for an entirely new hospital incorporated several of his own inventions.

It was designed to replace the original cottage hospital at Newtown, a converted house deemed out of date. The Worcester Sauce partner, C. W. Perrins provided funds and an ideal site, overlooking Manor Park and commanding views of the Malvern Hills and surrounding country (39).

As the site was steeply sloping, it was possible to have two ground floors, so that the lower one accommodated the hospital kitchens store rooms and general offices while the floor above, still at ground level when approached from the rear elevation contained wards sufficient for 24 patients including a small ward for children. The wards were provided with balconies overlooking the park (40).

Although it was a small hospital, its equipment, following the advice of Henman fresh from his work at the Royal Victoria Hospital, Belfast, was very advanced, and included a well-lit operating theatre and the most recent X-Ray equipment.

A special feature of the building was that it had been designed to be fire proof : no timber or combustible material being incorporated in floor or roof construction. Henman used concrete beams

38. Serious cases had previously been taken to Worcester Infirmary. Countess Beauchamp performed the opening.
39. The Malvern Gazette, 2nd June, 1911
40. The Builder, 9th June, 1911

reinforced by metal skeletons designed and patented by himself. (Pat.6483 dated 30th August 1906) (41). The roof was supported by steel principals, the sloping surfaces covered with slates fastened direct to the reinforced concrete. The brick walls were faced with Cradley stone and Bath stone dressings. The floors throughout were of terrazzo paving.

In the thin partition walls, expanded metal skeletons for strengthening the cement and plaster was used. These metal ladder strips were also designed and patented by Henman (Pat.2569 20th Sept., 1906) and supplied by The Metal Ladder Tape Company Limited of Birmingham. The balconies outside the wards were entirely of reinforced concrete.

Heating was by hot water pipes throughout but in addition a special form of register fireplace also invented by the architect was included in each ward, the advantage being that when the register was closed it did not prevent the passage of air for the ventilation of the room. (Pat. 9768, 22nd April, 1911).

Malvern Cottage Hospital, showing split level site.

THE GUEST HOSPITAL, DUDLEY.

This was originally known as the Blind Asylum because it was intended by the Earl of Dudley to provide for the limestone miners blinded or maimed in workings owned by him. There was however, resistance by the workers to enter the hospital and be separated from their families, and the buildings therefore remained empty for six years (42).

In 1867 Joseph Guest, a rich ironmaster bequeathed £20,000 for the endowment of a hospital for Dudley and the Earl was glad to offer the vacant buildings for conversion.

In 1872 the hospital was opened with 60 beds and five "skilled" nurses (43). During the following twenty years improvements were made, but by 1890 a long-felt need (44) for modernisation and extension was realised.

Henman's additions were described as "the most marked since its foundation". They were completed and formally opened on Jubilee Day, 22nd June, 1897 (45). The extensions consisted of the enlargement of

42. Whitehead F. 'Dudley Guest Hospital, Birmingham Post, 21st June, 1980.
43. The Dudley Guardian, 28th October, 1871. W. Bourne of Dudley designed the original building.
44. Hurst H.R. The Guest Hospital, Dudley. Centenary brochure 1871-1971 p. 11 Dudley Health Authority.
45. Blocksidge's Almanack, Dudley 1898-1901, p.103

the Women's Ward from 24 to 31 beds, two smaller wards for special cases, a new operating room and a steam laundry. The extensions increased the total bed complement to 100 and the operating theatre was finished on the latest scientific principles of the day. Consideration was given to the provision of electric lighting but implementation was deferred until 1908 (46).

46. Hurst H.R. Op.Cit. p.24

STRATFORD UPON AVON COTTAGE HOSPITAL.

The Stratford Hospital was built in 1884, the gift to the town by the Bevington-Gibbins family of Ettington, Edward Mountford being the architect (47). By 1910 however, considerable extensions and improvements were needed to meet growing demands on the institution.

After William Henman had been consulted (48), a scheme was approved which provided an entirely new block, two storeys high, each containing five wards with bath and sanitary arrangements. Other work at the hospital consisted of the remodelling and refitting of sanitary annexes, the enlargement of the sterilizing room and dispensary, the provision of two consulting rooms and a new mortuary and post-mortem room.

Connecting corridors to the existing hospital building were provided and the whole of the heating apparatus and hot water supply was remodelled.

The new block, costing £2,450 was officially opened by Lady Jane Carleton on 18th October, 1911 (49).

47. E. W. Mountford (1855-1908) Designed Battersea Polytechnic (1891) Sheffield Town Hall (1897), Central Criminal Courts, Old Bailey (1906).
48. Minutes of 88th Annual General Meeting, Stratford Hospital para 10, held at Records Office, Henley Street, Stratford-upon-Avon.
49. Ibid "Building Alterations and Extensions".

This was the last of the hospital commissions undertaken by Henman, as he retired from practice in 1912, but other minor works which he had undertaken during his career included additions to the Infirmaries at Shrewsbury School and Malvern College (50).

50. At the foot of a handwritten list of hospital works by the architect. Possession of Derek Wortley, grandson.

CHAPTER 3.

THE EMERGENCE OF THE PRINCIPLES OF HEATING AND VENTILATION IN THE 18TH AND 19TH CENTURIES.

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Many distinguished scientists and engineers applied their energies to the imporvement of the interior environment of buildings. The achievements of Franklin, Lavoisier, Priestley, Boulton, Watt and Strutt form landmarks in the progression towards better ventilation, and it is necessary to examine the stage reached when William Henman, in collaboration with William Key, the engineer, made his own contribution towards the improved heating and ventilation of hospitals.

Very little scientific thought had been applied to the problem of heating prior to the beginning of the eighteenth century. The open fireplace with its attendant wastefulness and smokiness provided the normal means of interior warming. The domestic chimney, having first been introduced into Italian houses during the fourteenth century, provided a significant advance in ventilation since it also formed a ventilating shaft to expel used air. A further improvement was noted by Palladio in his Quattro Libri di Architettura of 1570, (1), when he demonstrated the advantage of the Lipped chimney in the elegant villas designed for Venetian noblemen. "Chimneys are made in the thickness of the wall. Some make the funnel crooked, that by this construction, and the force of the fire which drives the smoke upwards, smoke may be prevented from flowing back".

Little progress was made during the following century, but isolated experiments took place in the

1. Bernan W. History of the Art of Warming and Ventilation, London, 1845, p.131.

mansions of the rich. Prince Rupert suggested in 1678 a method by which the amount of heat entering the room could be increased and ventilation promoted. This was the ingle nook fireplace, in which "a wall is built ten inches from the back of the fire recess, carried up to the mantel and terminates at the ceiling" (2). A descending flue then conveyed the warmed air into the ingle nook.

In France at this time, Louis Savot described a fireplace he had seen fitted in a room in the Louvre (3). In this, air was drawn from near the floor and passed underneath the hearth and behind the grate where it was warmed by the fire. It then re-entered the room through a grill in the mantel piece, thus re-circulating the air already in the room. An air-warming fireplace in this simple form was developed under the name "Cheminée de Nancy", but it was limited to the treatment of the air within the room.

The first true "ventilating" fireplace which admitted fresh air from an external source for heating and circulating was invented by Nicholas Gauger in 1713. He published "La Méchanique de Feu" (4) describing a number of such constructions. This work attracted the attention of Dr. J. T. Desaguliers, a distinguished physicist of Oxford University (5).

2. Ibid p.208. Walter Bernan was a pen name for Robert Meikelham C.E.
3. Bedford T. Modern Principles of Ventilation and Heating, London, 1937 p.5.
4. Nicholas Gauger may have been a nom de plume for Cardinalde Polignac,according to Bernan Vo.2, p.1.
5. J. T. Desaguliers, born 1683 in New Rochelle.

He translated it in 1715 and it became an important source book in Britain, Dr. Desaguliers emerging as a key figure in the development of ventilation. He was of Huguenot birth and had been brought to England by his father following the revocation of the Edict of Nantes. By 1710 he had become a lecturer in Experimental Philosophy at Oxford with special emphasis on the physics of air and the effects of heat. He published Gauger's book under the title, Fires Improved, or A New Method of Building Chimneys so as to Prevent Their Smoking, in which a Small Fire Shall Warm a Room Much Better than a Large One Made in the Common Way. (6) The operation of the fireplace was described, "In the centre of the hearth recess a channel or cold air duct from four to six inches square is made under the hearth and carried outwards until it meets the open air : a trap door hinged to a metal frame beneath the fire regulates the air intake. Behind the fire are "CALIDUCTS" which carry the warmed air back into the room". The book also gives additional, and somewhat unusual uses to which the Gauger fireplace could be put. "By fixing a flexible tube to the aperture at which the warm air enters the room from the caliducts, it may be conveyed into a bed between the sheets and made to fall on any part of the body of a person reposing, and warm it in the gentlest manner imaginable" (7).

6. Billings J.S. Ventilation and Heating. New York 1893 p.27.
7. Bernan W. Op.Cit. p.8

Benjamin Franklin's "Pennsylvanian" stove of 1745 marked a distinct advance (8). He had an active interest in ventilation and combined the principle of Prince Rupert's descending flue with the caliducts of Gauger's device. His fireplace was developed from the cast-iron, wood-burning North American stove by fitting two flues, one for the ascending smoke and another for a descending current of air that became warmed by proximity to the up-cast, thus supplying warm fresh air to the room. Franklin reckoned with his stove to save 5/6ths of the fuel otherwise needed to heat a room, but it is suspected that to achieve such spectacular saving he must have reduced ventilation to a minimum. Iron closed stoves in their simplest form had been invented in Russia (9) and widely used in the colder countries of Europe where, in severe winters their greater output of heat, delivered directly into the room, was a significant improvement on the open fire, but in Britain there was considerable distrust concerning their use. Dr. Neil Arnott, Physician to Queen Victoria and the inventor of an improved stove which he called the "Thermometer Stove" (10) declared that "the heated surface of the iron acts upon air in contact with it, which acquires a burnt and often sulphurous smell - Englishmen unaccustomed to it cannot bear it : giddiness, stupor, loss of appetite, ophthalmia have resulted". When iron stoves, from which the smoke was ingeniously sucked downwards under

8. Dufton A.F. Early Application of Engineering to the Warming of Buildings. Trans. Newcomen Soc. 1940-41, Vol.21, p.3
9. Arnott N. Warming and Ventilating, London 1838, p.29
10. Ibid. p.36

the floor, were installed in the Bank of England building, they had to be removed in 1787 because the employees claimed that the air in the room was not changed and purified as it would be by a fireplace, and all suffered from "the iron cough". Dr. Desaguliers carried out experiments to prove that the air from iron caliducts was not unhealthy. He passed the hot air to a cage containing a linnet. His first experiment was successful. The bird "was as brisk and as lively as a linnet could be". Unfortunately, for a repeat experiment the Doctor used a fire which was burning charcoal to prove that the complaint of "burnt air" was unfounded, and "the bird put into this air died in a moment, and a lighted candle was immediately extinguished" (11). These findings were made public by a Mr. Worster and so there spread the widely-held impression that "burning the air destroyed the vivifying spirit which it contained"(12). Later, Thomas Tredgold a noted engineer who in 1824 issued a valuable guidebook, Principles of Warming and Ventilating (13) wrote, "Dry heat up to 212° F will not injure anyone, but a higher degree produces "burnt air". At this stage of thought, the key to the real difficulty, namely relative humidity, had not yet been realised. Most people held firmly to the view that the unpleasant sensations felt in a crowded room were due entirely to excessive warmth, but Gauger's Méchanique de Feu had pointed to the want of ventilation combined with inequalities of

11. Billings J.S. Op.Cit. p.30
12. Ibid p.30
13. Tredgold T. Principles of Warming and Ventilating London, 1836, p.44.

temperature within the room. Lavoisier claimed that the source of discomfort was the presence of Carbon Dioxide and this was also a widely-held belief for many years, followed by Pettenkofer's experiments in 1862 (14) which enlarged the list of poisonous substances supposedly present in expired air. Thus the Victorians became obsessed with the concept of "vitiated air", the presence of "Carbonic Acid Gas" as a by-product of breathing, and with its dangers to health.

Gas lighting, although superior to other forms of artificial illumination at the time, added greatly to the problem by increasing the heat and the carbon dioxide content of the air, particularly before the introduction of Welsbach's incandescent mantle. Dr. Scurfield, the Medical Officer of Sheffield, stated in a paper reported in The Builder (15) that "an average human being gives off 6 cubic feet of carbonic acid per hour. Gas light burns 3 cubic feet of gas per hour but it forms more carbonic acid gas than that given off by two persons". This dilemma was emphasised by Florence Nightingale in her Notes on Nursing (16) under the heading "Ventilation and Warming". She points out the absurdity of airing a sick room from a passage "through the door, near to which were two lights, each of which consumes as much air as eleven men".

Army barrack rooms and the wards of military hospitals provided a ready-made source for scientific

14. Billings J.S. Op.Cit. p.153
15. The Builder, 20th January, 1906 p.66
16. Nightingale F. Notes on Nursing. London 1859 p.42.

experiments. The conditions of overcrowding within them were often scandalous, furthermore when in 1856 it had been realised that the casualties during the Crimean War had been caused more by spread of disease than by combat, Parliament ordered an enquiry into the living conditions in barrack rooms. The Report of the Commissioners of the Board of Health on The Warming and Ventilation of Buildings (17) ordered by the House of Commons was published on 25th August, 1857 and recommended that a breathing space of 15 to 20 cubic feet was necessary for the health of any person in a multi-occupied room, yet the Report also states that at Wellington Barracks, where sixteen men were accommodated in each barrack room measuring only 33 feet by 20 feet and 10 feet high, "living and breathing in such an atmosphere, impregnated with impurities of putrificient bodies or the effluvia proceeding from the lungs of so many persons in such small a space is quite sufficient to account for the unhealthy state of the Army" (18). As an example of what could be accomplished, the Report states, "The Victoria Hospital for Soldiers recently erected at Netley, Southampton is an example showing the attention paid to ample space for respiration". However, The Builder (19) commented that as the windows were placed only on one wall of the wards, many patients could still die from lack of ventilation.

At this time, a Captain from the Royal Engineers, Douglas Galton, made a valuable contribution by

17. Breathing space meant change of air in cubic feet per person per hour.

17. Ritchie R. A Treatise on Ventilation, London 1862 p.97
18. Ibid p.98
19. The Builder 8th July, 1854

inventing a self-ventilating stove which became widely used in barracks and hospital wards throughout the country(20). It was also adopted by the French, and General Morin considered it the safest and best method of heating produced so far in the century (21). Galton had descended from a famous family of Birmingham gunmakers, his great grandfather, Samuel Galton being a member of the Lunar Society (22). Douglas Galton showed considerable scientific prowess even at the age of twenty when in 1842 he was chosen to solve the problem of how to clear the wreck of the Royal George from the channel at Spithead. This he did by means of an underwater explosion, the first time that dynamite had been detonated by an electric charge. Galton's fireplace and stove were refinements of the Gauger and Franklin principles. Fresh air was admitted to a chamber at the back of the grate, moderately warmed by a large heating surface, then carried by a flue, adjacent to the smoke flue, to an outlet in the upper part of the room. The body of the stove was of iron but lined with fire clay to avoid "burnt air", the giving off surface being about 18 square feet. Another form of the stove which Galton installed in the wards of the Herbert Royal Military Hospital, Woolwich in 1860 (23), was designed to stand in the centre of the ward, the metal chimney suitably encased passing beneath the floor was enclosed within a duct which admitted fresh air to be warmed by the stove,

20. Marks P.L. Ventilation and Air Conditioning London 1938 p.33
21. Galton D. Health Hospitals, Oxford 1893, p.160
22. Galton F. Memories of my Life, London 1908, p.4. Sir Francis Galton was cousin to Sir Douglas Galton.
23. Galton D.Op.Cit. p.109

thus utilising an extra 36 foot length of heating surface. Galton stoves became widely used in hospitals as an efficient and safe method of circulating as well as warming the air. They were used in the experiment at Wellington Barracks in 1857 (24) when the fresh air was fed to the stove in the centre of the room by wooden conduits under the floor and caliducts at the back of the grate conveyed the warm air to slots near the ceiling. Two deficiencies were noted however, "when the fire goes out at night, the cold air enters", and an earlier Report of 1835 had indicated that "the atmospheric air should be received into a chamber of preparation at the basement from a locality where air was entirely free from damp or smells of any kind" (25).

The Ascending or Descending Controversy.

Before an efficient system of ventilation could be effected, it was necessary to determine the direction taken by the "vitiated" air caused by respiration and gas light. Since the "Carbonic Acid Gas" was heavier than air, did it rise when warm or fall? The positioning of wall ventilators and ducts for inlet and outlet clearly depended on the solution to the direction of air flow. Thomas Tredgold was quite certain that "the heavy gas (Carbonic Acid) will be so mixed with azotic gas and vapour, both of which are lighter than air that the combination must ascend and occupy the upper part of the room. Hence the ceiling of the apartment is the proper place for the outlet. Spaces for admitting fresh air should be near the floor and should be nearly of the same size" (26).

24. Galton stoves were made by Yates and Haywood of London and ordered in quantity by the War Office.
25. Ritchie. Op.Cit. p.77
26. Tredgold Op.Cit. p.73

This view was supported by Dr. David Boswell Reid, a Scottish physician and lecturer in Chemistry at Edinburgh University, who became a leading authority on ventilation. In 1844 he published his observations in a widely-used book Illustrations of the Theory and Practice of Ventilation (27). He considered that ventilation had social consequences - "The habits of men are greatly influenced by the state of their dwellings. Its effect can be to make them sober and industrious or perhaps the reverse. It has long been observed that vitiated air greatly increases the tendency to intemperance. All rational means should be adopted to improve the dwellings of the labouring classes" (28). Dr. Reid thought that not less than ten cubic feet of air should be changed per minute per person in a room, and added, "as a general rule, vitiated air collects above in any apartment more than below. An ascending movement should be given accordingly to the air as it enters, so that when it has come into contact with the ventilating system, it may be propelled onwards. I have had several trials with descending atmosphere, but this is not desirable. It is a common error to suppose that as Carbonic Acid is a heavy gas the air vitiated by respiration and combustion tends to descend to the floor" (29).

The hazards of breathing vitiated air were not confined to the labouring classes alone. A report

27. Reid D.B. Illustrations of the Theory and Practice of Ventilation, London 1844 p. 108.
28. Ibid. p.60
29. Ibid. p.78

by Dr. Gavin Milroy from "The Lancet" of May 1859 (30) states, "On one occasion I saw a clergyman half stifled by preaching in a pulpit where the windows were unusually low and the pulpit very high : his head was above the level of the tops of the windows so that the air he breathed was only the respired air of the congregation below".

Despite these examples, the view that used air should be extracted at ceiling level was not held by all experts. Experiments in the design of prisons, where acute problems in ventilation concerning large numbers of men confined in small cells enclosed within an outer case, had led to the opposite principle of ventilation to be adopted. In the Prison Reports of 1844 (31) plans were devised for fresh air to be introduced into the cells at ceiling level and foul air drawn off near the floor. Many prisons were built according to this plan, as for instance in the "Model" prison at Pentonville (1842) built by Joshuah Jebb, who also received architectural advice on this project from Charles Barry (32).

Soon afterwards the original opinion prevailed, and when new blocks of cells were added to some of the prisons, as for instance at Perth Penitentiary designed by Dr. Reid, the ascending principle of ventilation with extraction vents at ceiling level was followed. This also happened at Pentonville (33).

30. Quoted by Ritchie p.81
31. Prison Reports 1844-1847. Quoted by Ritchie p.84.
32. Ritchie R. Op.Cit. p.84
33. Ibid. p.86

The suffering of prisoners and soldiers having contributed to the solution of the direction of air flow, the admission of air at floor level still posed problems. If allowed to enter through gratings in the floor, these became receptacles for dust and debris from sweeping, which could contaminate the incoming air. Robert Ritchie found a further objection : "Cold air openings in winter are highly injurious. In a closed school room lately built, where cold air was admitted from gratings in the floor, the teachers, both male and female suffered from swelling of the legs" (34). He advised as a solution to this problem that the skirting or dado round the walls of rooms was the most convenient position for the admission and diffusion of the incoming air. The inlet could be concealed by means of an ornamental trellis or perforated pattern, thus forming "breathing walls" (35). This device appealed greatly to architects and heating engineers. Similar ornamental features were designed to cover the outlet ducts at ceiling level, and a form of control to regulate the release of the used air to prevent strong draughts was invented by Thomas Tredgold (36). A pulley worked on a plug which could close or regulate the opening of the main outlet at the top of the building similar in principle to the method by which the Romans regulated the temperature of the Laconicum.

In an effort to assist ventilation but also to avoid draughts, an abundance of patent inlet and

34. Ibid. p.102
35. Used by Henman in the Gilstrap Library, Newark.
36. Tredgold T. Op.Cit p.73

outlet ventilators were designed, most of which were of little practical value, but Tobin's inlet tubes (37), fitted to the interior walls of a room, effectively admitted fresh air and directed it in a gently ascending current. These were widely used, but less successful were the outlet ventilating cowls fitted at the highest point of the buildings. Robert Boyle, engineer of Glasgow and London, made strong claims for his revolving ventilator cowls (38) which, he stated could maintain an air current through a building of 700 cubic feet per minute. These were installed in such well-known buildings as Caius College, Cambridge (by Alfred Waterhouse), the Guildhall, London, and also the Mormon Tabernacle, Salt Lake City (1889) (39), but Boyle's claim to have invented "the most efficient ventilator in the world" (patented 1882) was exaggerated and was exposed by an event called "The Kew Farce" by The Architect in 1889 (40). In the previous year, a series of experiments were made at the Royal Observatory, Kew, on various ventilating exhaust cowls by a committee of the Sanitory Institute which included Sir Douglas Galton. Four upright iron tubes, twelve feet long and projecting two feet above the roof of Kew Observatory were used. Three had patent cowls attached and one was left open and free. The sub-committee found that "none of the exhaust cowls cause a more rapid current of air than prevails

37. Billings J. Op.Cit. p.258
38. The Architect, 9th June, 1879 p.383.
39. The Architect, 7th July, 1889 p.70
40. The Architect, 9th September, 1889 p.366

in an open pipe under similar conditions, but without any cowl fitted on it" (41).

Thomas Tredgold had shown that "natural" or "self-acting" ventilation depending only on the forces of convection would be ineffective during gloomy, still, and windless days regardless of the use of cowls, and "The most difficult season for ventilation is the summer when the difference between inner and outer temperature does not exceed 10 degrees. In close and gloomy weather spontaneous ventilation is impossible for it works by producing a current of air, but if external air is still, saturated and the same temperature as internal air, no current for ventilation occurs" (42).

It was apparent therefore that in order to ventilate large buildings which were intended to accommodate many persons, some form of forced ventilation would have to be used. The only known sources of practical experience in this field of ventilation at that time were to be found in mines and in the holds of ships sailing through equatorial waters. As early as 1655, the Transactions of the Royal Society, London, (43) recorded that Sir Robert Moray had described how fire heat was applied at the mines at Liège. "A fire cradle placed within a chimney 30 feet high created air currents". By 1842, in concern for greater safety, John Murray gave evidence before the House of Commons Select Committee on Accidents in Mines and Employment of Children (44), in which he urged improvements by

41. Billings J. Op.Cit. p.282
42. Tredgold T. Op.Cit. p.75
43. Ritchie R. Op.Cit. p.119
44. Quoted by Ritchie p.130

using "a system of tubes, one to carry heated air from the mine interior and one to bring down a current of fresh air". An adaption of mining ventilation was used in large buildings as a means of creating a strong up-cast current to draw a quantity of fresh air by ducts through the interior. William Strutt of Derby and his engineer, Charles Sylvester (45) were particularly influential in the furtherance of this technique, Dr. Reid used it to ventilate the Perth Penitentiary, and it was applied on several occasions in the attempts to ventilate the Houses of Parliament (46).

The experiments carried out in the interior of the Houses of Parliament provide a case study valuable for its indication of the various problems faced at the time and methods applied to resolve them. That an account of these was studied by Henman is known from pencilled marginal comments in his personal copy of Ventilation and Heating (1893) (47) an authoritative text on the subject from both theoretical and practical standpoints written by Surgeon-General John S. Billings of the U.S. Army, who held doctorates of Edinburgh, Harvard and Oxford Universities. He had carried out extensive experiments and tests to determine the amount of "turbidity" in the air of rooms as a result of human occupation. Turbidity was defined as the presence of excessive quantities of carbon dioxide and also "watery vapour from the respiration of individuals, their perspiration, the burning of candles etc., organic matter and ammonia.

45. Egerton M. C. William Strutt's Heating System. Annals of Science Vol.24 London 1968 p.73
46. Billings J. Op.Cit. p.29
47. In the possession of his grandson Mr. D. Wortley.

This organic matter consists of epithelium and molecular and cellular matter" (48).

In establishing a theoretical basis for the study of ventilation, atmospheric conditions had first to be defined in scientific terms. Professor J. S. Haldane's experiments (49) provided a starting point by suggesting that the proportion of CO_2 present at a given time in the air could be taken as a sufficient index of vitiation. Thus the standard for the measurement of turbidity was determined by comparison between the amount of CO_2 in 10,000 "parts of air" in doors, taken by simple lime-water tests, and the amount taken from a similar sample in air measured out of doors. The problem first of all was to determine a norm for the "fresh" air CO_2 content. In the open country only 3 to 4 parts of CO_2 per 10,000 parts of air were found to be present, but in the towns much larger quantities accumulated - 6.8 parts were measured in confined streets in Manchester and as much as 14 in 10,000 volumes of air taken in a dense London fog (50). In good weather it was noted that there was an average of 3.8 parts in the streets of London as compared with 3.0 in the parks. Eventually 4 parts CO_2 per 10,000 of air was assumed to be the standard amount of CO_2 for outdoor content.

Concerning indoor content, Dr. de Chaumont's experiments (51), made in barracks and hospitals,

48. Billings Op.Cit. p.39
49. John Scott Haldane (1860-1936) whose researches led to improvements in public health and industrial safety.
50. Galton D. Op.Cit. p.62
51. Quoted by Billings p.117. From the Proceedings of the Royal Society of London, Vol.25 pp 76-77.

indicated that when, as a product of respiration, the proportion of CO_2 per 10,000 parts of air rose to 6 or 7 parts, "a faint, musty odour is usually perceptible". His investigations showed that if one man occupied a breathing space of 1,000 cubic feet for one hour with no change of air, 0.6 cubic feet of CO_2 would be present and that 3,000 cubic feet of "fresh" air per subsequent hour would be needed to maintain normal ventilation. De Chaumont's further experiments led him to the conclusion that it would be difficult to effect by natural means a change of air in a room more frequently than six times per hour and that this would normally cause a sensation of draught : a limit of three complete changes of air per hour per 1,000 cubic feet would be preferable, Professor Faraday having demonstrated that an air velocity of two feet per second would not be perceptible provided that the intake of air was through properly arranged inlets (52).

Moisture in the air and its bearing on ventilation was also investigated scientifically, though it is perhaps surprising that the subject remained for so long unresolved by the Victorians in practical terms, considering that some degree of humidity control had long been of constant daily concern in the cotton mills. Eventually, as is frequently the case, the needs of industry became instrumental in providing indications for wider application. De Chaumont's experiments showed that air loaded with moisture transmitted more heat per unit of time than air when dry. He showed that an increase of one per cent of humidity had as much influence on the condition of air space as a rise of 4.18 degrees Fahrenheit of

52. The Builder, 20th January 1906 p.66

temperature. He advocated regular readings of wet and dry thermometers in hospital wards, a difference of not less than 4 degrees at a room temperature of 62° - 67°F between wet and dry bulbs being the best to maintain human comfort, but how to effect accurate regulation by mechanical means was beyond the technology of the time.

The scientific principles governing the power necessary to promote the movement of air as a means of controlling forced ventilation were also examined. Problems related to air currents produced by the expansion of air by heat in up-cast chimneys were readily solved in theory (53). The volume of air passing through the chimney at a given time was simply a matter of taking anemometer readings of the air velocity at a given point and measuring the cross-section of the flue. The formula $A = \frac{Q}{V}$ provided an initial assessment, (where A = the area in sq. feet, V = the velocity in ft. per second, and Q = Volume in cubic feet discharged per second), but modifying factors such as friction, angles in flues, eddies, height of chimney and the laws governing the expansion of gases also received scientific enquiry. The application of high pressure steam heat for the purpose of accelerating the movement of air was investigated by Professor W. P. Trowbridge of Columbia University who published formulae for calculating the external area of steam pipe coils needed to produce an air flow of five feet per second -

53. Galton D. Op.Cit. p.84

a velocity accepted as a norm for ventilating most buildings. His paper, "Rival Systems of Heating" reprinted in The Architect (54) mentions the new term "radiator" and "indirect radiation" as the method by which air heated over steam coils was conducted by flues to rooms. He also made a comment of particular significance : "It should be a fundamental principle of architecture that the first problem to be studied after the general design of a building is determined is the proper positions of heating and ventilating appliances for the structure as a whole and for each room in particular".

This maxim, although intended to alert designers to the inseparability of form and function, had been well understood and acted upon far more than a century earlier by a small band of enlightened and progressive factory and mill owners who faced the difficulties of securing internal conditions suitable for manufacture. Three methods of heating and ventilation, namely by steam, hot air cockle and by hot water all received trials at industrial locations, some of which provided pioneering data.

Heating by Steam.

Mill owners such as Bage of Shrewsbury and Lee of Salford (55), in close collaboration with their engineers, explored the use of steam for heating and humidity control to prevent warp breakages. Steam

54. The Architect, 3rd July, 1884. p.20
55. Collins P. Changing Ideals in Architecture 1750-1950. London 1965, p.237

heat was closely allied to the problem of fire prevention. It had several advantages in this respect : the furnace fire could be sited in a boiler house apart from the main building, and considerable economy followed when steam power required to drive mill machinery could be channelled into heating. According to Tredgold (56), one cubic foot of boiler space could heat two thousand cubic feet of cotton mill space at the high and humid atmosphere of 70° - 80° F. and Boulton and Watt calculated that 14 pounds of good Newcastle coal produced one horse power - which was capable of warming fifty thousand cubic feet of space. (57)

The idea of warming rooms by steam was first suggested by Colonel William Cook and reported in the Philosophical Transactions of 1745 (58), but no practical application was attempted until the winter of 1784 when James Watt used steam to heat his study (59). The room was 18 feet by 14 feet and he fitted a box made of tin plate 3½ feet by 2½ feet near to the floor. The box was supplied by steam from a boiler in the basement and fitted with a valve to release air together with a return pipe for the condensed steam. He was disappointed to find that the box did not radiate the amount of heat he had expected. The solution to this problem had to wait until 1801 when Professor (later, Sir John) Leslie (60) investigated the properties of radiating

56. Tredgold T. Op.Cit. p.167
57. Buchanan R. Essay on the Warming of Mills and Other Buildings by Steam. Glasgow 1809 p.10.
58. Quoted by Tredgold p.11 from Philosophical Transactions 1745 Vol.43 p.370.
59. Bernan W. Op.Cit. p.241
60. Dufton A.F. Early Application of Engineering to the Warming of Buildings. Paper read to the Institution of Civil Engineers, London 12th Feb.1941.

surfaces, proving that black paint increased the amount of heat emitted, and Henry Houldsworth showed that cast iron was better than copper or tin plate.

In 1799 Matthew Boulton also heated a room in his house at Soho, Birmingham by steam (61). Ducts were installed by Samuel Wyatt, his architect, and his bath was also steam heated. Within a few years Boulton had used steam to heat the library of the Marquis of Lansdown and also the library of his friend Dr. Withering of Birmingham but unfortunately the pipes, made of copper, being soft-soldered, smelt when hot, and were removed as Dr. Withering was in poor health (62).

Industrial application followed very quickly. In 1791 a patent was taken out by John Hoyle of Halifax (63) for heating a cloth factory with steam pipes. This was followed by a patent in 1793 by Joseph Green (64) to pass air through a pipe enclosed by a steam jacket in order to avoid the complaint of "burnt air". "I enclose pipes through which the warm air is conveyed in larger pipes to which the steam rises".

During 1796-97 Charles Bage had built his five storey Flax Mill at Shrewsbury, the first iron-framed building to be constructed. This became the inspiration for the new fire proof seven storey Cotton Mill for Philips and Lee of Salford in 1799-1801, in which Boulton and Watt saw the possibilities of using the hollow iron colonnettes supporting the floors for the

61. Bernan Op.Cit. p.241
62. Ibid. p.243
63. Patent 7th July, 1791.
64. Patent 9th December, 1793.

circulation of the steam for heating (65). G. A. Lee, whose house was nearby, arranged for it to be heated by steam also from a boiler at the works. The steam was conveyed underground to a cylinder under the entrance hall. The staircase and passages were heated, and the dining room also by means of two ornamental cast-iron vases filled with steam (66).

The year 1799 also saw the introduction of steam heating in Scotland. This was by Neil Snodgrass in the Dale and McIntosh Cotton Mill on the banks of the Spey (67). Tredgold reported that it was found "greatly superior to other methods, and a more salubrious mode of obtaining the high temperature which these mills require (68). Until the machinery acquires a certain degree of warmth, the spinners find it nearly impossible to keep their work in order : and this is most felt on Monday mornings when everything is cold. In addition to bad work, it too frequently occasions the children employed to be treated with unmerited severity".

Count Rumford (Benjamin Thompson) not only contributed to the theory of the use of heat by clarifying the principles of radiation and convection, but he also had practical advice to offer. In 1800 he showed how the vats in the Dye Works of Messrs Wormauld and Gott of Leeds (69) could be heated from

65. Working Drawings (Folio 242) and correspondence held at Birmingham Reference Library Boulton and Watt Collection. Ref. 242.
66. Buchanan R. Op.Cit. p. 195
67. Trans Soc. of Arts. Vol.24, p.198. Quoted Bernan. p.260
68. Tredgold T. Op.Cit. p.167
69. Dufton A.F. Trans Newcomen Soc. 1940-41 Vol.21 p.102.

one steam boiler instead of separate fires for each vat, the installation being by Boulton and Watt. He followed this by designing a system to heat a lecture hall in the Royal Institution (70), in which he introduced thin copper drums, two feet in diameter, attached to the iron pipes to allow for the alternate expansion and contraction without opening the joints. For the same hall Rumford recommended double glazing. Circulation of the steam relied on gravity as the latent heat of the steam was given up and condensed water formed in the pipes. Tredgold described the installation at the Silk Mill of Messrs Shute and Co. at Watford in 1817 (71). Main steam pipes were fed to the ceiling of the top storey and cast iron branch pipes descended to each floor, ending in a return pipe for condensed water to reach the boiler. One advantage of this was that "The children are free from chaps and chilblains in the winter season, which may be in some measure owing to their having warm distilled water to wash their hands".

Heating and Ventilation by Hot Air Cockle.

During the time when advances were being made in steam and hot water heating. Ventilation was commonly treated as a separate process. Rumford was firmly of the opinion that if stuffiness occured then throwing open the windows or a door was all that should be needed (72). Improvements in window design

70. Thompson B. Count Rumford. Essays Political, Economical and Philosophical, London Vol.3, p.380.
71. Tredgold T. Op.Cit. p.289
72. Egerton M. Op.Cit. p.82

had helped the regulation of ventilation to some extent. The sash window, introduced during the age of Wren, allowed for smaller adjustments to openings at top and bottom, and another notable advance was the hinged hopper window. This was first used in St. Thomas's Hospital, London which was ventilated by John Whitehurst of Derby, in 1784 (73). In every second window one to one and a half inches of each pane in the bottom sash was cut away and a hinged frame substituted which allowed air to be directed as needed towards the ceiling.

The prospect of combining ventilation with heating by introducing into a hospital building a current of air, previously heated by direct passage around the surface of a stove, or "cockle" was the achievement of the partnership of William Strutt and his engineer, Charles Sylvester (74).

Heating by hot air hypocaust in the Roman manner was an approach re-introduced by Sir William Chambers when heating the Kew Palace Orangery in 1761 (75). He followed the methods used by the Chinese over many centuries. The Kang, or hot air stove, heated by a furnace could be connected to hollow bricks to provide Ti-Kang (under floor heating) Tong-Kang (inner wall heating) or Kao-Kang for sitting on. Sir William fed heated air into the house through a flue connected with the heating apparatus.

William Strutt's apparatus used the same

73. Ibid p.74
74. Fitton R.S. & Wadsworth A.P. The Strutts and the Arkwrights 1758-1830. Manchester 1958 p.10
75. Bernan W. Op.Cit. p.147

principle. The son of Jedediah Strutt (76), partner of Richard Arkwright, he was a man of very wide interests and formed friendships with many famous men of his day. With Erasmus Darwin he founded the Derby Philosophical Society to which Whitehurst also belonged, he owed some of his success to the influence of Josiah Wedgwood who was President of the General Chamber of Manufacturers when he joined in 1789 and he was in friendly correspondence with Dr. Herschel, Jeremy Bentham, Maria Edgeworth, fellow mill-designers Bage and Lee, and with Boulton and Watt. Strutt's main scientific interests lay in the transmission of heat by convection and the construction of fire-proof buildings by the use of cast-iron framing.

In 1803 Jehediah's timber-framed North Mill at Belper was destroyed by fire (77) and William rebuilt it in five storeys with "arches springing from iron columns erected one upon the other through the whole height of the Mill" (78). Maria Edgeworth wrote (79) : "He built it, a noble building, hot air from below conveyed by a "cockle" all over the house. The whole institution a most noble and touching sight, such a great thing, planned and successfully executed in so few years by one man! " The steam engine was built by Boulton and Watt.

Strutt had experimented with hot air systems

76. Typescript copy William Strutt, Derby Reference Library believed to have been writted by a grandson.
77. Derby Mercury, 13th January, 1803.
78. Description in Rees's Encyclopaedia, Derby Ref. Library.
79. Quoted p.8 Typescript William Strutt. Maria Edgeworth's father Richard Lovell Edgeworth became W.Strutt's friend through Darwin. Typescript located at Derby Reference Library. (Strutt Collection).

in his house and his mills from as early as 1792, but it was not until his meeting with Charles Sylvester during the construction of Derby Infirmary which he supervised in 1807 (80) that his work became known as a result of the account published by Sylvester describing the ventilation and heating system. Sylvester, a self-educated man from Sheffield, became an authority on chemistry and electricity. He visited Derby to lecture, liked the people and remained there.

The Derby Infirmary was a fine piece of environmental engineering. It was designed to combine the propulsion and extraction of air by natural means in order to maintain a steady flow through the building, which was cubic in form with a central dome, at the top-most point of which was a vaned cowl, or turn cap, that swung so that its mouth was kept continuously away from the wind. This worked as the outlet from the wards of foul air which had been carried up through ducts in the walls from openings at floor level in each ward. The flow of air through these ducts depended partly on the difference between inside and outside temperature, and partly on the movement of the atmosphere (81).

The fresh air was propelled into the building from the top of a tower in an exposed situation away from the main building. This was fitted with a turncap

80. Sylvester C.S. The Philosophy of Domestic Economy Adopted in the Derbyshire General Infirmary. London 1819 p.3

81. The ducts had openings for winter use at floor levels,which could be closed in summer, and openings for summer use at ceiling level to be closed in winter.

with opening facing always into the wind. The air was thus forced down the tower, then entered the basement of the hospital through an underground culvert having an area of four square feet and a length of 210 feet. After heating to a temperature up to 280°F when necessary, inside the cockle, the air was conveyed by ducts to each ward.

The effect of drawing the fresh air through an underground tunnel was in itself beneficial as a means of warming it in winter and keeping it cool in summer. Sylvester stated that in August when the temperature in the shade was 80°F the ducted air was only 60°F. Boulton and Watt also used this device when ventilating the Hunterian Museum in 1810 (82).

Strutt's heating cockle was an advance on previous iron stoves. It was enclosed in brick and thus contributed to the prevention of fires. He discovered that it was better to raise the temperature of a large amount of air through a few degrees than vice-versa. He therefore accelerated air flow by feeding it to the cockle from a vertical well underneath the stove, which was itself a minimum of 15 feet below the wards. The cockle was 4 feet high and 3 feet square, being made from rivetted wrought iron 3/4 inch thick. It had a domed top to collect the heated air, the brick surround being honeycombed with holes to increase the heating area. Pipes were built into the brick casing to direct the air to within 3/4 inch of the cockle. Several improvements were made by Sylvester who originated the "Gill" stove in 1830 which prevented overheating (83).

82. Egerton M. Op.Cit. p.85
83. Hood C. Ed. Dye F. Warming Buildings by Hot Water, London 1897 p.395. Sylvester's Gill stoves were installed in St. Paul's Cathedral.

The ventilating achievement at Derby still suffered partly from the defect inherent in any system based on "natural" ventilation as had already been noted by Tredgold in 1824 (84), namely that on windless days when internal and external conditions were balanced no exchange of air could take place. Under these conditions, only the introduction of fan technology could solve the problem and this was already receiving the attention of progressive mill owners, for Dr. Arnott was able to write in 1838, "The accomplishment of near-perfect ventilation for a crowded place was not, as might be expected, the Houses of Parliament, or the assembly rooms of the great, but in the Cotton Mills. It was in the Cotton Mills that fan wheels were first set in motion to extract air". (85).

With the introduction of mechanical propulsion humidity could be introduced more efficiently. Air was drawn by fan across a perforated grid covered with a layer of coke on which water of any required temperature fell in a shower from a pipe having a rose termination similar to a watering can. Additional perforated grids covered by a constant flow of water could be slotted into a square box formed of sheet iron to further humidify the air flow if required.

Heating by Hot Water.

Concurrent with steam heating, the use of hot water was also being experimented with, steam, despite

84. Tredgold T. Op.Cit. p.75
85. Arnott N. Op.Cit. p.48

its advantages when utilised in mills and factories, had certain disadvantages when used elsewhere. It required the constant attention of a trained boiler attendant to keep up the supply of heat and owing to the high temperature of steam radiators as compared with hot water ones, it was more difficult to regulate or diminish the warmth radiated according to the day to day requirements. As was discovered at the House of Commons, the "batteries" of radiators required an attendant constantly employed to cover with thick cloth a portion of the heating surfaces not required to be exposed to the inlet air.

William Key C.E. of Glasgow designed a method at the Victoria Hospital, Glasgow whereby the steam pipes were arranged in sections, one or more of which could be heated as desired. The sections were covered by a series of shutters to prevent air passing over them when necessary (86).

Steam heating installations were somewhat more dangerous, especially at joints and pressure points, and noises caused by the presence of steam and water in the same pipe but flowing in opposite directions could be prominent. Complaints in the House of Lords concerning noise caused the removal of the Marquis de Chabannes' apparatus (87).

The use of hot water as a means of providing controlled heating began in France when, in 1777 M. Bonnemain (88) devised a chicken incubator heated

86. Key W. Mechanical Ventilation, Glasgow 1894, p.2
87. Billings J. Op.Cit. p.34
88. Dufton A. Op.Cit. p.103

from a stove fitted with a thermostatic control. An expansion rod inside the stove regulated a valve to open or close the ash pit door and so control the air flow to the fire. In 1816 the Marquis de Chabannes introduced the idea into Britain and published a descriptive pamphlet in 1818 claiming to be the inventor of the method (89). He was, however, the first to suggest the fixing of a small boiler to the back of a kitchen fire. The hot water thus produced he connected to a cylinder containing 20 or 30 small pipes all open at both ends and surrounded by the hot water. This device was used for both warming and ventilating. The cylinder was placed under the stairs of the house so that the convection currents set up in the small open pipes caused a current of warm air in the staircase. This "radiator", with heating surface increased by the insertion of pipes, he named the "Calorifère" (90). It was perhaps more successful as a ventilating device than for heating. In 1820 the Marquis ventilated the Covent Garden Theatre placing a Calorifère at every entrance and stairway communicating with the external air. A number of cylinders each containing thirty pipes of 2 inches diameter were placed under the stage. He was said to have made Covent Garden the most comfortable theatre in London (91).

Dr. Arnott designed a self-regulating fire in 1834 which he named the Thermometer Stove (92). This was water clad and fitted with an expansion rod

89. Bernan W. Op.Cit. p.264
90. Described by Chabannes in On Conducting Air. Bernan p.267.
91. Collins P. Op.Cit. p.237
92. Arnott N. Op.Cit. p.12

operating the amount of air admitted under the fire to prevent the water over-heating. Advantages claimed were saving of fuel, more equable heating, cleanliness and the elimination of the need for sweeping boys. "The sufferings of these wretched children give great pain to many humane spirits" (93). Automatic control and self-regulating hot water systems were widely adopted by horticulturalists for greenhouse heating. The circulation in such systems was at low pressure and operated by combined convection and gravity. Tredgold had first investigated the subject and Charles Hood established the rule that the hot flow pipe from the boiler must always be connected at the highest point and that the sloping return pipe gave the most efficient working (94).

It was also discovered that hot water under pressure gave out more heat. Jacob Perkins (95) introduced a system by which the water was heated and circulated under considerable pressure within a continuous and closed iron tube of one inch diameter. About one sixth of the tube was coiled and placed inside a furnace, and the remainder, suitably shaped and coiled to fit the heating requirements of the interior of the building. To withstand the internal pressure, special wrought iron pipes were patented and manufactured by James Russell and Sons of Wednesbury. They were tested to 3,000 lbs per square inch pressure. The Perkins high pressure system was widely used for some years and was successful in such buildings as the British Museum.

93. Ibid p.4
94. Hood C. Op.Cit. p.28
95. Dufton p.104.

Ventilating the Houses of Parliament.

One large group of buildings for many years epitomised the problems of warming and ventilating large assembly halls. This was the Houses of Parliament. The long sequence of repeated attempts successfully to ventilate the Houses of Parliament provided wide publicity and exercised the ingenuity of some of the nation's finest architects and scientists from Sir Christopher Wren onwards. The long saga of apparent successes followed by subsequent failures covered a period of more than two hundred years and attracted the attention of architects wishing to design large buildings, not only in Britain but in America and mainland Europe also.

As almost every device and apparatus was tried out in the Houses of Parliament at one time or another the history of these attempts may be regarded as a reliable guide to contemporary thought in the art of ventilation up to the year 1898 when a Plenum System was installed (96). These attempts were published widely in Parliamentary Reports and examined in detail in the Architectural Press. They were of interest and value to William Henman and his contemporaries.

The problem stemmed originally from Sir Christopher Wren's rudimentary form of ventilation (97), which was to cut a large square hole in each corner of the ceiling of the Chamber, covering the holes with short funnel-shaped tubes which could be opened or closed by valves to allow air to be released and flow upwards into the rooms

96. Billings J. Op.Cit. p.356
97. Collins P. Op.Cit. p.240

above. However, as there was no special provision for the supply of fresh air to enter the Chamber, in consequence the tubes provided a reverse air flow contrary to Wren's intention and admitted cold air from beneath the roof, thus causing complaints from Members of uncomfortable down draughts.

In 1723 Dr. J. T. Desaguliers was called in to advise on a remedy and he decided to stimulate ventilation by the use of a fire (98). He caused "foul air grates" to be fixed above the Chamber so that tubes carrying air from Wren's ceiling apertures could then be heated to set up strong upward convection currents. This proved successful provided that the fires were lit early in the day before the House assembled, and were kept well alight. Unfortunately, the installation of the tubes, fires and chimneys had greatly reduced the living accommodation in the janitor's rooms above the Chamber, and it appears that Mrs. Smith, the housekeeper, prevented the scheme from working properly by omitting to light the fires sufficiently early. Dr. Desaguliers gave an amusing account of his experiment and subsequent failure in his book (99) A Course in Experimental Philosophy, in which he claims to have been the first to apply this principle to buildings.

In his next attempt, Dr. Desaguliers devised a mechanical method to extract the respired air and at the same time to introduce a flow of fresh air. This was by means of a large "Blowing Wheel", (100) a hand-operated fan of 7 feet diameter and one foot

98. Ritchie R. Op.Cit. p.138
99. Quoted by Billings. p.29.
100. Bernan W. Op.Cit. p.83

width enclosed in a case with an exhaust or "blowing pipe" at the top and a "suction pipe" at the base which fed air into the centre of the wheel. The fresh air, as it reached the centre, was expelled from the fan by centrifugal movement. The man operating the handle of the fan was called by Desaguliers the "ventilator" which was the origin of the term. The apparatus was installed in 1736 and remained in use for the next eighty years with varying but limited success (101). Although Dr. Desaguliers was the originator of fan ventilation in buildings, its effective use was delayed a further century pending the invention of an efficient form of mechanical driving power for fan propulsion.

At the request of the Admiralty, Desaguliers produced a similar blowing wheel to be tried on ships of the Royal Navy (102), concern having been directed to the foul and offensive conditions of the ships and the incidence of infectious fever among the soldiers embarked in them. Experiments using large bellows were also made by Rev. Stephen Hales, rector of Faringdon, who had used them to ventilate Newgate and Winchester Prisons. Experience gained from the ventilation of ships' holds eventually provided guide lines for installations in buildings ashore (103).

The Houses of Parliament once again featured

101. "In 1791 it was moved to another position over the centre of the House the better to improve its office" - Bernan p.84
102. Billings J. Op.Cit. p.31
103. Captain Ellis, bound for Jamaica, reported that the bellows "afforded good exercise for the slaves and a means of preserving the cargo and lives". Quoted Billings p.32.

prominently in the progress of ventilation when in 1811, Sir Humphrey Davy was approached to improve the heating and ventilation in the House of Lords (104). Thermo-ventilation as used by Desaguliers was again envisaged but Sir Humphrey's solution was to introduce fresh warmed air into the Chamber through a large number of holes bored in the floor, the extraction of the used air being at ceiling level through two outlets connected by metal tubes directed upwards and outwards from the building, heated by stoves to accelerate convection. Unfortunately the experiment was a failure because the outlet tubes, with openings of only one square foot each, were inadequate to carry the necessary volume of air from the building. Robert Meikleham C.E. described the fee received for the work accomplished somewhat forcefully :

> "For boring twenty thousand holes The Lords gave nothing - damn their souls" (105).

In time, the heating flues beneath the floor gradually cracked and allowed furnace gases to enter the Chamber. Finally the disastrous fire of 1834 which destroyed both Houses of Parliament was started when a large quantity of waste paper was being burned and the near-by woodwork caught fire (106).

The Select Committee Report that followed in 1835 suggested that "some, if not all, of Dr. D. B. Reid's suggested alterations should be submitted to experiment during the recess of Parliament as the only means of accurately ascertaining the soundness

104. Ritchie R. Op.Cit. p.136
105. Billings J. Op.Cit. p.33
106. Dr. Arnott blamed the spread of the fire on the drying effect of the heating and ventilating system. Other buildings suffering fire damage at this time were the Mechanics'Institute, Liverpool and University College,Belfast. Both in 1836.

of the principles stated in evidence, and their useful application" (107). This led to the "experimental" House of Commons in which Dr. Reid's ideas were carried out in the temporary chamber. They were successful, but sceptics wondered whether this success within one hall could be applied equally to a larger complex of buildings.

By 1838, when the new Houses of Parliament designed by Barry, were commenced, it was decided that steam heating would be safer both for warming and for assisting ventilation, but despite this view, Dr. Reid, still adhering to his thermo-ventilation system was appointed in January 1840 (108) to be in charge of the heating and ventilation of the new building. It is an indication of the complete lack of understanding of the problems involved, that Dr. Reid was appointed to do this work without the knowledge or approval of the architect. The possibility of friction between Barry and Reid was only to be expected.

Reid published a full account of his plan in 1844 (109). One powerful furnace nine feet in diameter was placed at the foot of a central tower, three hundred feet high. Barry had not envisaged a central tower, but was prevailed upon to design one in response to the demands of Reid's system - an early instance of mechanical services influencing architectural design. The cold fresh air, regulated

107. Quoted Ritchie p.137.
108. Billings J. Op.Cit. p.35
109. Ritchie p.138 Report entitled Illustration of the Theory and Practice of Ventilation London 1844.

in temperature and moisture, entered a chamber below the floor, and the stale air was released at ceiling level then directed downwards by ducts. The fire had to be very large and hot in order to draw the spent air downwards and then force it up the ventilating tower.

After six years of dispute, in which the Lords tended to support Barry and the Commons usually favoured Reid, it was finally decided that the architect alone should be in full charge of all arrangements. Reid departed in annoyance to America, but by that time the central tower had been built (110).

Two advisers now assisted Sir Charles Barry. These were Professor Michael Faraday and Dr. Goldsworthy Gurney (111). Different arrangements were made for Lords and Commons. In the Lords the removal of stale air was assisted by Gurney's patent steam jets placed in the roof, and lighting was by Faraday's gas burners, and fans were re-introduced : "A twenty horse power steam engine forces the air up as well as down, the foul air being pushed out by a fan, as well as the cold air pushed in by a fan" (112).

When complaints followed concerning the noise and draughts caused by Gurney's steam jets, he removed them and advised that "the present cumbrous and complicated mass of warming apparatus be removed" (113). Fresh air was to enter partly through the

110. Billings J. Op.Cit. p.36
111. Ritchie R. Op.Cit. p.138
112. Report of Prof. John Leslie to House of Lords Select Committee 24th July, 1854. Quoted Ritchie p.139.
113. Ibid p.139

floor, which was to be of cast iron drilled with holes covered with haircord. However he reverted to the use of large coke fires under the roof for extracting stale air and a special descending shaft 10 feet by 20 feet extended all the way from the floor of the House, communicating with the Clock Tower. "The Clock Tower is made an up-cast", he reported, "a furnace at the base converts it into an up-cast" (114). Faraday was not enthusiastic, especially concerning the large coke fires burning under the roof (115). A simple plan was found for moistening the air. A small jet of water striking a revolving disc caused spray to fall upon porous cloths through which air passed, but even so the Hon. Members frequently needed to open the windows to maintain comfort. This led to a remark by the Hon. E. P. Bouverie, "I have heard it said that the result of our spending £200,000 in ventilating the House of Commons has been to prove that the best way of ventilating a room is by opening the windows" (116).

An attempt, however, had been made to regulate the warmth of the Chamber according to the number of Members present. This was by the use of steam to heat the incoming air. Sir Douglas Galton described the process (117) "Fresh air is admitted into the lower chamber where it is warmed by steam pipes with vertical flanges to increase the heating surface. Frequent alteration in the number of occupants of the House of Commons makes it necessary to alter the temperature of the air. This alteration is effected by an assistant who watches the thermometer

114. The Architect, 12th February, 1870 p.83.
115. Ritchie R. Op.Cit. p.140.
116. Ibid p.141.
117. Galton, p.63. Blocks of ice were placed on Wooden racks in the airways, but lowered the temperature only about one degree.

and covers with pieces ofwoollen fabric a greater or less number of these flanges of the pipes so as to diminish or increase the heating surface as may be required. The fresh air is supplied to this chamber from the adjacent courtyards which are asphalt covered and kept tolerably clean.

The grated floor and the grated risers of the steps on which the seats are placed are all available as inlets. The glass ceiling of the House of Commons has openings into the space in the roof, from which a channel leads down under the basement to the foot of the clock tower where a large fire is maintained : and this forms the exhaust by which the air is drawn through the House, as much as 1,500,000 cubic feet have passed through per hour. If the House were full, this would represent somewhat under 2,000 cubic feet per occupant per hour, including Members, attendants and strangers. In summer the air is made to pass over ice, but this is an expensive method".

Steam made an effective, though fairly brief contribution as a source of power to drive fan mechanism, but by 1880 outstanding inventions in the field of electrical energy were emerging. The Gramme generator had been invented in 1875 and the Crompton - Burgin machines, available in number after 1880, (118) provided a compact and clean power unit. At the same time, sea-faring problems had encouraged improvement in fan design.
Samuel Cleland Davidson's "Sirocco" fans, developed in Belfast in 1881 (119) originally for the drying

118. Bowers B. Crompton's Electrical Work HMSO London,1969.
119. MaGuire E.D. The Sirocco Story, Belfast, 1969.

of tea, were also built into cargo holds to facilitate preservation of perishable goods on long voyages. The introduction in 1880 of electric carbon filament lamps by Swan and Edison ushered in the banishment of the fumes of spent gas on shore, and also meant that ocean-going passenger liners were wired for electric lighting and power, and, for instance, the Capell power fan used in mine ventilation was installed in S. S. Athenian for passenger comfort (120). Such environmental advances eventually combined to make possible an interior sealed from external atmospheric conditions which was the objective of plenum ventilation.

By 1870 many large public buildings were being ventilated by fan propulsion. Colonel Scott's installation at the Royal Albert Hall in 1870 (121) (W. Phipson C.E., engineer in charge) was typical and received wide reportage. 26,000 feet of 4 inch cast iron coils in the basement were fitted with "a moistening tank to ensure the requisite hygrometrical degree of air" which was strained through wire gauze screens and drawn by fans 6 feet in diameter. The reporter was at a loss when confronted with the electric motors - "The fans are driven by two small 5 h.p. engines of somewhat peculiar construction", but stated that a similar arrangement had been installed in the Houses of Parliament. The equipment there however differed in the heating device - "A battery of forty zinc and copper plates invented by Sir. Goldsworth Gurney heats the air and jets of water form a spray for moisturising" (122).

120. The Architect, Contract Reporter, 8th April 1887 p.13.
121. The Builder, 4th February, 1871 p.80.
122. The Architect, 12th February, 1870 p.83.

Adaptions followed, and it was not until 1898 that a plenum system was installed.

Similar advances followed both in the provinces and abroad. The ventilation of the Reichtag building by the English designer D. Grove received comment with drawings, detailed descriptions and plans (123). In Birmingham, the Aston Webb and Ingress Bell winning design for the Victoria Law Courts in 1886 envisaged the inclusion of the latest ideas in ventilation (124). "Fresh air will be warmed in chambers beneath the courts, and run through a number of coils having entered down a shaft in one of the towers, screened and 'washed' in its passage to the basement and issued into the courts through a network of air ducts. As it is vitiated by use, it will be withdrawn through extracting flues by means of a steam-driven fan in the basement and discharged through another shaft. The lighting will be provided by a dynamo machine in the basement boiler house which will generate electricity".

Henman's design for the Birmingham General Hospital six years later, planned to stand in architectural affinity with the Law Courts, was originally intended to receive similar treatment, but by the sealing of windows and other adaptations became the first building south of the Scottish border to receive full plenum ventilation.

123. The Builder, 17th January, 1885. p.99
124. The Architect, 5th July, 1886. p.57

Heating and Ventilation in the Development of Hospital Design.

An amplification in hospital building took place in Britain from the middle of the eighteenth century, but designs were largely similar in form to Georgian mansions, wards were overcrowded and cross-infection caused appalling mortality. The need to provide hospitals with better than usual ventilation was not fully realised nor acted upon until the lessons provided by the three wars - in Crimea 1854, American Independence 1775, and the Franco-German war of 1870-71, indicated the apparent paradox that patients treated in tents and huts, even though exposed to most unfavourable conditions of cold and wet, recovered more rapidly and in greater numbers than those treated in the permanent hospital buildings then in use (125). A temporary hospital at Philadelphia had consisted of wooden huts arranged rapidly around a central operating area, and in the similar German hutted military hospitals along the Rhine, some surgeons even caused patients to be carried in the daytime into adjoining fields (126). The favourable influence of fresh air and cleanliness had been clearly demonstrated by Florence Nightingale, and the pavilion system of hospital construction was the outcome.

The dispersal of wards was not new. From medieval times, the S. Maria Nuova Hospital in Florence (127)

125. Galton D. Healthy Hospitals, Oxford 1893 p.3
126. Ibid p.5
127. Pevsner N. A History of Building Types London 1976 p.142.

had been built in cruciform plan and this pattern, frequently with a central courtyard and chapel, was followed during the Renaissance and beyond (128), but despite the apparent wide spacing, the wards themselves were overcrowded and ill-ventilated. Conditions were so appalling at the ancient Hôtel-Dieu, Paris, that the fire which destroyed it in 1772 came as an opportunity and impetus to consider new forms (129). The outcome was a move towards smaller wards arranged either in radial or in grid form. A design by Charles-Francois Viel and Jean-Baptiste Le Roy (130), who was a scientist, suggested separate pavilions arranged in rows placed at either side of a central courtyard. This idea had been inspired by the Stonehouse Royal Naval Hospital at Plymouth 1756-64 by M. Rowehead, which though on a smaller scale, had received praise in John Howard's Account of the Principal Lazarettos in Europe in 1789 (131). In addition, Sir Christopher Wren had anticipated this lay-out at least fifty years earlier when he produced an alternative design for the Royal Naval Hospital, Greenwich. This shows pavilions arranged in rows on each side of a long central court (132).

The first hospital built with a Pavilion plan in Britain was begun in 1858 at Blackburn by James Turnbull four years after the Crimean War (133). The second, the Herbert Hospital, Woolwich (134) built in 1860 was better known as it was designed by Douglas Galton

128. Only one cruciform hospital was built in England. This was on the Savoy site, London, under the direction of Henry VIII.
129. Pevsner N. Op.Cit. p.147
130. Ibid p.148
131. Howard J. An Account of the Principal Lazarettos in Europe. London, 1789 p.180
132. Pevsner N. Op.Cit. p.147
133. Ibid. p.154
134. Galton D. Op.Cit. p.193

and named after Sidney Herbert, later Lord Herbert of Lea, who as Secretary of War had asked Florence Hightingale to go to Scutari. An essential prerequisite of a Pavilion ward was that the windows be on opposite walls to facilitate cross-ventilation and that the number of patients be limited to approximately sixteen per side - this being the standard advised by Florence Nightingale (135). At the Herbert Hospital, Galton calculated that on a normal day the volume of air passing through the building by each pair of opposite windows was at least 500,000 cubic feet per hour. During Winter when windows could not be fully opened, the Galton patent ventilating stoves, placed in the centre of each ward, provided heat and also ventilation through the chimney-flue extraction shaft (136).

Attempts in large city hospitals to combine ventilation with warming followed the various experiments undertaken at the Houses of Parliament, the Louvre or the Capitol. The New York Hospital (1875, by G. B. Post) used a fan assisted air intake, warm air ducting, and extraction of stale air by heated up-cast aspiration using two tall chimneys. At the Johns Hopkins Hospital Baltimore (1876 by J. R. Niernsee) considered the most advanced design in the United States, each ward was practically a separate small hospital, the basement being equipped with heating coils and every ward surmounted by its own extraction chimney. A small propelling fan was installed to assist the aspirating shaft on windless days. By this design however, it was impossible to move from one ward to another without going into the open air, and the system was very costly.

135. Nightingale F. Notes on Matters Affecting Health. London 1858 p.11
136. Galton D. Op.Cit p.109

At the very large Hamburg Hospital (1889 by Gropius & Schmieden with W.F. Deneke as their engineer) the pavilions were warmed by heating the entire floor on the principle of the Roman Hypocaust. Steam pipes ran beneath the cement and tiled floor. Fresh air entered through ducts passing underneath the heating channels (137).

French designers were the first to employ the Pavilion plan combined with ventilation by propulsion. At the Hospital Lariboisière, Paris (1854 by M.P. Gauthier and engineers Thomas and Laurent) (138) two 15 h.p. steam engines with fan blowers attached conducted air along the arched basement of the hospital by an iron duct with branches feeding the various buildings. The air was introduced into the wards through pedestals five feet high in the centre of the floors, stale air being extracted at floor level between beds and carried through flues in the walls to the roof. The system proved costly and inefficient when ducts became narrow and bends too acute to maintain air pressure and heat.

At this point, the contribution of William Key C.E. of Glasgow was significant. On the assumption that air was to be drawn into a building at a central position, distributed, and finally collected for expulsion, he asserted that only by sealing all windows and controlling air flow and temperature at the point of entry could the system work efficiently. His Plenum system, tested first in local Board Schools,

137. Billings J. Op.Cit. pp 333-345
138. Pevsner N. Op.Cit. p.154

was installed at the Victoria Infirmary, Queens Park, Glasgow in 1889 (139) and marked a watershed in environmental engineering related to hospital design.

For some years, "Artificial" ventilation, as it became termed, provoked opposition from a large section of medical and architectural opinion - having strongly favoured "Natural" ventilation after striving for so long to maintain the curative value of abundant "fresh" air. The point lost was that Glasgow air was far from fresh, and had to be washed and sifted by screens as it entered the hospital. The main air duct beneath the centre of the wards was 5 feet high and 3½ feet wide, large enough to allow for constant cleaning and inspection. Dr. Nicholson the Medical Superintendent reported, "The wards provide accommodation for 160 patients nominally, but with Mr. Key's system we do not hesitate to add 25% more beds to normal accommodation" (140).

This was the hospital visited in 1892 by William Henman with the members of the Birmingham General Hospital Building Committee, who resolved to make their hospital the first in England to contain Plenum ventilation. Having completed this hospital in 1897 (141), it then remained for Henman to show that the main cause for loss of efficiency still persisting in Plenum ventilation was the Pavilion layout itself, that its provisions were no longer necessary and were at variance with the needs of

139. Key W. Mechanical Ventilation Paper read to the Sanitary Association of Scotland 24th August, 1894. Copy in Archives, General Hospital, Birmingham.
140. Chapter 4.
141. Following completion of the Birmingham Hospital in 1897 Key began his eventful collaboration with Charles Rennie Macintosh in the design of the Glasgow School of Art 1897-1909

Plenum ventilation, which required the minimum possible of air trunking to achieve its optimum results. Henman's compact design at Belfast Royal Victoria Hospital in 1903 was the outcome, and also the achievement by which his reputation as a pioneer in the sphere of design for environmental control must rest.

CHAPTER 4.

THE PLENUM VENTILATION ACHIEVEMENT AT THE BIRMINGHAM GENERAL HOSPITAL AND THE BELFAST ROYAL VICTORIA HOSPITAL.

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Origins of the Hospital.

Doctor John Ash, whose portrait by Reynolds hangs in the boardroom, was the founder of the original General Hospital in Birmingham when in 1765 at a meeting of local gentry, manufacturers and bankers, a sum of £1,000 was raised, Dr. Ash himself donating twenty guineas and John Baskerville the printer fifteen guineas (1).

An eight acre site was chosen in Summer Lane, at that time a rural area bordering the town, but by November 1766 building activities ceased when funds ran out, and it was not until thirteen years later that the hospital was completed. It was opened on 20th September 1779 (2) with ten patients and staff of four nurses, each to receive four guineas per year and an extra guinea bonus "if they behave well". A musical concert in 1768 had raised £200. These concerts became a valuable continuing source of financing the hospital when the Triennial Festivals were held at the Town Hall, and attracted performances of original works such as Mendelssohn's "Elijah" conducted by the composer in 1846 (3).

The rapidly expanding population of Birmingham caused increasing demands which were met with a series of six extensions between 1792 and 1888, but by 1887 it was realised that these were only palliatives : the original building, now surrounded

1. Aris's Gazette, 21st November, 1765
2. Ibid 22nd September, 1779.
3. The Birmingham Town Hall organ, provided by Festival receipts was originally the property of the General Hospital.

by factories, could only remain inadequate. In the opinion of the Senior Surgeon T. F. Chavasse, it had become " dear, dirty and dismal pile" in which "the ghosts of former inhabitants in the shape of germs, very often troubled, and sometimes carried off, some of the present generation" (4). Accordingly, at a meeting held in Birmingham Town Hall on 29th January, 1891, the first resolution was moved by Joseph Chamberlain M.P., "That the present hospital is inadequate for the requirements of the city, on account of its sanitary arrangements, site and surroundings, and that it is therefore desirable to rebuild the hospital on the site in St. Mary's Square approved of by the Governors" (5). His call was supported by Lord Leigh, Sir Thomas Martineau and P.A. Muntz M.P. and donations reached a total of £84,000 by 1891. This included a bequest of £25,000 from the will of Miss Louisa Ann Ryland of Barford (6), a generous benefactress to the citizens of Birmingham. Four donors each gave £5,000 and a list of twenty-two donors headed by Joseph Chamberlain each gave £1,000. (7).

Two members of the Hospital Management Committee were particularly suited to advise on the choice of site. These were Frank B. Osborn, an architect who had been elected President of the Birmingham Architectural Association in 1885, and Frank Wilmott a surveyor.

4. Meeting of the Hospital Governors 9th October 1890.
5. Birmingham Weekly Post. 31st January, 1891. Chamberlain added, "The hospital does something to equalise conditions between rich and poor. It provides for the latter in time of trouble and distress the assistance and skill for which the former would be willing to give all their wealth".
6. Ryland's Estate Act 9th June, 1893.
7. These were John Holder, C.A. Smith-Ryland, George and Richard Tangye.

They had been looking at every possible site, and had reported in detail in the case of about ten of them, but finally a site near the eastern end of Corporation Street, which by Chamberlain's continued initiative had been extended to Aston Street by 1882, offered the maximum advantage. It was 3¾ acres in area, close to the new Victoria Law Courts under construction by Aston Webb and Ingress Bell (1887-1891) and bounded by St. Mary's Square, Steelhouse Lane, Whittall Street and Loveday Street (8), within which a collection of small houses in Russell Street was to be cleared. Although near the heart of the city, no noxious processes were carried out in the immediate vicinity : the St. Mary's district was occupied largely by the small workshops of the Gun quarter. The shape of the site would have been approximately rectangular except for a small plot at the corner of Steelhouse Lane and Whittall Street having a forty years' lease on it, and acquisition was not proposed at that time. This shortened the space available in Steelhouse Lane, but Henman chose this point for the principal frontage because it had the advantage of easy accessibility from the city, and the lower end advanced slightly towards Corporation Street, thus providing an opportunity to make any building placed at that particular point especially prominent.

The Architectural Competition.

On Monday 2nd March, 1892, Alfred Waterhouse began his examination of the thirteen sets of plans submitted by twelve architects (9). The design

8. The dimensions of the site were:- St. Mary's Row - 500 feet, Steelhouse Lane - 300 feet, Whittall St. 225ft, Loveday St. 430 feet.
9. The Builder, 19th March,1892 p.217. Seventeen invitations were issued : twelve architects responded. Brightwen Binyon, Dempster & Heaton, Dunn & Hipkiss,Cossins and Peacock, W. Doubleday W. Hale, Bateman & Bateman, Ewen Harper, W. H. Bidlake, Worthington & Elgood, F.B. Osborn and W. Henman.

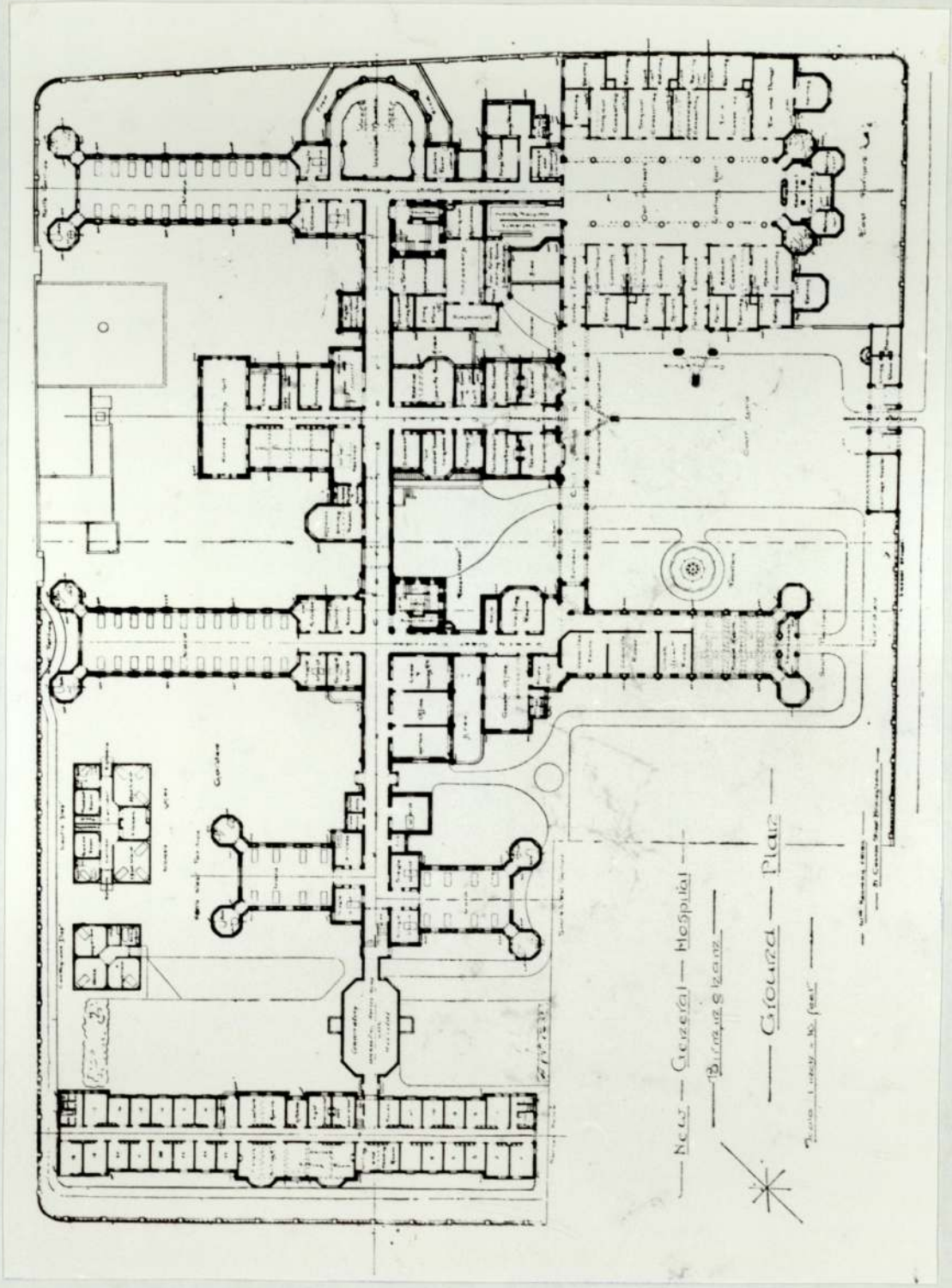
conditions were for a hospital of 117 medical and 156 surgical patients and 31 beds for special cases. Wards were to hold 24 beds each, and out-patients up to a total of 400 per day were to be catered for. The estimated cost suggested by the Hospital Committee was £80,000. All the competing architects had indicated that this sum was insufficient though some had attempted to design close to the stipulated amount and in so doing probably jeopardised their chances. The Birmingham Post (10) reported that "some of the plans are so severely treated as to be suggestive rather of a workhouse or barracks than of a hospital". All the designs were for brick-built structures, many favouring the "Queen Anne" style or else a part-Flemish modification of it, evidently, as the Birmingham Post suggested, "because the style affords a façade in which large square windows, embellished by very simple mouldings are a predominating feature". One of the designs however was described as in Renaissance style, another in "Scotch Gothic with a clock tower" and a third showed a prominent tower-like structure placed as near as possible to Corporation Street. Many of the designs, including Henman's made use of external balconies set into arched wall enclosures for patients in fine weather, this feature having been an attraction of the recently-built Liverpool Infirmary. The competitions differed in their choice of entrance position but most designs favoured the lower corner of Steelhouse Lane, nearest to Corporation Street.

10. The Birmingham Post 3rd March, 1892.

Waterhouse awarded first premium (£150) to plan 1 (W. Henman) second (£100) to Messrs. Worthington & Elgood of Manchester, and third (£50) to Frank Osborn of Birmingham (11). In his assessment, Waterhouse stressed that "In design No.1 among the points which struck him as particularly good was the distance of the wards apart. In a place like Birmingham it is a matter of great moment that they should get all the air they possibly could throughout the entire hospital" (12). When the decision was made subsequently to install a Plenum System of ventilation, this winning feature operated to the architect's disadvantage. The name of the successful architect appeared to be little known to the members of the General Hospital Committee, "but they were shortly informed that Mr. Henman had done work which more than warranted his inclusion in the list of architects invited to compete" (13). On his part, Henman, from previous experience, had clearly taken account of Waterhouse's likely preferences as an assessor (14). Although his design is composite and eclectic in approach, elements of Perpendicular character predominate. In his own description of his design intention Henman stated, "An endeavour has been made to design every part specially as most suited to its particular uses, in a consistently uniform manner : which it is hoped would result in a pleasing architectural composition harmonising with the Victoria Law Courts which stand in close proximity" (15).

11. On Tuesday, 8th March, 1892.
12. The Architect, 11th March, 1892 p.174
13. Birmingham Daily Post, 9th March, 1892
14. The Builder, 19th March, 1892 p.217. "A certain impression is somehow conveyed by the design that the work of Mr. Waterhouse has received a certain amount of study".
15. The Birmingham Post, 9th March, 1892.

Henman's drawing exhibited at the Royal Academy in 1893.

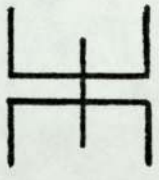


Birmingham General Hospital. Plan showing wide distribution of the Pavilions.

A weakness in the second premium plan was that the administration services were located on the upper floors and the number of lifts was excessive. Henman's layout required only two large lifts for the entire hospital, suitable for both passengers and goods. The third premium design placed the medical officers' and Nurses' quarters on the second and third storeys.

The Layout of the Hospital.

The main feature was a long transverse corridor, three storeys in height communicating like a back-bone from the N.E. (Loveday Street) end of the site to the S.W. (Whittall Street) where, owing to a rise in the ground, it diminished to two storeys. From this link the various pavilion blocks projected forwards towards Steelhouse Lane and backwards to face St. Mary's Square. Two dominant pavilion structures at each end were carried to the full extent allowed by the site : between them lay two shorter pavilions placed in the centre, resulting in a general layout resembling a double capital 'E'.



(16)

A further extension of the main corridor gave access to two more small pavilions and finally passed

16. The Builder, 26th March, 1892 p.247

Birmingham General Hospital completed in 1897. From Steelhouse Lane.

through a conservatory to reach the Nurses' accommodation in Whittall Street. The unequal lengths of the ward blocks were designed to ensure the maximum light and air. Small isolation wards for infectious diseases were placed well to the rear, facing St. Mary's Square.

The principal façade in Steelhouse Lane presented a balanced appearance. The main entrance was reached through a covered gateway of three arches, the central archway being for carriages, beyond which was a quadrangle bordered at each side by the octagonal towers of the two main pavilion blocks and terminating in the administration block, placed centrally also framed by smaller octagonal towers and linked to each side pavilion by a cloistered way.

Thus, approached from Steelhouse Lane, the hospital appeared to have been built around a central courtyard in which was placed a green terra-cotta fountain presented by Sir Henry Doulton (17). A drawing prepared from William Henman's design and exhibited at the Royal Academy in 1893 emphasises the balanced nature of the composition, but noticeable also is the varied outline at roof level controlled by the strong brick verticals which prompted Alfred Waterhouse to comment that he considered the design to be of "free classical style conceived in a Gothic spirit" (18).

The materials used were Staffordshire bricks from nearby kilns; deep red from Cradley which were relieved by deeper plum coloured bands of bricks from

17. Atterbury P. & Irvine L. The Doulton Story V. & A. Museum, London 1979 p.84.
18. The Architect 11th March, 1892 p.175

Kingswinford. Red terra-cotta was chosen by Henman as the main feature for decoration in order to harmonise with the adjacent Law Courts, but a noticeable difference was that he insisted that the terra-cotta should have a roughened surface, believing that it improved the appearance and probably resulted in greater durability. All the modelled ornament was carried out under his direction, mainly by Doulton's modellers at the Rowley Regis Works.

Undoubtedly the most arresting external feature of the hospital was the pair of large octagonal towers with pyramidal roofs of green Westmoreland slate (19) reaching, at the finials of their lantern-shaped terminals to a height of 120 feet. These Henman placed at the two important points of intersection at each side of the administration block. They were not merely decorative features : they provided important functional services within the hospital. Each carried the two principal staircases communicating with the ward pavilions and each contained in its summit a large cistern for water storage which was fed from an artesian well within the hospital. Henman's reasoning for this provision was : "Although Birmingham is fortunate in having a constant water supply there are occasions when, for repairs to mains or other causes, the supply is cut off for a time. Even such a temporary stoppage might be attended by serious or even disastrous results, or in case of fire. Hence what at first sight may appear simply ornamental features added for architectural affect, are in reality when used as proposed of utmost importance for the well-being and safety of the establishment" (20).

19. From the Buttermere Quarries.
20. The Builder, 26th March, 1892 p.246

Main Entrance, Quadrangle and Administration Block (left).
Statuary and cloisters were destroyed by air-raid.

The entire composition of the hospital is characterised by the octagonal turrets appearing at the corners and along the walls of the ward blocks. They serve to emphasise verticality, but all have a dual purpose. They carry the vent and waste pipes from baths and lavatories and the smaller octagonal spirelets placed between the windows are ventilating flues from the wards. This ability to get his decorative elements mainly out of constructional features provided another reason for Waterhouse's approval of Henman's design. The assessment reported in The Architect strongly suggests this (21). "Then another matter, a secondary one, he admitted, but which, considering the site selected, was of some importance, was the question of architecture - the external appearance of the hospital. It seemed to him that number one design evinced in a remarkable degree the work of an artist. It was not necessary that this should entail extra expense, for there was an artistic and pleasing way of doing the simplest kind of building as well as the most ornate, and he thought that the author of design number one had shown himself a master in this way. He had also shown in his report very great knowledge and thought in respect of the sanitary details on which the success of the hospital must depend. He felt that, on the whole, design number one really ought to take the first place".

On 23rd November, 1892 the hospital building

21. The Architect, 11th March, 1892, p.174. The Builder of the same date commented, "Architectural effect has combined with practical arrangement and construction more completely than is usual in large hospital buildings".

Committee under the energetic leadership of John Holder (22) accepted the tender of £4,880 from Messrs Barnsley & Sons to construct the foundations and basement of the out-patients' department in order that work could proceed on that part of the site then available. Barnsley & Sons were very experienced builders already responsible for the construction of large projects such as the Birmingham Council House and Art Gallery (Yeoville Thomason 1874 and 1880). A provisional estimate of the cost for completing the hospital proved to be higher than the Committee had hoped, and Henman was asked to revise his design. After some months of extra work he succeeded in reducing the cost, largely by substituting less expensive materials, as for instance, in the elimination of large quantities of glazed bricks for the interior walls - which he was not sorry to see dispensed with - and the loss of some architectural embellishments at the back of the building. Nine tenders for the main building were considered on 12th March, 1894, and the lowest, for £117,888 from Messrs Barnsley was accepted (23).

The foundation stone of the new hospital was laid on Sunday 8th September, 1894 by H.R.H. the Duke of York (24). Among those present were the

22. Later, Sir John Holder, Bart. Owned a Midland brewery with offices in Nova Scotia Street, Gosta Green, and was an active benefactor in the parish of Bishop Ryder's Church.
23. Other tenders were : Sapcote (Birmingham) £121,891 Walker (Derby) £122,541, Neill (Manchester) £123,920, Bowen (Birmingham) £118,652, Surman (Birmingham) £123,990, Parnell (Rugby) £125,154, Webb (Birmingham) £129,735.
24. Bunce J.T. Birmingham General Hospital, Birmingham, 1897, p.24.

Earl of Dartmouth (President of the hospital for that year) and the Rt. Hon. Joseph Chamberlain M.P. The ceremony took place in a pavilion 300 feet by 85 feet especially designed by William Henman for the occasion and paid for by J. C. Holder, who also provided an unusual sculptured level for the stone-laying (25). The silver trowel and mallet presented by the architect and the builder respectively, were designed by Henman and executed by Messrs Elkington's.

An important feature of the new hospital that had not been foreseen in the original design or specification, was the method of heating and ventilating that was eventually adopted. This proved to be a significant, and later, a controversial factor, in establishing the reputation of the Birmingham General Hospital as one of the pioneer buildings contributing to the development of Plenum ventilation in hospital design. The architect faced unexpected problems of adaptation in arranging for artificial ventilation for a large, dispersed hospital designed for natural ventilation. That Henman was able to accept the challenge to his ingenuity was due to his interest and experience in the engineering and sanitary aspects of his profession. This can be seen in the five Patent Applications he had already taken out between 1876 and 1893, and five more were to follow before 1911 (26).

25. Designed by J. Wenlock Rollins in the form of a bronze sculpture, a model eighteen inches high, to be placed life-size at the hospital entrance. Three female figures representing Medicine, Sugery and Philanthropy. From their clasped hands hung the silver thread of life terminating in an 'egg' which formed the plumb bob. Under their feet lay the serpent of death trying but failing to reach the egg.
26. Chapter 6.

The Plenum Decision.

Shortly after the plans had been accepted, Holder received a letter from a friend who asked him to see a hospital in Scotland that had been ventilated by the Plenum system. In a later account that he gave at the R.I.B.A. (27), he explained that he was very much against artificial ventilation at that time and did not respond, but after receiving a second, strong recommendation, he went to view the system in operation. This was at the Glasgow Royal Infirmary where, in 1889, William Key, Civil Engineer, the originator of the Plenum system, had applied his experience of marine ventilation in Clydebank shipyards to the possibilities of fan propulsion in buildings.

In a seminar paper (28) read before the Sanitary Association of Scotland in Glasgow on 24th August, 1894 he explained the operation of his method. "My system may be described thus :

1. I draw the air supply for a building from a point where it is of undoubted purity, and is also furthest from any possibility of contamination.
2. The entering air passes through an outer warming coil, and then through the air filtering, air washing, and humidifying screen.

27. Journal of the R.I.B.A. 19th December, 1903 p.110.
28. Key W. Mechanical Ventilation and Extermination of Spores and Germs of Disease. Corporation Galleries Glasgow 24th August, 1894.

3. It is then warmed by coming into contact with coils, clustered in batteries within the air warming chamber. The air passing through this chamber can be instantly reduced in temperature by admitting filtered cold air through the bye-pass doors for the purpose, the warm and cold air mixing while passing through the air propeller.

4. The air is propelled into the main air ducts: from these it passes into flues leading into each room. Secondary air warming coils are placed at the base of each flue so that the air to each room may be warmed to any desired temperature. The air volume to each room may be regulated or shut off altogether.

5. The pure air enters each room in a manner so that it is directed to the ceiling thus forcing out air already in the room. This may be done of renewal from 6 to 15 times per hour without experiencing the slightest draught.

6. The outgoing air passes off at the floor level and is led to roof ventilators".

Holder returned from Glasgow filled with enthusiasm. He called a meeting of the Committee and took five members on second visit (29). This took place in November when they were shown over by the medical superintendent Dr. Nicholson. They

29. Two surgeons, two physicians and a layman. He did not name these delegates.

noted that the wards, normally providing for 160 patients, could now accommodate 25% more beds without harm owing to more efficient ventilation. It was a foggy day but in the Infirmary no trace of fog could be found. The cost was £500 to £600 per annum, which was about average for a hospital of this size. They were next taken to a Glasgow Board School in a very poor neighbourhood. A large classroom was packed with infants (some with shoes and others without) but "the atmosphere was perfectly free and clear. When they got back they decided to adopt this Plenum system for the Birmingham General Hospital, although they were much enchanted with the natural system which Mr. Henman had provided". (30).

Henman's response was immediate and positive. In his final report, read before the Hospital Committee on 31st December, 1901, he stated, "Had I realised the enormous amount of additional labour and responsibility which devolved upon me by the adoption of Plenum ventilation in so extensive a building I might have hesitated to have given that system its just due when asked to report thereon; but when adopted, I spared neither time nor trouble in mastering its requirements in adapting the construction of the buildings so as to ensure its permanent success" (31). The General Hospital Plenum apparatus is of historic interest, not only because it was the first to be installed in England and was the subject of much discussion when Henman lectured on its merits at the R.I.B.A., but because the motors William Key installed, designed in the workshops of Colonel Crompton (32), were

30. The Builder, 19th December, 1903 p.630.
31. The Architect, 10th January, 1902 p.31.
32. Bowers B. R.E.B. Crompton, Pioneer Electrical Engineer. London 1969 p.12

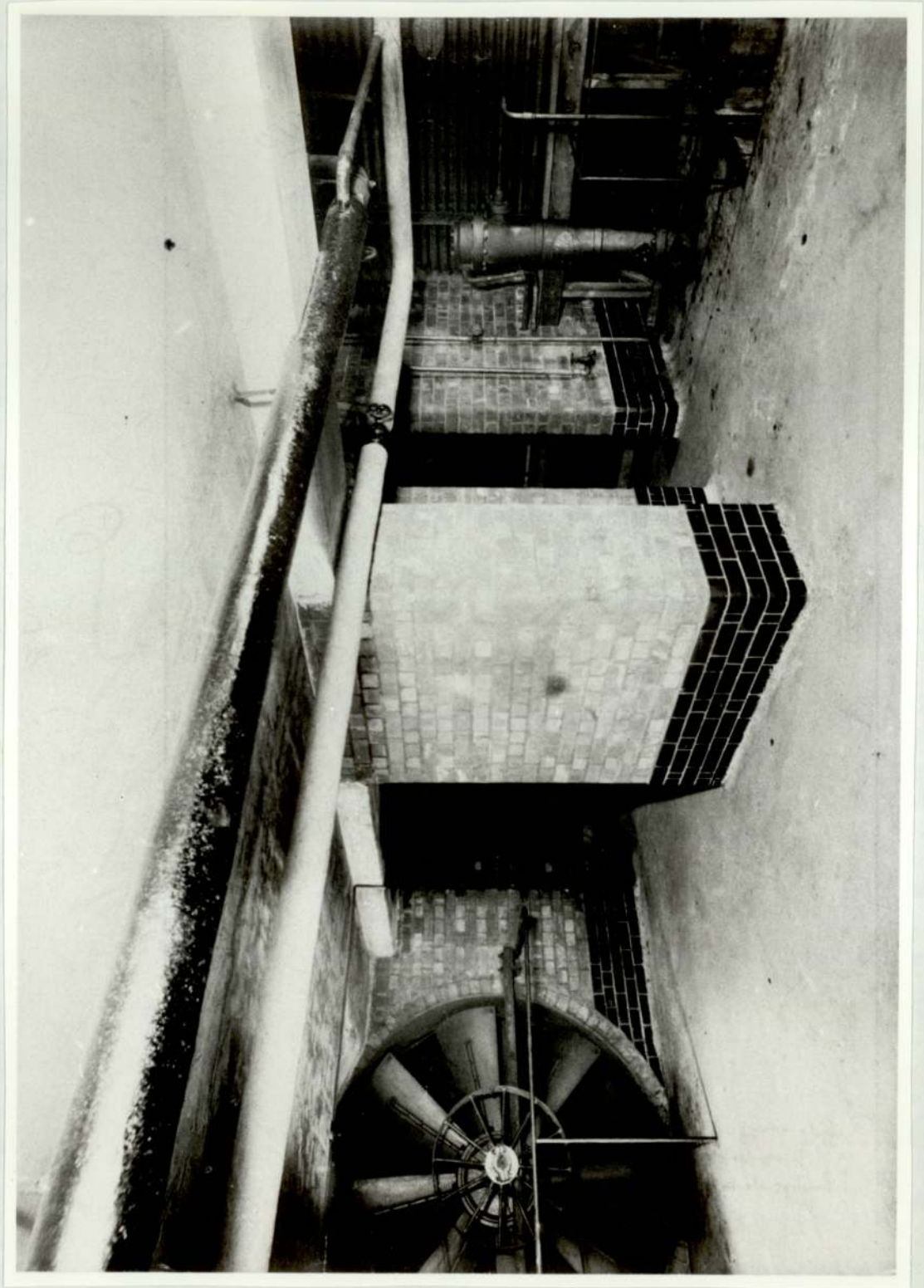
excellent examples of the latter's pioneering work in the field of electrical generator design, being now preserved in the collection of the Science Museum, London (33).

The windows Henman had designed were all permanently closed and double doors fitted to the main entrances. The air entering the hospital was now taken down shafts outside the building and through holes in the wall of the basement below the lecture theatre in the North Pavilion where, at four selected points chosen to be as free as possible from risk of contamination, it was drawn by large Blackman fans 8 feet in diameter through moistened screens by which it was cleansed of suspended impurities. The cleaning apparatus was fixed just outside the building at the base of the inlet shaft and consisted of a coconut fibre screen strengthened by interwoven strands of copper wire. It was kept thoroughly wet by means of small streams of water supplied by a perforated pipe fixed above it. In addition, at intervals a flush of water was discharged over the screen from above similar to the system used in public lavatories, the purpose being to dislodge any particles that may have been caught in the meshes of the screen. As an added precaution, the apparatus was periodically overhauled and sprayed with high-pressure fire hoses. The air thus entering the hospital was free from suspended carbon from manufacturing smut and was cooled to a temperature a

33. Correspondence concerning the transfer of Gramme Chelmsford "M" type motor in 1951 held at Birmingham General Hospital.

few degrees above that of the cleansing water. In cold weather the air was raised to a higher temperature by batteries of closely-placed steam pipes placed vertically. After passing through these, the air was propelled slowly at low pressure along the main duct. This was situated below the principal axis corridor of the hospital, and smaller ducts operated by six fans of 6 foot diameter boosted the air to different parts of the building. Near the entrance of each branch duct more coils of vertical steam pipes with regulating valves had to be placed so that air entering that section could be raised in temperature if needed. The temperature in the wards was maintained at a level between 60°F and 62°F day and night, winter or summer, with the option of raising it in certain rooms to 72°F, if required. The fans maintained a steady change of air between 7 and 10 times per hour.

The current of fresh air was led into the various wards and rooms at a height of about 8 feet from the floor, and considerable ingenuity was shown by the architect in concealing the openings to the ducts to avoid any unsightly appearance. The inlet ducts for the wards, for instance formed part of the lower window sills from which the air was made to pass in an almost vertical direction, so that it curved over at about 8 feet from the floor. The outlet ducts were placed under the beds practically at floor level in the wainscot and were connected to shafts leading upwards to outlet turrets protected by flaps and louvres to enable the used air to be expelled without interference by external weather conditions. These turrets formed an attractive feature of the external architecture. All the main ducts were fitted with hose connections for cleansing.



The Fan Chamber. Battery of heating pipes on the right.

The Crompton-Gramme Electrical Machines.

The electric motors used to activate the ventilation system at the General Mospital were among the earliest of those invented, but such was the robust craftsmanship applied to their construction that they served continuously for 54 years. Colonel R.E. Crompton, whose electrical engineering works at Chelmsford provided them, had shown his interest in electrical power even as a schoolboy at Harrow when he had constructed his own frictional electric machine. After the conclusion of his army service in 1875, he began his professional electrical career when he visited Gramme, the Belgian inventor (34), in Paris and set up a business importing Gramme generators and arc lamps, with which he illuminated the new London Law Courts in the Strand (A. E. Street 1874-1882). Crompton made several improvements to the Gramme design, especially in the construction of the armature, in which he introduced the idea of laminating the core and increasing its cross-section(35).

34. Zenobe Theophile Gramme (1826-1901) inventor of the smooth iron ring Gramme armature.
35. Bowers Op.Cit. p.23 (Also "Crompton himself often kept examples of his early products in order to indicate progressive development over the years, and after his death in 1940 the Crompton Historic Collection was established at Chelmsford, where documents and many more examples of early equipment were added. In 1968 this collection was transferred to the Science Museum, London. News that the original electric motors were still working in Birmingham prompted an endeavour to secure such a fine example for the Collection, and an offer of free replacement with a more recent motor was made. Details were given in letters dated 28th May, 1961 and 5th July, 1951" (36).
36. Letters (from N.A. Pitts & H. Spencer of Chelmsford to J.L. Woollett & P. Cocker of Birmingham General Hospital, held at Document Collection, Science Museum, London. "It really was amazing to find machines of this type still running after 54 years. Five machines between 3 and 7½ horse power of the original Gramme type smooth core armatures have been running since 1897". Motor number 6461 was transferred to the collection.

The Completion of the Hospital.

The official opening of the hospital took place on Wednesday 7th July, 1897 (37). Joseph Chamberlain made a tentative enquiry to see if the Queen could officiate but in the event Princess Christian performed the ceremony..

On completion of the main group of buildings, Henman was able to state in his Final Report that he had been able to complete the hospital for £776 less than the contract sum of £117,888. The number of beds provided was 346 and the total cost, including site and medical equipment was £210,000, resulting in an expenditure of £607 per bed (38).

There is no doubt that all concerned regarded the new hospital as a complete success. In appearance it was considered an asset to the city. J. Thackray Bunce praised the architects "employment of octagonal forms in the towers, turrets, the buttresses and the angle and gable terminals, the vertical lines of all these features being counter-balanced by horizontal bandings and panelled work" (39). The decorative statuary, placed at various points around the

The golden key to open the main entrance which was presented by the architect, may now be seen on display in the out-patients' hall.

37. Official Programme of Opening Ceremony 7th July 1897 held in Birmingham General Hospital archive.
38. Possession of Mr. D. Wortley, grandson of architect.
39. Bunce p.31.

quadrangle was executed by J. Wenlock-Rollins, Sculptor of Chelsea, who had been trained at the Birmingham School of Art. At the entrance to the administrative block was a group of three figures in terra-cotta displaying with Victorian symbolism the "Art of Medicine", the "Science of Surgery" holding high the lamp of life, supported by "Philanthropy" trampling below their feet the serpent of 'Death'. A similar triangular entrance to the out-patients' department was embellished with figures representing "light", "Air" and "Purity" these being the three essentials to health. Over the entrance to the Nurses' Home were "Perseverance", "Patience" and "Prudence" modelled in terra-cotta by W. Neatby (40).

Henman provided some impressive statistics. The capacity of the buildings was two million cubic feet within which 20,000,000 cubic feet of air cleansed by 2,00 square feet of filtering screen and warmed by 35,000 feet of steam tubing, was changed every hour (41). Sir John Holder, speaking at the R.I.B.A. reported with understandable over-emphasis : "In the coldest day in winter he had been round the hospital and the lowest temperature he had found was 59°F whereas there was 14 degrees of frost outside. He had gone to the hospital on the hottest day in summer with a temperature outside of 84 degrees in the shade and he found the highest temperature in the hospital was 69 degrees. Some time after the hospital was

40. Only the latter now remains. The quadrangle figures and fountain being swept away by air raids and structural alterations.
41. Journal of the R.I.B.A. July 1894 p.439

built, he went to America. The Johns Hopkins Hospital of Boston was put before them as the model they should follow. He went over the hospital, and it was certainly a fine institution, but it did not compare with the Birmingham Hospital. He also went over the new hospital of the McGill University, Montreal, but when he told the authorities who he was, they told him that their chairman had been over the Birmingham General Hospital and was not half so satisfied with his own since. Sir William McCormack the great surgeon, came to Birmingham and afterwards said to the Medical Faculty, "I have been over hospitals in Europe and almost every place, and I must say I have never seen a finer and better equipped hospital than you have in Birmingham" (42).

The real situation was somewhat different. Despite such fulsome praise, Henman was well aware that technically the hospital had been an exercise in compromise and adaption in order to make the ventilation system work (43), but the experience he had gained convinced him that Plenum could revolutionise hospital design for the future - as he demonstrated in an important letter he wrote to The Builder to be examined later (44) - on the principle that a hospital planned specifically for Plenum could be more compact, improve the efficiency of medical care, and bring added

43. Journal of the R.I.B.A. 19th December 1903 p.90. "It was somewhat unfortunate that the building was designed before it was determined it should be mechanically ventilated, for it entailed many constructional difficulties which had to be overcome".
44. The Builder, 8th August, 1896 p.122

comfort for patients. The pavilions at Birmingham had necessitated costly air trunking extended over a large area, the provision of four points of intake, two large fans for initial propulsion and six booster heating batteries with supplementary fans driven individually by the Crompton motors, but with better deployment he was convinced that Key's Plenum was the answer for large city hospitals. As an ardent advocate, he read papers on the subject to Architectural Associations in London, Liverpool, Leeds and at the National Sanitary Congress held in Birmingham, at which Henman was chosen to preside over Section II of the Conference, "Engineering and Architecture" (45).

The personal opinions of medical staff actually at work in the new hospital are not recorded in the Hospital Reports 118 to 123 covering the years immediately after completion (1897 to 1902) (46) but a verbal tradition by long serving members speaks of the strict disciplinning of nurses to close all doors after them, and even a "legend" to the effect that if a door had been left open, the engineer was immediately made aware of the occurrence by the change of note of the electric motors (47).

A more reliable assessment of how the system functioned is available from twenty years after the hospital was opened at a period too of additional pressures on hospital resources during the First

45. The Architect, 20th September,1899 p.159.
46. Held at Birmingham Reference Library, Local Studies Ref. L.46.21.
47. A third tradition concerning medical students falling asleep in summertime lectures can hardly be attributed to the Plenum.

World War. It appeared in The Hospital in 1916 : "There are said to be no draughts anywhere. Entrance to the building is by swing doors which are fairly frequently on the move, but the opening or closing of one of them appears to make no difference to the atmosphere inside the buildings. There is absolutely no sense of draught, not any feeling of change of air when passing from a corridor into a ward, or vice versa. The air current also performs the very important service of carrying off all unpleasant smells. During meal times there is absolutely no smell of any kind" (48).

Listing the disadvantages, the writer stated that doctors and nurses complained of the effect of sleeping in "Plenum" air ; that they got up in the morning feeling stale. "At Birmingham, the writer understands, the Plenum system was cut off from the doctors' and nurses' quarters after a little time, and at the Belfast Victoria Hospital the doctors' and nurses' quarters were specially excluded from the system when the building was designed". Another complaint that had been examined was the possibility of dust being brought into the wards by the air current but it was stated that this had not caused appreciable trouble at the Birmingham General Hospital.

A professional assessment of the architectural qualities of Henman's hospital is worthy of mention because it was made by W. H. Bidlake. "Allow me to congratulate you most heartily, and join in the chorus of praise which has greeted you on the opening

48. Hobday J. The Heating of Hospitals, 23rd September, 1916 p.589.

of the New General Hospital. It is a noble building and the towers and general grouping are superb" (49). But there is evidence from his correspondence that fully a year before the completion of the hospital, towers and embellishments had ceased to claim Henman's attention : a radical review of the interior organisation of any future hospital would govern its outer appearance, consideration of which he regarded of secondary importance. A letter written by a surgeon had appeared in The Builder (51) of June, 1896, putting forward the new possibilities for re-thinking hospital design following the recent innovations in medical and engineering pratice, and Henman's reply published shortly afterwards had significant consequences.

The surgeon's letter appeared under the heading "On the Plan and Construction of Hospitals and Infirmaries" in which he reasoned that the Pavilion Plan which was the outcome of terrible mortality in the crowded conditions of Crimea had been an endeavour to admit light and air, but two innovations had taken place - the introduction of anti-septics (52) in surgery and Plenum ventilation, "Of which Lord Kelvin says, 'It approaches as near perfection as human ingenuity can make it'" (53). There was no longer need for long pavilions with beds arranged between windows, the old "block" plan could be reintroduced

49. William Henry Bidlake M.A. (1839-1902). Former pupil of John Bodley and Thomas Garner and leader of the Arts and Crafts Movement in Birmingham.
50. The Builder, 27th June, 1896 p.561. Letter merely signed "F.R.C.S."
51. The Builder 8th August, 1896 p.122. This letter provoked interest in Belfast.
52. By Lord Lister (1827-1912) who gave details published in The Lancet, March-April 1875. See Appendix.
53. William Thomson, Lord Kelvin (1824-1907).

to allow rows of four or even six sets of beds with screens between. The number of detached buildings could then be reduced by half with considerable saving in cost of land, especially in towns.

Henman's response dismisses the idea of over-large "block" wards, but expresses very clearly his philosophy concerning the future direction of hospital planning, and needs to be quoted because of its bearing on the design of the Belfast Royal Victoria Hospital which followed. "The time may be at hand", he wrote, "when it will be possible by the employment of scientifically-applied means of ventilation and of the antiseptic treatment, to adopt an arrangement of plan differing from single ward pavilions. Architectural effect is of slight importance to the welfare of patients and ease of administration, which in a hospital should receive first consideration". He then condemned the use of dwarf central divisions because they obstructed the view of the wards and ventilation became more difficult in a large area where a central division would retard circulation of air. He continued, "The real disadvantage of the Pavilion Plan, particularly in some of the large and recently-erected hospitals, is that of administration in consequence of the great distances traversed by staff:the direction therefore in which advance should be sought is concentration of wards, which becomes possible with an efficient system of ventilation and the employment of antiseptics. Hospitals and Infirmaries may be considered 'health manufacturies' and the arrangement of plan should, as in ordinary manufacturies, principally be considered which a view to perfection of work and its accomplishment with ease and dispatch.

What I would suggest instead of erecting detached pavilions of several storeys, it might be better to spread out the wards on one storey only,

placed side by side and lighted by continuous lantern lights. Such an arrangement would secure greater comfort to the patients, simplify ventilation by mechanical means, and very considerably reduce corridor communication as well as dispense with the inconvenience of staircases and lifts, thereby facilitating administration.

For the accommodation of the staff there would be no objection to buildings of several storeys, but with all the patients compactly arranged on one floor level, their wants could easily be supplied, and other difficulties of the Pavilion Plan would be overcome". He concluded, "I feel that some such revolution in hospital planning would be accomplished, and do not doubt that in time it will be demanded partly in consequence of the great cost of the Pavilion Plan, but more particularly in consequence of the excessive labour thereby involved".

The design concept envisaged in this letter is, in terms of its originality, the basis on which a claim for Henman as an innovator maybe placed, and publication of the letter became crucial to future developments when its contents were noted and acted upon by the new hospital building committee in Belfast.

The Royal Victoria Hospital Belfast.

The preliminary planning for the new hospital to be built at Belfast was probably more methodical than is usual by local bodies. The Chairman of the Hospital Committee was the Rt. Hon. W. J. Pirrie of Ormiston, Lord Mayor of Belfast in 1897, with a lifetime of experience in shipbuilding and marine design (54), so that the essential ingredients of

54. Chairman of Harland & Wolff.

compactness and efficiency entered naturally into the thinking of the Chairman and many of his colleagues, making an "engineering" approach to the initial planning almost inevitable.

The financial impetus for the project was provided by Mrs, Pirrie who inaugurated the "Victoria Jubilee Fund", and a six-acre site at the junction of Grosvenor Street and Falls Road was secured. An additional six acres would be available after the removal and rebuilding of an asylum. Members of the Construction Committee formed in 1898 with W. J. Pirrie as chairman were deputed to visit recently-completed hospitals, including the Birmingham General, which they described as "a building of considerable architectural importance replete with many modern improvements" (55).

The architectural press had also been examined, and Henman's letter published in The Builder urging a fresh outlook on the designing of hospitals in terms of "health manufacturies" based on Plenum ventilation was noted with interest by men experienced in fan ventilation of ships' engine rooms and cargo holds. (56).

Dispensing with architectural competition, the Construction Committee approached William Henman to provide plans for an entirely new style hospital based on his ideas. An under current of protest from local architects may be seen from the announcement

55. Descriptive Account at the Official Opening of the Royal Victoria Hospital. 27th July 1903. Author Anon p.3.
56. Ibid. p.4

in The Architect of 1898 (57). "It is understood in Belfast that Mr. William Henman of Birmingham will be selected as architect of the new Royal Hospital. The buildings will cost £150,000. There are many architects in Belfast, and this work would be a boon to them, but there is a tendency to accept low fees to secure commissions. Besides it is common to submit to the caprices of clients to an extent that is not professional. The adoption of a stranger to Belfast will prevent the Dutch auction to discover the architect who will accept the lowest commission".

As Henman said later, (58) it never occured to him that this letter would lead to his being invited to Belfast, but the Minutes for 29th November, 1898 record that : "The Sub-Committee having had an interview with Mr. Henman, the architect for the Birmingham Hospital it was:- (59).

Resolved that the Sub-Committee recommend that Mr. Henman be employed as Architect for the Royal Victoria Hospital, to undertake the preparation of all plans, working drawing, and specifications, and superintend the construction and erection of the buildings, his renumeration to be four per cent on the cost of the building and travelling expenses". On the 5th January, 1899 Henman accepted the commission together with Henry Lea M.I.st. C.E. as consulting engineer (60). Thomas Cooper had entered into partnership with Henman during the previous year. He

57. The Architect, 10th September, 1898 p.408
58. Journal of the R.I.B.A. 19th December,1903 p.94
59. Archives of the R.V. Hospital, Belfast. Members present were Professor Cuming, Chairman,W.J. Pirrie, Sir James Musgrove, R.H. Reade and M. Dixon.
60. The Architect 20th December, 1898 p.408

was the son of a Coventry ribbon manufacturer and was articled to Alfred Waterhouse, becoming after many years of service, his chief assistant. Henry Lea of Birmingham, was experienced in electrical and mining engineering and had worked with William Key on the Birmingham Plenum (61).

Sketch plans for a single storey hospital with the wards arranged compactly side by side were first drawn up which when known, raised some opposition from members of the main Hospital Committee, who could not accept the new idea that windows should be dispensed with (62). Architectural influence was brought to bear against the scheme and some opponents "went to considerable trouble, visited other hospitals, and consulted supposed authorities to obtain evidence against the adoption of the plan" (63). It was an anxious time for W. J. Pirrie, Dr. Cumin and the Sub-Committee, and matters hung in the balance until Professor Byers, an honorary member of the medical staff declared convincingly that, "when first he heard that it was proposed to place all the wards side by side without intervening open spaces, to light them principally from above and to have no windows to open, it appeared to him so contrary to all his preconceived ideas on hospital design that he determined to oppose the carrying out of such a plan by every legitimate means, and, to enable him

61. I am indebted to Mr. Donald Lea of Hoare, Lea & Partners, Consulting Engineers, as grandson of Henry Lea for use of working note books both at Birmingham and Belfast.
62. Allison D.R. The Seeds of Time, A Short History of the Belfast Royal Victoria Hospital 1850 - 1903 Belfast. 1972 p.245.
63. Journal of the R.I.B.A. 19th December, 1903 p.94

to do so effectively, he set about independently to study the subject in all its bearings : but to his surprise, the more thoroughly he probed it, the more and more convinced he became that Mr. Henman was right".

Working drawings were now prepared for a hospital that in the opinion of Professor Reyer Banham "is extremely modern and ahead of its time in its environmental controls. The first major building to be air-conditioned for human comfort. The importance of the hospital in the history of architecture lies in its total adaptation in section and plan to the environmental system employed" (64).

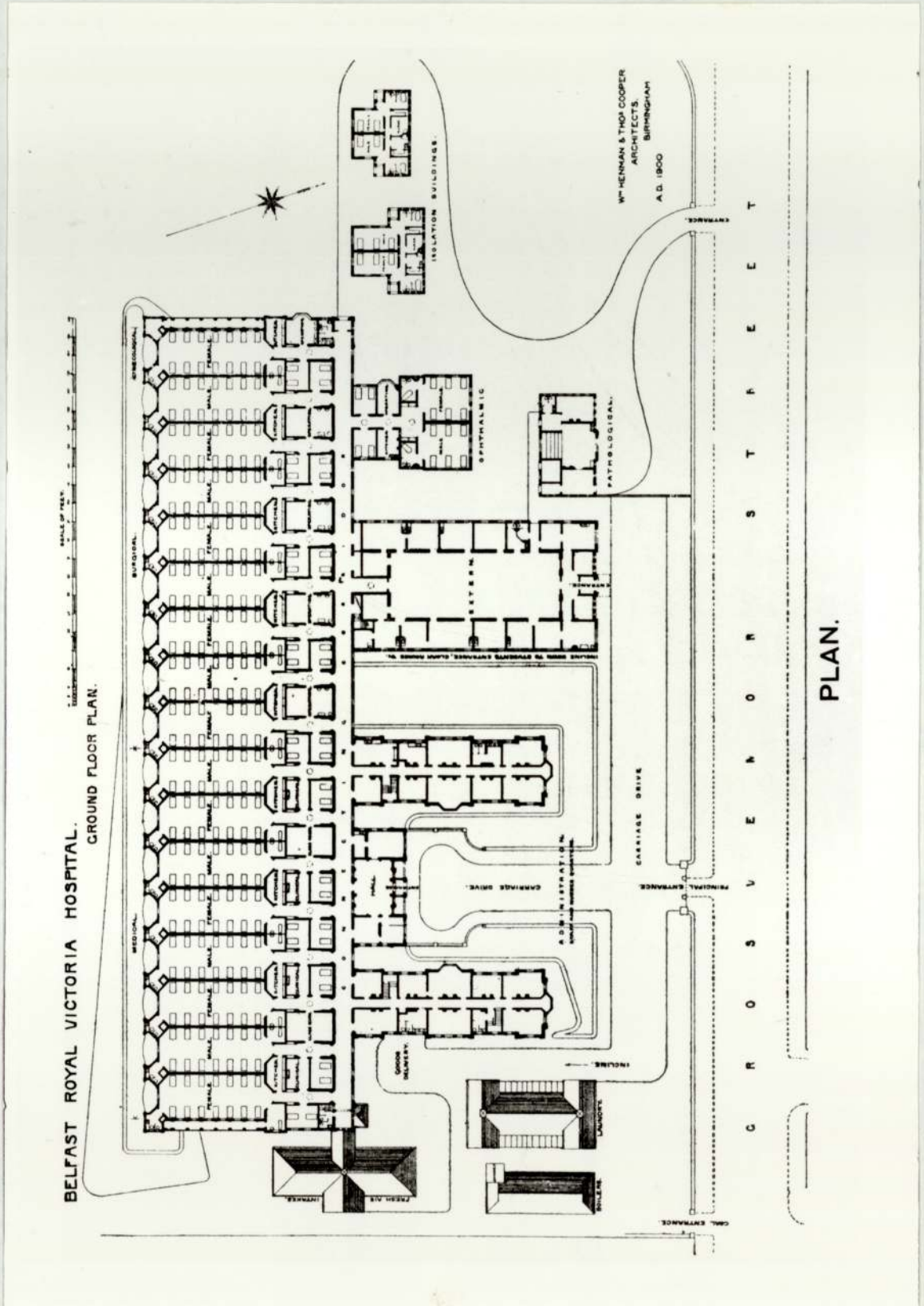
At the design stage however the project suffered a set back. "We wereled on to elaborate the architectural character", reported Henman, "but again we experienced a check. Tenders for the erection of the buildings were received early in Spring of 1900 - just when prices had run up abnormally and little was thought of but the disasters of the South African War : the cost came out at a higher figure than was expected, and beyond the funds at disposal" (65). It was therefore decided to reduce accommodation treatment". The external appearance of the hospital, criticised as mediocre by Professor Reyner Banham, was sacrificed to some extent in favour of the first priority - the interior environment - in keeping with Henman's maxim that "architectural effect is of slight importance to the welfare of patients and ease of administration" (66).

64. Banham R. The Architecture of the Well-tempered Environment, London, 1969 pp 82 & 83
65. Journal of the R.I.B.A. 19th December,1903 p.95.
66. Ibid p.92

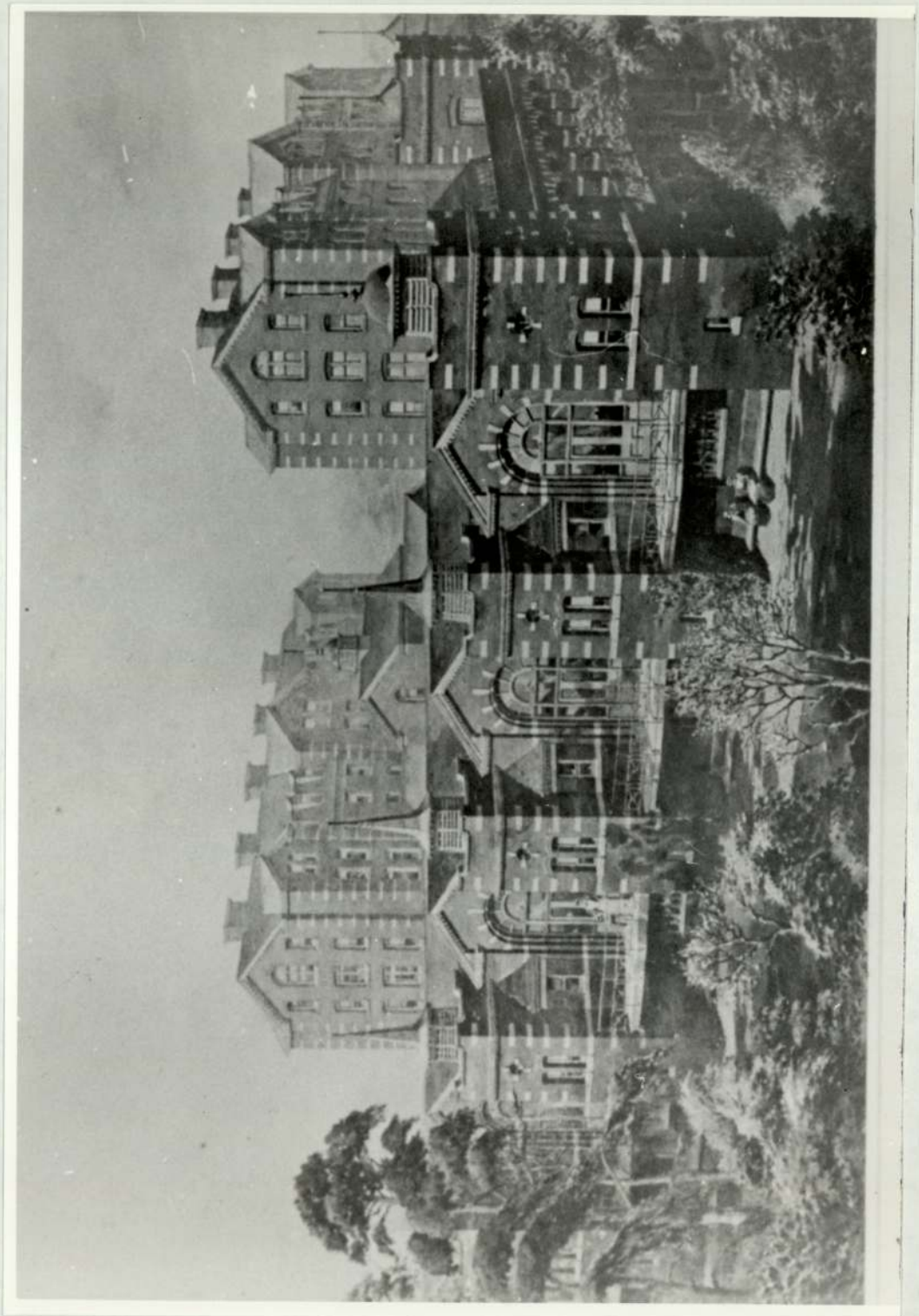
Tenders were then resubmitted for the modified design Messrs. McLaughlin and Harvey of Belfast received the contract to build, G. A. Flower appointed clerk of works and W. H. Stephens Quantity Surveyor.

The general design of the hospital was planned in two quite distinct sections strictly according to their different environmental needs. The section for the sick, comprising seventeen wards, four operating theatres, kitchens etc., was under continuous roof, in one single-storey "sealed" block Plenum warmed and ventilated. The other section, which provided services for out-patients, administration, nurses' accommodation, board room and similar offices, therefore requiring only occasional heating and freedom for individual control of ventilation, was designed in conventional style with three separate tall buildings consisting of basement and four storeys with sash windows, and gas fires to avoid the need to bring coal into the hospital. The tall elements were well spaced apart and faced to the North so that no shadow would fall upon the low ward block to the South, each ward having its own large South-facing window opening through a casement door on to a balcony.

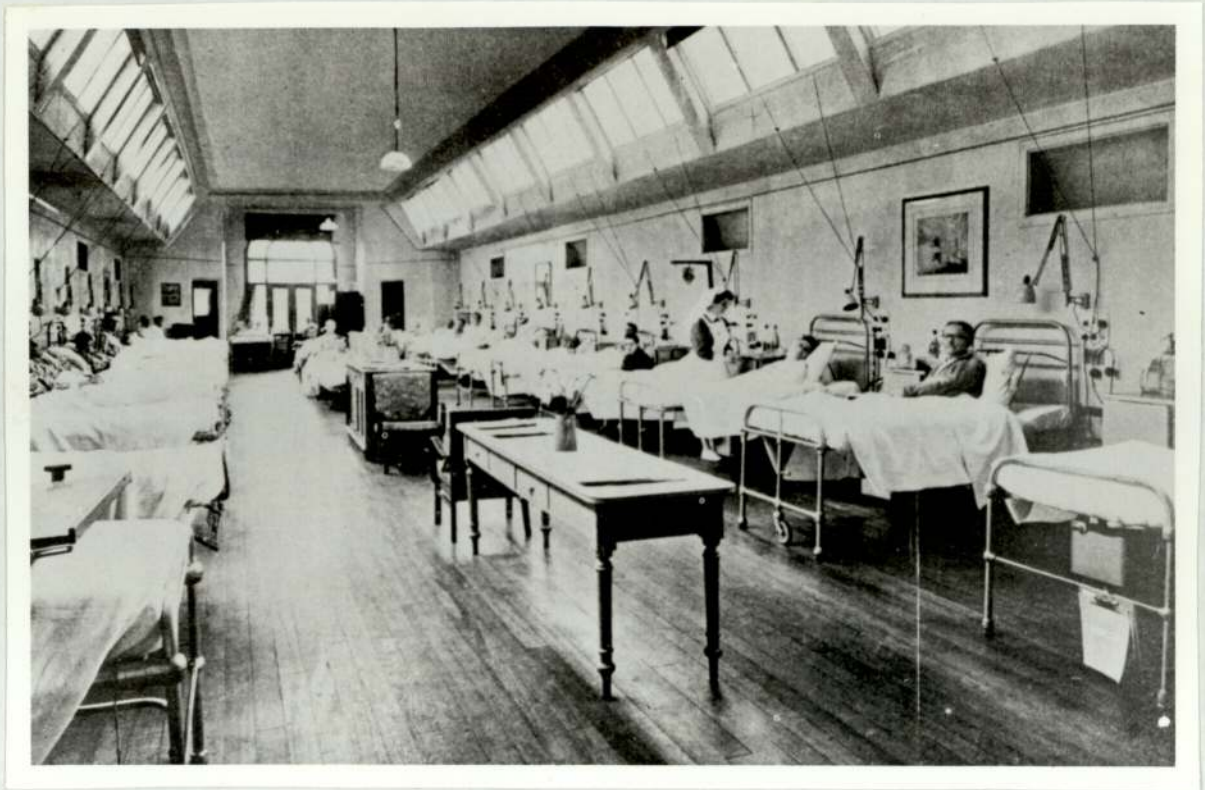
The main corridor 450 feet long and 9 feet wide, ran east and west between the two distinct areas of the hospital yet linking them functionally. As Henman had predicted, his accommodation for the sick had no side windows, since the wards, eight surgical, eight medical and one gynaecological, were all placed side by side. They were lit from above, on both sides and from end to end by sloping clerestory windows set at 60°, this angle being thought the best for light to pass through without being refracted. Blinds were provided to avoid glare and over-heating in Summer. The length of the main corridor was lit in the same way.



Single storey 'sealed' ward block south of longitudinal corridor.



The Wards from the S.E. From a painting by William Herman.



Ward Interior. The Royal Victoria Hospital.

Showing clerestory lights and ventilation inlets.

The wards facing south following the extensions,1938.

The Plenum mechanism, though basically similar to the Birmingham installation, was more efficient. A very large, brick-lined air duct nine feet wide and 443 feet long ran beneath the main corridor of the hospital. At the Eastern end, where the fan chamber was situated, the duct reached to the remarkable height of 20 feet, but as the duct extended along the full length of the building, and branch ducts conveyed air to the wards, its base rose gradually so that as it reached the far end of the hospital, its height was reduced to 5ft 6ins (67). These spacious dimensions were necessary in order to provide the 703,000 cubic feet of air needed to ventilate the patients' side of the hospital enabling seven changes of air per hour in winter and ten changes in summer. The liberal dimensions ensured that the stream of air moved along its length at the leisurely pace of only 7.06 feet per second in winter and 10.85 feet per second in summer thus eliminating the possibility of draughts and, because of the correspondingly slow rate of revolution of the driving fans, effecting a considerable saving in fuel costs. There were two fans each 9ft 2inches in diameter, though normally only one was needed. All essential equipment was in duplicate to allow for repair, rest or cleaning. There were no auxilliary fans or electric motors as at Birmingham. The Belfast fans were driven by a steam engine, the exhaust steam from which was used for the heating of water for baths and domestic use, thus making substantial savings in the cost of electric power.

67. The lowering in height of the duct followed a natural rise in ground level of the site from East to West.

The cleansing and warming of the air was broadly similar to the arrangement in the Birmingham hospital. There were two separate intakes, each thirty square feet with numerous openings on three sides for admitting the air from outside. The entering air first passed across an outer series of vertical steam pipes to warm it slightly before passing through the cleansing process, the object being to prevent very cold air in winter from freezing the cleansing screens. These were made, as before, of coconut fibre, but wound on to rollers fitted into wooden panels for ease of removal, as it had been discovered that the older, fixed coconut screens tended after a time to rot first at the top thus causing the whole screen to fall. The vertical cleansing screens were kept continuously wet by means of perforated sprinkler pipes with automatic flushing tanks operating every ten minutes. After cleansing, the air passed through the inner battery of steam coils which were arranged by Henry Lea so that only two regulating valves were necessary for control by the engineer in charge. The air thus leaving this apparatus was about 58°F and therefore suitable for the entrance hall and corridors, but for the wards it needed to be raised to about 62°F and this was done by installing large heating pipes running along the ceiling of the main duct which fed supplementary steam coils in the branch ducts to each ward. In this way, the temperature for the operating rooms was raised to 70°F. Two small isolation wards at the end of the site were supplied from an extension of the main duct even though 600 feet away from the driving fan.

The main wards were identical in lay-out. Each contained fourteen beds and received treated air "cleansed from suspended impurities and brought to suitable hygrometric condition" from wall inlets at a height of about eight feet and removed by outlets placed just above floor level in the wainscot. As

at Birmingham, Henman's method of disposal into the atmosphere was by risers in the external walls, terminating in a series of ornamental louvred turrets, one for each ward. These extended along the south façade of the ward block and provide a modest architectural feature.

The official opening of the hospital, by the King and Queen, took place on 27th July, 1903. The commemorative booklet for the occasion expresses satisfaction with the economical aspect of the new hospital. "The guiding principle in the design and equipment of the hospital has been to economise daily labour... The buildings are unique in their external simplicity, as well as in their internal arrangements, but their size and the care bestowed upon the design combine to produce a very satisfactory architectural effect. The cost of the buildings has been exceedingly moderate and, including the whole of the mechanical appliances will not exceed £300 per bed, a very low figure for such a complete and up-to-date hospital" (68).

The reputation of the Royal Victoria Hospital as a pioneer building cannot be examined without reference to the assessment by Professor Reyner Banham (69), in which he traces the influence of mechanical services on architectural design, and includes a detailed description of the hospital, claiming for it a niche in the history of architecture by declaring that "the duct is one of the most monumental in history

68. Descriptive Account The Royal Victoria Hospital 27th July, 1903. Author anon. Copy sent to hospital archivist.
69. Banham p.75 et seq.

of environmental engineering", but he is disparaging concerning the contribution of William Henman and Henry Lea, questioning their ability to envisage such an advanced building and throwing suspicion on their integrity by hinting that they might have concealed the identity of the true originator. "At face value", he writes, "the credit for its design goes straight forwardly to the Birmingham architectural firm of Henman and Cooper, with Henry Lea as their engineering consultant, but a fog of rumour has always surrounded the design, because local pride insists that the whole project is too original to chime with the rest of Henman and Cooper's work, and at first sight it must appear strange that in a city where the forced ventilation of ships was a technological habit, and where Samuel Cleland Davidson's "SIROCCO" Works was producing the world's most advanced centrifugal fans, neither influence should have had any apparent effect on the design, installation and subsequent maintenance of the heating and ventilating machinery .... The external aspect of the Royal Victoria Hospital also demonstrates with painful clarity the total irrelevance of detailed architectural "style" to the modernity of the functional and environmental parts.

"The hospital is extremely "modern" and ahead of its time in its environmental controls ... But in its detailing, in what its designers doubtless regarded as its "art architecture" it belongs dismally and irrevocably to a conception of "Welfare" architecture fathered by the London School Board some forty years before".

In a radio talk given in 1967 (70), this criticism

70. B.B.C. Third Programme Talk entitled "The Architecture Below", published in The Listener 9th February, 1967 p.196.

becomes more pungent : "Stylistically, the Royal Victoria Hospital is indeed a stinker..." Both Henman and Lea read papers on the design at the R.I.B.A. in 1904, and made strong claims for its superiority to earlier hospitals, including Henman's Birmingham General. But something nasty seems to have happened to the discussion after the papers. The impressions one gets from news-paragraphs and letters in the architectural magazines in 1904 and 1905 is that the discussion was either rigged or filibustered out of time, to prevent something discreditable coming to light. Ostensibly this was the allegation of inordinately high running costs, but covertly it seems to have been that someone other than Henman or Lea was the "real" designer".

All these claims can be refuted by reference to Henman's previous career (71). It seems, for instance, that Professor Banham was unaware that Henman had considerable engineering experience and inventive flair. His contact with shipbuilders and engineers of high repute such as Thomas Wrightson had begun on Tees-side twenty years before (72) where Henman had invented a "Hopper Barge", and his design for the Great Tower For London Competition in 1890 had received favourable comment and a full-page illustration in The Engineer of 20th June, (73). Furthermore, his series of inventions, covered by patent applications,

71. Journal of the R.I.B.A. October 1981. Ventilating the Royal Victoria Hospital.
72. Sir Thomas Wrighton M.P. of Norton Hall, Middlesbrough. Alexander & Henman had restored Norton Church and built Norton School in 1876.
73. The Engineer, 20th June, 1890 p.493. In collaboration with Professor Robert H. Smith of Birmingham University.

ten in number, between the years 1876 and 1911 indicate his capability to formulate new approaches to the engineering problems connected with architecture. (74).

One invention in particular is relevant to the suggestion of incompetence at Belfast. This was covered by patent number 23531 of 7th December, 1893 - seven years before the Belfast installation. Henman was concerned that spores and germs discharged in the foul air from outlet turrets of the infections diseases wards at Birmingham could re-infect the atmosphere. He invented an adaption of William Key's cleansing screen, by which an apparatus forced the out-going air through a solution of carbolic acid trickling down the cords of the screen. "I consider this invention", said William Key, "one of the greatest sanitary discoveries of the year" (75).

Professor Banham gives complete credit for the ventilation system at Belfast to the fan manufacturers, Davidson's but the Minutes of the Committee for August 1901 (76) state : "Resolved that as the whole responsibility for the ventilation of the hospital rests on the architects, that the architects in conjunction with Mr. Henry Lea be hereby authorised to obtain and receive tenders for the engineering contracts". A later entry states, "Mr. Reade reported the acceptance of the following tenders :
£630-0-0 Davidson and Co. for fans.
£1200-19-6 William Coates and Son for electric wiring and fittings".

74. Chapter 6.
75. Key W. Paper read at Glasgow 24th August, 1894 Means of Destroying Spores and Germs from Infectious Diseases Hospitals, Belfast.
76. Archives of Royal Victoria Hospital, Belfast.

A Mr. James Davidson, who may have been a member of the Sirocco Engineering Works, was a member of the Board of Management of the hospital at that time.

The criticism belittling the external architecture of the Royal Victoria needs to be counter balanced by the realisation that funds were not available to build the hospital as it was originally planned. Henman reported his "regret at losing the chance of carrying out a large building of good architectural design" (77). He settled for a utilitarian one and in view of this, his three tall blocks are admittedly somewhat gaunt, as befits his concept of a "health manufactury" as he termed it, but the touches of architectural embellishment on the medical block are not from a style of forty years before: the cupolas and disc-topped pinnacles were popular features at that time (78).

Professor Banham finds praise for the subterranean elements. "All the wards are carried on an elaborate system of arcaded undercrofts ... I was struck by its calm, business-like and, above all, classical air. It is the kind of rock-bottom classicism of brick piers and brick arches that would have delighted Sir John Soane - or Sir John Summerson. Not only the first air-conditioned building but also the last and only air-conditioned building the Romans might have built" (79).

The claim that he makes for the Royal Victoria Hospital to stand as the first building to be air-

77. Journal of the R.I.B.A. 19th December 1903. pp.89-110.
78. The corner tourelles of Norman Shaw's New Scotland Yard (1890) for instance.
79. The Listener, 9th February 1967. p.197.

conditioned for human comfort arises from a custom adopted in the hospital, reported to have begun some time before the nineteen twenties, for the humidity of the air in the wards to be tested morning and evening using a wet and dry bulb hygrometer. The attendant was then instructed to alter the flow of water over the humidifying screens accordingly. Despite the crudity of this method of control, if the term "air-conditioning" as originated by Stuart Cramer (80) and defined by him as the controlled humidifying of the air as well as cleaning, heating and ventilation, then, as Professor Reyner Banham claims, "The Royal Victoria Hospital became a building air-conditioned for human comfort, and very likely the first in the world" (81).

At the time of its completion neither the merits of the hospital nor the theories of its architect and engineer were generally accepted or appreciated, but the work attracted considerable interest and controversy. Commercial engineering interests on both sides of the Natural versus Artificial ventilation lobbies became acutely involved. The interests of the patent cowl manufacturers, particularly those of the highly successful firm of Robert Boyle & Son were threatened. This firm had for instance, provided "self-acting Air Pump Ventilators" for Waterhouse at Caius College and Reading town hall, and its international reputation extended to the supply of patent ventilators for the Mormon Temple, Salt Lake City (82). Sensing the

80. Banham p.82. Quoted from a lecture given by Stuart Cramer in 1906.
81. Three years before the Larkin Building, New York (1906) by Frank Lloyd Wright, previously considered the first.
82. The Architect, 9th July, 1889, p.95

challenge of Plenum, Messrs Boyles had published a book in 1899 (83) containing a collection of extracts lifted out of context from the writings of Sir Henry Burdett, Sir Douglas Galton, Surgeon-General Sir Thomas Crawford and others, affirming "the complete failure of artificial ventilation in this country". Medical opinion on the whole was puzzled and mainly convinced of the effectiveness of the way to health through fresh "natural" air.

Henman, for his part, continued to read papers to architectural associations in the provincial manufacturing cities where fresh air was conspicuously absent, and also to gatherings such as the Institute of Heating and Ventilating Engineers (84). By the close of 1903 he was invited, together with his partner Thomas Cooper and consulting engineer Henry Lea, to give details concerning the design and engineering features which they claimed were unique at Belfast, before the Council of the Royal Institute of British Architects.

83. Boyle R. Natural and Artificial Ventilation London 1899.
84. Report of the Institute of Heating and Ventilating Engineers 1902-1903 p.90.

The Royal Victoria Hospital Ventilating Controversy.

On 10th December, 1903, under the Presidency of Aston Webb, Henman assisted by Lea presented his paper "The Royal Victoria Hospital, Belfast : its Initiation, Design and Equipment" to the R.I.B.A. He chose as an opening statement, "There is much that is unique in its inception, original in its design and novel in its equipment", and added that he would be giving "the reasons which led up to what has been termed "a revolution in hospital design" (85). Henman's appearance before the R.I.B.A. marked the culmination of a series of speeches and papers, to describe what he regarded as his break-through in hospital design, made during the previous nine years. At Leeds in 1894 he had laid emphasis on the need to prevent air circulating from ward to ward - which plenum ventilation prevented (86). At the Sanitary Congress of 1894 held in Liverpool his paper "Air Purification in Hospitals" (87) took as its starting point "air is the chief conveyance of disease", and the air washing screens received special mention - though opposition came from the physician Sir Thomas Crawford, "no hospital should be built where the in-going air has to be pumped". A subsequent paper by Keith D. Young F.R.I.B.A. quoted the authority of Sir Douglas Galton, "The system of propulsion for hospital ventilation has not found general favour with hospital architects or managers in this country". Young supposed there would be difficulties in keeping the air shafts clean in a system involving "large expenditure to keep air moving when windows could be opened for nothing". On 5th

85. Journal of the R.I.B.A. 19th December, 1903. p.89.
86. The Architect 9th March, 1894 p.264
87. The Architect 9th June, 1894 p.342.

August 1898 when the Sanitary Congress was held in Birmingham with Henman presiding over the Engineering and Architecture section, his view received support from Professor Napier Shaw's paper "Alternatives to Cross Ventilation" (88) supporting "mechanically driven blowing machines to propel air into a room instead of suction by fire and chimney". In that year Henman had received the commission to build the Belfast hospital in accordance with the compact design for wards described in his letter to The Builder, and at the next Sanitary Congress in London 1899 (89), he explained his idea in a paper "Developments in Hospital Planning and Construction Resulting from the Employment of Plenum Ventilation" (90). "After the Birmingham General Hospital 'high authorities', having predicted failure, were all agreed that it was a success. He could not suppose that the bolder step would meet with unqualified approval, and although he would not presume that absolute perfection would be obtained, he felt thoroughly justified in making the attempt".

Informed medical opinion was moving in Henman's direction. In 1895 The Lancet appointed a Special Sanitary Commission on Ventilation and the Treatment of Infected Air (91). The Commission dismissed natural ventilation as "obviously unsuited for a hospital since it cannot be placed under control" and recommended the Plenum System "as devised by the Glasgow engineer William Key and installed in the new Birmingham General Hospital". But gathered at the R.I.B.A. to hear the papers by Henman and Lea were architects of considerable standing sharing the views

88. The Architect, 20th September, 1898 p.236
89. The Builder, 8th August, 1896 p.122
90. The Architect, 20th September, 1899 p.156.
91. Quoted Painter F. The Evolution of Hospitals in Britain. London 1964. p.218.

of A. Saxon Snell, who, with his father had been responsible for the St. Charles Hospital, South Kensington and the Marylebone Infirmary, where a method of humidity control had been introduced and considered a great advance at the time, although heating was by open fires which warmed coils of hot water pipes.

Henman emphasised that he had no desire in his paper to raise the controversy on the subject of mechanical versus natural ventilation : it was obvious that his block of wards could not have been ventilated without mechanical means and that the availability of the means had provided the opportunity for innovatory design (92). "It would be as unreasonable to condemn the employment of mechanism as it would be to assert that sailing vessels can compete with steamships for speed, carrying capacity or punctuality" (93). He claimed that it had been twelve years since Key's method had been proved successful and it behoved architects to master its details and apply them for public benefit. The real disadvantages of pavilion wards especially in large hospitals, he emphasised, lay in administrative delays in consequence of great distances, stairs and lifts. Future advance should lie in the concentration of wards made possible by antiseptics and controlled ventilation. Henman then gave a detailed description of his design, aided by drawings and lantern slides, and pointing out that the South African War had caused drastic external modifications but that the essential ventilation system had been saved. All the principal wards had South-facing windows opening onto balconies and lit by lantern or clerestory lights made of half inch

92. The Builder 25th June, 1881 p.792.
93. Journal of the R.I.B.A. 19th December,1903 p.90.

plate glass set from end to end, fitted with blinds. To conclude he urged that he was not putting forward his design as a model to be copied but as a ventilation scheme designed to meet the actual requirements of a particular building. Henry Lea's paper describing the technical details of the system was then presented.

In the discussion that followed Dr. Childs struck the first discordant note. "Did the air contain that invigorating freshness which they recognised was possessed by fresh air?" He cited the wonderful effects produced by the open-air treatment of phthisis. It was true that the plenum ventilation eliminated draughts and produced uniform temperature, but was this best for the patient? Saxon Snell interposed to say that extreme importance attached to the subject because the advocates of plenum were introducing to the public and to architects a system which had great attraction as something novel and complicated, and those who considered that the plenum system was a huge mistake felt that they should do their best to have it argued out. He suggested that at that late hour the debate might be adjourned to a future occasion. The President replied that the subject was of great interest to all engaged in the erection of buildings of a large and public character and that Henman had made a novel and bold effort to meet the difficulties which a long extended hospital presented. He agreed that the more they could discuss it the better.

It was not until 6th June, 1904 that the special follow-up meeting was held at 9, Conduit Street, with Aston Webb again in the chair (94). Henman first

94. The Builder, 11th June, 1904. p.629.

defined efficient ventilation as "continuous change of air within a building without causing discomfort or adversely affecting the health of the occupants", and defended his position : "It is no argument to say, 'I dont like plenum ventilation', or even to point to failures which have occurred : nor is it sufficient to bring forward some fanciful idea that in an indefined manner air moved by mechanical means is deprived of an unknown vital essence". He pointed out that in Summertime plenum ventilation was so effective in maintaining a cooler and invigorating atmosphere and that any failures in plenum usage had resulted either from want of knowledge and experience on the part of those who installed it, or from neglect. His next point emphasised the considerable economy in fuel for the power needed at Belfast. This he illustrated by a table of comparisons with other large institutions. The fuel consumption cost at £20 per million cubic feet of air circulated per annum at Belfast was clearly the lowest.

S. Perkins Pick F.R.I.B.A. opened the ensuing discussion. He first complimented Henman & Cooper for their courage - almost audacity, in designing a building "so utterly at variance with nearly all preconceived notions of buildings of this class " (95). He had made a careful inspection of the hospital and noted that after eight months occupation that the superintendent, sisters, nurses, engineer, "and even the patients themselves appeared equally pleased with the arrangements, but in spite of the satisfaction expressed, in his judgment the plenum system for a hospital was not essential, nor did he think that the administrative advantages gained

95. Ibid p.631.

by concentration of wards were commensurate with the risks incurred and the loss involved by the omission of "those side windows which most of us dearly love and appreciate". He thought that for crowded conditions in assembly halls, plenum gave satisfactory results; for operating theatres where control was essential, and in out-patient departments" where a waiting hall is crowded with people of lower classes" no method was better than plenum. He thought arrangements at Belfast were quite excellent, and although crowded when he inspected, the various rooms "were entirely fresh and healthy". He questioned whether the drainage system might leak and affect the air duct, and there appeared a lack of inspection chambers; the main air inlets should have been at least eight feet from the ground level instead of three feet, and that exhaust steam from the fan engine should have been used to generate electricity for general lighting. Despite this, he declared the scheme at Belfast the best he had seen "and whether other architects follow the daring lead of Messrs Henman and Cooper or not, the enormous educational advantage they have given us in having the boldness to carry out their convictions is properly appreciated by every member of this Instite".

A. Saxon Snell said that although the original discussion had been on Henman's hospital, the council had altered it to one on plenum ventilation since the hospital was the very incarnation of plenum. He admired the enthusiasm Henman had given to the building but he had reverted to a type of ward built by his (Saxon Snell's) father forty years previously. The wards of the Marylebone Workhouse were of the same type though rather worse because they had no top lighting. He would not recommend that type of ward for a hospital : it was unfortunate that the question of plenum ventilation had been canvassed so much in the Press by one or two firms commercially interested in

the matter. He had no bigoted objection to plenum and had tried, though unsuccessful, to induce a hospital board to allow him to install it for two operating theatres, for these were exceptional buildings and "for doing work under exceptional circumstances one wanted an exceptional system of ventilation". Snell then widened the issue by raising the criticism that "downward ventilation", being contrary to natural laws of air movement caused patients to breathe air containing less oxygen and to suffer from the effects of monotony in conditions of constant temperature. He concluded, "Go back to nature : go into the fresh air and live purely".

Dr. S. Rideal observed that the speech by Saxon Snell "as interesting but not a scientific statement of objections to the Plenum System". The warmed air even if slightly deficient in oxygen was germ free and dust freed : slightly quicker breathing could easily make good the loss. He then demonstrated Aitkin's consicope, an instrument to determine particles of dust in different parts of a room as an aid to better ventilation.

Rev. J. B. Lock of Cambridge University maintained that mechanical ventilation was not new - the fire and chimney drew air mechanically and was a good method until the fan was introduced. At Cambridge he had had the responsibility of assisting to decide on methods of ventilating. In one building they chose the vacuum (or fire) method and in the other the plenum because it was a medical school and they wanted more certainty of ventilation. In certain cases the plenum was one they could not do without.

At this point, the main thrust of the argument

seems to have been lost (96). Several comments of a minor character followed one another. W.K. Parry (Dublin) drew attention to the actual weight of air to be moved to achieve good ventilation. At 20 tons per hour mechanical means were essential and whatever the difficulty of keeping air passages clean, radiators as an alternative collected more dust. H. Griffiths criticised the cleansing screens and thought they should be made to revolve and so shed accumulated impurities. E. W. Hudson again raised the controversy concerning whether to admit pure air at high level and expel at low, citing the Capital Washington and Sir Joshua Jebb's Pentonville as unsatisfactory examples.

Max Clarke F.R.I.B.A. brought the discussion back to fundamentals. Queen's Square, London where he lived was crowded with hospitals : if it was necessary for hospitals to be in such places, was it not better to send in to the patients air as pure as they could make it rather than trust to Providence? All the little bickerings as to how it should be done, size and bends of pipes, were matters of detail.

The Chairman concluding said he thought they had spent the evening well. He would have liked the matter of cost to have been discussed - a point no architect could ignore. As time had not been available for Henman, Cooper or Lea to respond to the points of criticism, they did so in a series of letters (97). S. Perkins Pick was assured that all

96. Perhaps this was the 'filibusting' episode Banham mentioned in The Listener, 9th February, 1967. p.197.
97. Beginning in the R.I.B.A. Journal, 25th June 1904 p.462 and The Builder 25th June, 1904 p.688.

drains were kept well below the level of the air ducts and his remaining remarks, considered trivial and sometimes hypercritical, were answered. Saxon Snell received abrupt treatment. "Mr. Saxon Snell's remarks can scarcely be taken seriously ... in contrast therewith we commend the more thoughtful views expressed by Dr. S. Rideal and the Rev. Lock".

All other objectors at the meeting were briefly answered, but a particularly firm reply was given to a Mr. George H. Bibby, a Belfast architect who had written letters to the R.I.B.A. Journal (98) purporting to claim that Henman and Lea had falsified their reports concerning the success of the ventilation, and in respect of the fuel consumption at the Royal Victoria Hospital, that one medical official had complained of headaches when visiting, and that "beyond all possible doubt certain portions of this hospital are very badly ventilated, the odours of anaesthetics etc., passing from one ward to another by way of the corridor. This can be confirmed by the official who conducted me through the wards". This attempt to discredit the hospital by a disgruntled Belfast architect who was at the time in the process of publishing a book on ventilation, received an abrupt reply. "The deductions of Mr. Geo. H. Bibby are so obviously unreliable that we communicated them to the superientendent of the hospital and here give his reply : 'The general health of the hospital establishment is excellent. I cannot trace the doctor who is alleged to have said the hospital gives him a headache .... The nurses too are in better health than they were before we came here" (99). He suggested that the R.I.B.A. should send a

98. Journal of the R.I.B.A. 18th Juue, 1904 p.392 and 14th July, 1904. p.487.
99. Ibid 25th June, 1904. p.463

small deputation to resolve the matter on the spot. Reporting from the hospital, the architects and engineer could find no confirmation of Bibby's statements. "He was not shown over, or even seen, by the superintendent, neither could a diligent search discover his doctor afflicted with headache". A further examination of fuel consumption showed that Bibby had used the wrong quotations from the Annual Report, whereupon Bibby claimed that Henman's errors of calculation resulted from "the general arrangement of these Irish hospital reports" (100). After Henman had taken a page of the Journal to prove that the average cost of fuel used per bed was £4-5-6 in 1903, the editor had reached the end of his endurance (101). The dispute dragged on until 9th January, 1905 by which time C. H. Bibby had considered Henman's remarks libellous and had extracted published expressions of regret from the editor of the Journal and also from Spottiswoods the printers, but no recorded retraction of the part of the architects (102).

100. Ibid. 17th September, 1904. p.463.
101. Ibid, 26th November, 1904. p.64
102. The Architect, 16th January, 1905 p.4

CHAPTER 5.

THE SIGNIFICANCE OF THE ROYAL VICTORIA HOSPITAL TO PRESENT-DAY HOSPITAL PLANNING.

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After the completion of the hospital, there were no immediate successors in the form of other hospitals embodying full plenum ventilation with its strong philosophical design approach. Henman himself had no further opportunities though his interest in hospital construction continued and three more designs were completed before his retirement in 1912. These however were small ones : Ramsey Cottage Hospital (1905) Douglas (1910) and Malvern Cottage Hospital (1911). The influence of the work at Belfast remained however, and affected subsequent use of environmental engineering. The value of plenum for operating theatres and other specialised areas such as treatment rooms was acknowledged, and a gradual implementation in this direction was undertaken in large hospitals throughout the country : the medical system prior to the Second World War however consisted of two badly co-ordinated patterns of care - the voluntary and the public authority hospitals resulting in delays and misuse of available resources. When the Queen Elizabeth Hospital in Birmingham was opened in 1938 as one of the leading pre-war Medical Centres, the only major ventilation was in the operating theatres, and even this was very basic, for there was no provision for cooling (1). Air-conditioning in operating theatres was regarded as much as an anti cross-infection device as for the well-being of the patient or surgeon and theatre staff. Draughts from open doors would transmit germs from one area to another, whereas the mild positive pressure provided by plenum air acted as a barrier.

1. Report by D. Lea of Hoare, Lea & Partners, Consulting Engineer to the Queen Elizabeth Hospital project, Auchinleck House, Birmingham.

Although a high degree of mechanical servicing, including plenum chambers, were provided in the "super" cinemas of the 1930's (2) from strong commercial motives, the stringent cost climate in hospital work both before and after the introduction of the National Health Service in 1948 served to restrict the provision of mechanical services to strict essentials until comparatively recently, when in a few special cases the particular conditions of site and circumstance have led to the consideration of solutions which have their parallel in Belfast. On 27th August, 1980 members of the Low Energy Hospital team from the Department of Health and Social Security visited the Royal Victoria Hospital (3). The object was to assess the 1903 buildings in the light of modern medical practice, the unusual ward design being of special interest in view of the current D.H.S.S. Ward planning studies. The overwhelming impression, both in the wards, their ancillary rooms, and the main corridor was that "the continuous clerestories gave a very bright and sparkling appearance to the hospital .... No adverse reports were heard from staff or patients of the lack of 'normal' windows (4). Henman's Nightingale wards, designed originally for seven beds per side, were extended to eleven per side in 1938 retaining clerestory lighting and justifying the architects claim for flexibility to allow for future need. The plenum ventilation system, in spite of renewal of some plant, was still working as originally designed, with the great duct directly below the main corridor and the report noted particularly that, "In very hot weather the duct floor can be flooded to get extra cooling by evaporation". There were some comments of coolness at night,but "The absence of odours, even in the

2. The Astoria, Finsbury Park, London 1930. Architect E.A. Stone, was typical.
3. From D.H.S.S. Euston Tower, Euston Road, London.
4. Noakes A. Report of a Visit to the Royal Victoria Hospital, Belfast. 27th August, 1980 p.1

sluice rooms and two wards with a high proportion of elderly patients, was striking". The hospital engineer thought that the basic simplicity of the system was its greatest advantage, and maintenance was probably no more of a problem than in the newer buildings.

The main corridor, a principal feature of Henman's design philosophy, received special comment from the investigating team. "The main corridor also with clerestory windows is a noisy, bright, bustling place, very good for informal contacts between staff. It is perhaps a little too narrow; more absorbent finishes would make it quieter. The compact planning makes walking distances short. Corridors in the new buildings seemed gloomy and subdued by comparison, although less noisy" (5).

There is a close correlation between the favourable comments made in this report and the present day pattern of thought regarding the features desirable in the best modern hospitals. In Britain there was a hospital building boom extending between the mid 1950's until 1974 when re-organisation and the ensuing economic slump delayed progress. During that time experimental design by inter disciplinary teams was possible. Medicine and its associated technologies suggested that the old traditional boundaries between

5. The members of the D.H.S.S. Low Energy Hospital Team were:-
Armorel Billing - Nursing Officer D.H.S.S.
Michael Corcoran - Services Engineer, Building Design Partnership.
Richard Burton - Ahrends, Burton & Kovalek, architects.
Neil Taylor - Structural Engineer, Gifford & Partners.
Tony Noakes - Architect D.H.S.S.

departments and consultants were an impediment since many fields of treatment over-lapped. Communication - the way in which all concerned with patient welfare could come into contact with one another was a fundamental consideration. At first, emphasis was on short walking distances. There was a tendency towards "vertical" buildings where the limited perimeter reduced heating loads, but transportation had then to be centralised on lift shafts with small lobby areas which stratified the building and reduced informal contact or the element of chance encounter. It was found that a hospital that relied on telephones for communication and on lifts for transport could never be wholly successful. (6).

By the 1960's planners considered once more the possible advantages of a "horizontal" hospital plan, and thus the Victorian pavilion and corridor design began to reappear in 20th century garb. Wexham Park Hospital, Slough was one of the earliest (7). Here the wards were single storey 'bungalows' compactly arranged so that "most of the important journeys in a hospital - kitchens to wards, wards to operating theatres for example took less time with the bungaloid growth of wards than with the 'matchbox'. We thought of the hospital a criss-cross of walk-ways, intersecting at the centre of gravity below the tower" (8). The seven storey tower with views of Windsor Castle was for administration and medical

6. Stone P. British Hospital and Health Care Buildings, London 1980, p.121.
7. Built in 1962. Architects, Powell & Moya.
8. Journal of the R.I.B.A., March 1966. Architects Report by Powell P.

accommodation only - as were the higher buildings designed by Henman at Belfast.

More recent still is the Northwick Park Hospital, Harrow where pavilions capable of extension are placed at right angles to the communication corridor as at Belfast. "The first deliberate attempt to design a modern hospital with no finite form". The architect compared this basic idea with Brunel's design for the hospital at Renkioi (Dardanelles) (9) which Brunel described as "a number of separate buildings made all of the same size and shape so that with an indefinite length of open corridor to connect the various parts, they may be arranged in any form to suit the levels and shape of the ground." (10).

Perhaps the hospital approximating most closely to the Royal Victoria in design ideology and equipment is the Greenwich District Hospital built in 1969 and designed by D.H.S.S. Architects. The problem at Greenwich was to build an 800 bed hospital on a restricted site of 7½ acres in an area surrounded by a belt of heavy industry, 19th century housing and docks leading down to the Thames. The solution was to build a low-lying 4 storey building totally sealed and depending on a comprehensive air-conditioning system - which was a major aspect of the design and accounted for 50% of the cost of the first phase of building (since facilities were provided for the complete project). The very compact design allowed for convenient patterns of circulation especially as movement of people

9. Built in 1972. Architects-Llewelyn,Davies,Weeks.
10. Quoted. Stone P. pp 5 and 150.

between the floors was by escalator - this being the quickest and cheapest way of handling the bulk of passenger traffic and also providing ideal conditions for informal contacts. Lifts were available for beds and patients. The hospital was considered to be a significant departure from anything previously provided in this couutry and was the result of very close collaboration between engineers and architects during the early stages of the development.

It is not known whether the plenum installation at Belfast was studied by the Greenwich design team, but it is a matter for regret that the designers of another Thames Side hospital omitted to do so. The The Charing Cross Hospital, opened in 1973 rises to a height of 15 storeys. The lack of air-conditioning resulted from financial restrictions and ventilation is by open windows which, in the case of bedrooms on the outside walls command superb views over London. Unfortuuately another large section of the building runs parallel with the Fulham Palace Road, and since the hospital also lies beneath the Heathrow flight path, "one has the choice of stifling in peace or bearing the noise" (11). In the old Charing Cross Strand Hospital the centre point for contact and discussion was the spiral staircase around the lift shaft in the central well which was made of lattice ironwork so the view up and down was uninterrupted, providing opportunities for chance encounter. The new hospital has no focal point. A span of 70 years thus separates Belfast from Charing Cross, yet despite the intervening period rich in technological progress, the Royal

11. Ibid p.121

Victoria Hospital still functions well and upholds Henman's maxim that "architectural effect is of slight importance to the welfare of patients and ease of administration".

Following the appearance of the writer's article in the Journal of the R.I.B.A. in October, 1981, Tony Noakes, superintending architect at the D.H.H.S., submitted additional comments for publication in November, 1981. He was firmly of the opinion that the Royal Victoria Hospital anticipated many recent trends in hospital planning such as Le Corbusier's Venice design. Air-conditioning was the key to getting much accommodation into a small site and was also a means of combating noise and atmospheric pollution, while compactness of design reduced staff walking distances. The continuous balcony at the end of the wards at Belfast solved the fire escape problem that had beset so many old hospitals. The main corridor and balconies were both capable of extension to provide for extra accommodation and was so extended in 1923 when three additional fourteen bed wards were added to the original seventeen, and in 1938 all twenty wards were extended by 10 metres and so increased to twenty-two beds each. The resulting expansion along both axes thus demonstrates that Henman anticipated by sixty years the proponents of "indeterminate" architecture as a means of planning for growth.

CHAPTER 6.

THE INVENTIONS OF WILLIAM HENMAN.

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Since Henman's family background the early training at the Royal Academy were strongly artistic, it may appear surprising that not only did he show a ready understanding of mechanical techniques and engineering problems but he also developed an inventive capacity. In this respect he may be considered a true product of Victorian times, science-inspired and carried forward buoyantly by the creed of progress through the Machine. Most of his inventions were the outcome of problem-solving situations arising from his professional work, but at least two, one of which he did not develop, involved engineering devices related to hydraulics.

One patent registered by Henman in 1901, and three others in 1906 reflect the increasing interest in reinforced concrete in building construction which stemmed from Francois Hennebique's original patent for a concrete beam in 1892.(1). Hennebique demonstrated its value in structural engineering by the construction of a concrete bridge of three arches at Chatellerault in 1895 (2). It was introduced into Britain by L. G. Mouchel's ferro-concrete work in Liverpool and at the new dock works for the London and South Eastern Railway at Southampton in 1897 (3). In 1902 a paper by H. Cottrell, C.E. "Concrete with Interwoven Metallic Cores" was published in The Builder drawing the attention of architects to the "Cottancin" construction (4) whereby steel rods, beginning at foundation level were embedded in the

1. Hamilton S. History of Technology, Oxford 1958 p.480
2. The central span was 172 feet and the two side arches 135 feet. The Builder, 11th October, 1902 p.323.
3. Ibid. Paper-Hennebique System of Ferro-Concrete by M. Galbraith.
4. The Builder, 11th January, 1902. p.35.

concrete and carried through walls and floors right up to roof level. These rods were interwoven at suitable intervals on a lattice plan which dissipated cross-stresses within the construction (5). That Henman entered very early into this field is shown by his Specification Number 5748 of 1901 which utilised expanded metal sheeting to reinforce cement facing. John Brodie, city engineer for Liverpool (6) designed a block of tenement flats in 1904 consisting of pre-fabricated concrete slabs, each room being constructed in the form of a dove tailed box. Brodie also entered an experimental concrete cottage in the Letchworth Cheap Cottages Exhibition (1905).

Henman's specifications in 1906 all relate to the specialised lattice designs in metal to be enclosed in concrete and which were intended to be utilised on site. The main benefits to be gained lay in the reduction of weight, the supporting of curved forms in concrete and in resistance to fire, which was a problem he met frequently as a designer of hospitals and public buildings (7). The introduction of

5. First display at the Paris Exhibition of 1900 in a three-storey building erected on a subsoil of tipped rubbish adjacent to a leg of the Eiffel Tower. The Builder, 11th January, 1902. p.35
6. John Alexander Brodie (1858-1923) clearly anticipated 20th century high-rise construction. He had previously used concrete fabrication at Bilbao docks. He is also credited with the 'invention' of football goal nets in 1889.
7. Cast iron was liable to crack under intense heat. In 1799 Boulton & Watt had experimented with the cladding of iron beams at Salford. William Strutt used slabs of hollow earthenware "pots" to form fire-resistant floors in his Belper mill. By 1873 Doultons had designed hollow terra-cotta blocks for the same purpose (Hamilton p.470).

reinforced concrete was seen as combining the advantages of fire resistance with cheap but effective construction as a metal substitute, and Henman's inventions, which made provision for light-weight metal mesh, were among several devices introduced to prevent the cracking of the concrete pillars and partitions.

The patents fall into four broad categories : the first application, registered on 4th February 1876, numbered 448 was :-

Improvements in the Hanging of Window Sashes.

This invention dispensed with the use of sash cords to control the position of the two halves of a normal sash window. In their place was substituted a length of steel ribbon passing over pulleys fixed to the sash frame so that the top sash would always be tightly closed when the lower one was fully down but would descend by its own weight at the same time that the lower window were lifted. The two halves of the window were therefore held in counterbalance, and opened or closed to the same extent top and bottom. This device, though ingenious, would of course deny the operator the freedom to open or close one half of the sash window singly.

1880. 13th July. Number 2894. Hopper Barges.

The barge consisted of three sections, the upper part being a flat-decked floating platform with a series of vertical openings to contain slag or any other waste material to be deposited in the sea. Below the floating deck, and hinged to its sides were two water-tight compartments or "half boats" which, when closed together and fastened like double doors maintained the buoyancy of the complete vessel. When the fastenings were released, the weight of the slag resting on the decks of the two lower 'half-boats' caused them to open downwards on their hinged joints

and allow the material to slip off them into the sea. The buoyancy of the hinged 'boats' was made about equal to the weight of load they were intended to carry. They could be winched to their original fastenings beneath the barge quite easily after the "dumping" process, the speed of which could be controlled by the cogged teeth of the opening mechanism.

This invention indicates Henman's absorption with the industrial activities of Tees Side and his contact with ship-builders. His objective, to simplify and cheapen the construction of hopper barges, demonstrates his grasp of the problems involved in an activity distinct from architecture. By 1880 Henman was in Birmingham and on 20th July he transferred his provisional patent to Nathan Barney of Bergen Point, New Jersey, U.S.A. The craft subsequently went into production in America and was marketed successfully as "the Barney Dumping Boat". (8).

1884. 1st January. Number 38. Improvements in Sanitary Traps.

This invention concerns the familiar U-shaped water trap to be found below wash basins, sinks, baths etc. Henman's description includes all of these, but the drawing of his Complete Specification, Sheet One has particular reference to the outlet from a W.C. pan. It shows how, "what I claim is in the form of the trap, by which all untrapped joints within a building are avoided, and no lodgement of sewer gas is permitted". 1884 was the year Henman completed his

8. Edgbastonia Magazine, April 1892 No. 131. located at Birmingham Reference Library. Noticed also in Middlesbrough Gazette 20th July 1880.

hospital at West Bromwich. It had been designed so that each of the pavilion ward blocks two storeys in height, were terminated with "sanitary turrets" one above the other - a frequent and obvious solution to the clinical needs of the hospital, but posing problems in securing efficient hygienic conditions.

Lifts for Canals.

The next Patent Application was to cover Caisson Hydraulic Lift registered number 6888 on 11th May 1887. The object of this invention was to dispense with the use of locks on canals. It was given provisional category but was abandoned by Henman and so rendered void. The complete specification was therefore never published by the Patent Office.

1893. 7th December. Number 23531. Purifying Air Discharged from Hospitals.

This device arose during the building of the General Hospital, Birmingham when Henman was concerned to prevent infection from being carried into the atmosphere from air discharged from the isolation wards. It was an adaptation of William Key's patent screen for filtering and washing the inlet air of his ventilating system. In a paper addressed to the Sanitary Association of Scotland on 24th May 1894, Key reported that the outgoing air from smallpox hospitals had been passed experimentally through furnaces registering 700° F yet spores and germs were as virulent as ever, but William Henman had invented a practical and inexpensive method of elimination using his "destructor screen" fed by a solution of carbolic acid. (9).

9. The invention which prompted Key's comment, "I consider this invention one of the greatest sanitary discoveries of the year, if not of the age in which we live". Key W. Mechanical Ventilation. Glasgow 1894 p.31.

The three closely-related inventions concerning the introduction of expanded metal armatures for strengthening concrete were registered during 1906.

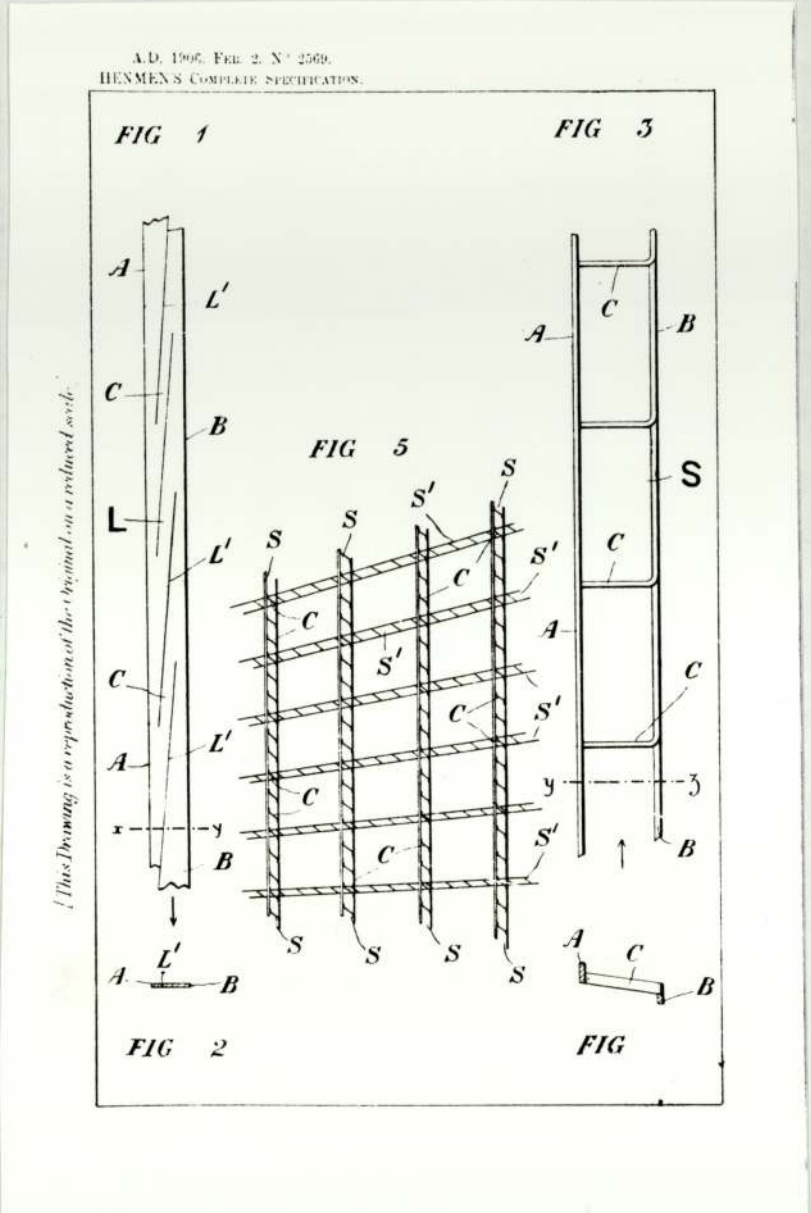
2nd February. Number 2569. "Improvements in Expanded Metal Skeletons for Strengthening Plaster or Cement Partitions".

Skeleton frames, very lightweight girders of ladder-like form, were made from strips of mild steel, each strip having been cut with slits sloping diagonally so that when "opened" it formed a ladder shaped girder. These were placed vertically at suitable distances apart and secured at right angles by similar strips. This lattice structure was sufficiently light for the strengthening of internal walls and partitions.

17th March. Number 6483. "Improvements to Reinforced Girders, Beams, Columns, Railway Sleepers and the Like".

The object of this was to provide a reinforcement of considerable strength combined with economy of space at moderate cost. Henman's invention avoided the need for a build-up frame joined with bolts or rivets. His skeleton girders made of thin mild steel were shaped in V section for strength. Several variations of girder sections and formations are illustrated in the specification to indicate the wide variety of constructional situations in which they could be used. Henman made use of these girders himself in the design of his Malvern Hospital in 1910. (10).

10. The Builder. 9th June, 1911. p.142.



Patent Registration 2569. 1906.

Improvements in Expanded Metal Skeletons.

For strengthening plaster or cement partitions.

21st September. Number 20987. "Improvements in Metal Reinforced Plaster or Concrete Structures".

This refers particularly to structures of curved or circular form as in columns, and once again makes use of the mild steel strip cut into shapes to be bent into circular form so that the outer edge is plain and therefore suitable to receive a smooth cement or plaster covering, and the inner edge crimped or corrugated for strength, strong radial connecting struts being formed between the two surfaces. Immersed in the concrete or plaster column, the metal formed a strong and easily constructed reinforcement.

1911. 22nd April. Number 9768. "Improvements in, or Relating to the Hearths of Fire Places".

The Specification is entered jointly by William Henman and William Beasley Heap, Manufacturer, of Stratford Road, Birmingham. It relates to the construction of "well" fireplaces using hearth tiles of hollow construction whereby the heat from the fire was prevented from being conducted to the wooden beams beneath the floor. The top faces of the tiles were covered with a layer of cement on which the fire basket rested.

In addition to the Patent Applications which Henman submitted over a period of 35 years, he entered the realm of competitive engineering design in direct rivalry to professional engineers on at least one occasion. This was the competition to design a "Great Tower of London".

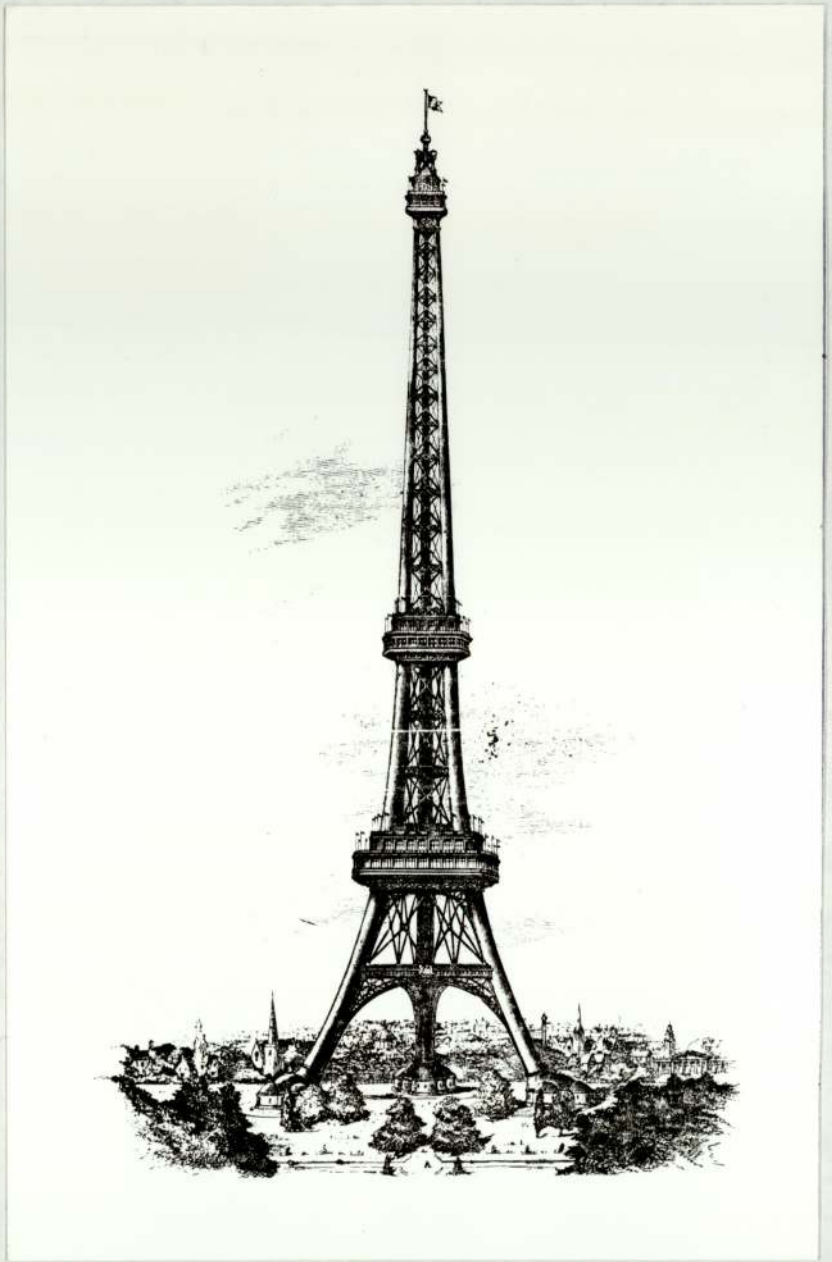
The Great Tower of London Competition.

Gustave Eiffel's all-metal tower for the Paris Exhibition of 1889 excited much interest among engineers, but in architectural circles opinion was more divided - as indicated by a view expressed in

The Architect of 1887 that the projected idea would result in a "useless, monstrous, tower of Babel," (11) but by 1889 its success and prestige was such as to prompt Sir Edward Watkins, M.P. to propose to set up a rival, and even larger, tower at South Kensington. His proposal was announced in both The Architect and The Builder. (12). In the latter it attracted the heading "Proposed 'Folly' of a Tall Tower for London" and the comment that it would be "a foolish piece of brag which was universally condemned and opposed by the most educated and intellectual section of Frenchmen".(13) Such comments were ignored, and the scheme went ahead with enthusiasm. The Eiffel Tower being 984 feet high, a condition of the design competition advertised on 23rd October 1889 was that the proposed tower must be at least 150 feet higher, and also capable of taking up to three times the number of passengers by lift. (14).

"The Great Tower for London Company" was formed, and prizes of 500 guineas and 250 guineas for first and second best designs were offered. By May 1890 The Engineer was able to report that 86 competitiors had submitted designs and 68 had been considered by the committee of jurors. (15). Eight of the final group of designs were considered worthy to receive detailed descriptions with full-page illustrations in The Engineer during May and June. Of these, the design entered by William Henman and Robert H. Smith, Professor of Mathematics at Mason College, Birmingham, received favourable comment. (16). A wide variety of

11. The Architect, 14th March, 1887. p.99.
12. The Architect. 8th September 1889. p.120.
13. The Builder, 26th October, 1889. p. 290.
14. The Building News, 26th August, 1892. p.303.
15. The Engineer, 2nd May, 1890. p.361.
16. The Engineer, 20th June, 1890. p.493. A full-page drawing of the Smith and Henman design was published with full technical details.



Design for a Great Tower for London. Height 1400 feet.

Professor Robert H. Smith and William Henman.

The Engineer. June, 1890.

designs were submitted : the competitors being inhibited by the need to avoid an imitation of the Eiffel Tower which in itself was a most satisfactory and obvious way of combining economical engineering with architectural grandeur.

Smith and Henman's entry was in the form of a tripod tower 1400 feet high, constructed from smooth steel tubes 30 feet in diameter at the base and tapering gradually to 6 feet diameter at the top. These great tubes, the designers claimed, being smooth and triangular in outline, offered less wind resistance and could withstand a hurricane wind pressure of 114 pounds per square foot. The tower carried three observation platforms, reached up to the first stage by two-decker lifts carrying 2,000 persons per hour, all seated, the last stage of the upward journey being in "a glass-walled cage to afford views all around". Henman's experience in the field of competitive architecture showed itself in the ten sheets of detailed drawings he sent in, and his estimated cost of £229,500 indicating commercial realism compared with entries from engineer designers costing up to £650,000.

The competition was judged on 17th June, 1890 and first prize was awarded to Messrs. Stewart, McLaren & Dunn, Engineers of King Street, Strand (17). By 1891 The Architect (18) was able to report that a site of 280 acres at Wembley Park had been chosen, Sir Benjamin Baker, appointed engineer, and H. Milner to lay out the grounds. A year later, The Building News (19) reported

17. Second prize was gained by Messrs. Webster & Haigh, Engineers of Liverpool.
18. The Architect, 7th May, 1891 p.271.
19. The Building News, 26th August, 1892. p.303

that concrete foundations were laid, £90,000 in hand, and that Wembley Park Station would soon be opened. The following year, Maxwell and Tuke were erecting their iron tower at Blackpool, but "Watkins' Folly" was never completed. Interest and finance lapsed and only the first stage 150 feet high was finished. After an interval of 17 years following the competition, The Builder (20) reported that Messrs. Henman & Froude were engaged to cut down the 3,000 tons of steel for scrap. A comparison between the Eiffel Tower and The Great Tower for London designed by Professor Robert H. Smith and Mr. William Henman.

	Eiffel	Great Tower
Height to top of flag pole	1,000 feet	1400 feet
Highest platform	984 feet	1250 feet
Second platform	895 feet	585 feet
Great platform	187 feet	282 feet
Total number of persons able to occupy the platforms	6,020	8520
Persons the lifts can carry per hour to the top	800	1000
Square feet in all platforms	59,180	76,400
Weight of metal	5,000 tons.	11,500 tons.

20. The Builder, 20th October, 1906. p.464

CHAPTER 7.

WILLIAM HENMAN'S CONTRIBUTION TO THE GARDEN CITY MOVEMENT HIS TOWN PLANNING TREATISES AND ARCHITECTURAL WRITINGS.

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The Letchworth Garden City Cheap Cottages Competition, 1905.

In 1901, a Garden City Conference was held at Bournville (1). Ebenezer Howard was present and urged support for the suggested new Garden City project at Letchworth. After spending five years in America, where he had studied the manner in which Brigham Young had led his Mormons across the mountains of Utah and founded Salt Lake City, Howard had written Tomorrow - A Peaceful Path to Real Reform, later retitled Garden Cities of Tomorrow. (2). At Letchworth, thirty four miles distant from Kings Cross on the Great Northern Cambridge Line, 3,822 acres of land had come onto the market : it consisted of three tiny villages, Letchworth, Norton and Willian, with a total population of 400 souls engaged in farm labouring. Ebenezer Howard saw this as an ideal opportunity to fulfil his new concept - a residential and industrial town with separate areas for dwelling houses, business premises, factories and workshops plus ample open spaces, the whole town to be encircled by a belt of permanent open space, a rural belt to protect it from overgrowth both from outside and inside, and also to ensure that the countryside should always be within walking distance of the town centre. His vision also included the concept that the town should be large enough to make possible a full measure of social and cultural life but no larger, and that the whole of the land was to be in such ownership as to ensure that it would remain in trust for the community.

1. The Architect, Contract Reporter 29th March,1901 p.10
2. The Builder, 9th August, 1902 book review of Ebenezer Howard's work - "Very Utopian, based on the theory that an attempt should be made to unite town and country. It is so fanciful and the projects suggested are so impossible of realisation, that it does not appear desirable to comment upon it at length". But Lewis Mumford said that Howard was "Unfettered by those forms of specialised competence that paralyse creative thought". The Culture of Cities, London, 1938. p.394.

To engage interest in his project Howard chaired 260 fund-raising lectures including the conferences at Bournville in 1901 and at Port Sunlight in 1902 (3). At the latter conference he invited Halsey Ricardo and W. R. Lethaby to submit one possible lay-out plan for Letchworth while Raymond Unwin and Barry Parker were to provide another (4).

In September 1903 The Garden City Pioneer Company Limited was formed with a share capital of £20,000 (5). No dividends were to be paid, but shareholders were guaranteed 4% interest. Lord Northcliffe was interested, and offered free advertising space in the Daily Mail. Parker and Unwin's plans were chosen, and the town took shape surprisingly quickly in a space of only five years.

Ernest Newton, writing in the Architectural Review of December 1902 (6), reported that at the beginning there had been scepticism and cheap sneers at "philanthropy at 5%" but G.K. Chesterton had declared that there was "nothing freakish about the conception of a Garden City. All cities grow up round a definite object, be that a temple or a race course".

One criticism was clearly valid. The houses built at first, having an average cost of £250 each, were financially well beyond the resources of the labourers building them. With this deficiency in view, St. Loe Strachey, editor of The Spectator advocated a "Cheap Cottages Competition". This was taken up by The County

3. Purdon C.B. The Building of Satellite Towns London, 1925. p.32
4. The Builder, 29th March, 1902 p.312.
5. Creese, W.L. The Search for the Environment Yale, 1966 p.9
6. Newton E. "The Garden City", Architectural Review July - December, 1902 pp 224-8.

Gentleman magazine (7), The Garden City Company offered a site for an exhibition, donations were solicited from the public and influential patrons also responded. The main objective was to secure the building of the best type of cottage within the cost of £150 and a prize of £100 was offered. The limit of £150 was calculated on the wages of the average agricultural worker, which at that time was between fourteen and sixteen shillings per week:for rent at 3/- this would provide £8 per year : the interest on £150 at 4% would amount to £6 and a further £2 was allowed for rates, repairs and insurance (8).

Henman had devoted considerable thought to the problem of financing with a view to eventual ownership in his paper on "Housing the Working Classes" (9). In this he had posed the question, "How could the occupier of a house become its owner without increasing the weekly outgoing hitherto paid as rent?" With his partner Thomas Cooper, he entered two designs for the Exhibition, which took place from 25th July until 30th September, 1905.

The exhibits were arranged to fall within three main groups : the £150 cottages suggested by St. Loe Strachey, pairs of five-roomed cottages not to exceed £300 per pair, and groups of three or four cottages no one cottage to contain more than six rooms including

7. St. Loe Strachey, J. (Ed.) The Book of the Cheap Cottages Exhibition, London, 1905. p.3
8. Cornes J. Modern Housing in Town and Country London, 1905. p.123
9. Henman W. Paper,"The Economic Construction of Dwellings for the Working Classes". Cleveland Institute of Engineers. Middlebrough and Stockton Gazette, 8th January, 1876.

scullery and not to cost over £35 per room. Of these the first group was the most important, and the final award would take into consideration appearance, accommodation, comfort, durability, material workmanship and skilful planning to catch as much sunlight as possible (10). Of the £150 cottages, seventy seven were completed by the July opening. The specification suggested as ideal required one living room and kitchen or scullery not under 7 feet 6 inches high, three bedrooms (two with fireplaces) having the same height as the living room, and with a cubic space of 2,000 cubic feet capable of sleeping six people (11). It was also hoped to explore the possibilities of new building materials such as reinforced concrete and asbestos.

The success of the Exhibition was mixed. It attracted much interest in architectural circles and famous names such as Bailie Scott contributed entries, but the attractive cottages would still have been beyond the £150 limit if built under normal circumstances. Henman and Cooper appear to have been the only architects who took up the financial and social challenge seriously and designed their two entries from the true needs and aspirations of a worker with his family moving from the slums of London to begin a new life, and for this reason Henman's designs and intentions were largely misunderstood and the cottages eliminated.

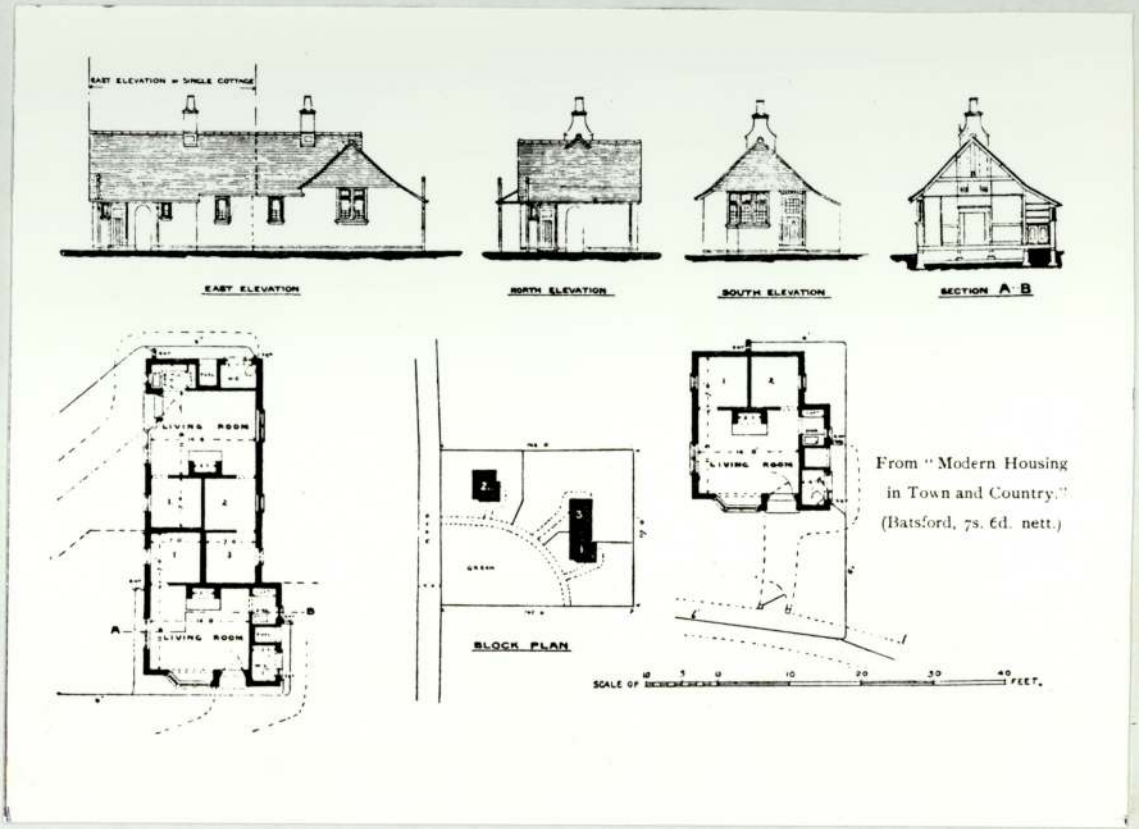
Double standards were applied to the competition. For instance, architects' fees were excluded : the editorial of The Architect (12) commented "Several

10. Creese W.L. The Legacy of Raymond Unwin, New York, 1967, p.62.
11. Architectural Review, July-December, 1905 pp. 108-115 & 154.
12. The Architect, 5th January, 1906 p.8

cottages were no doubt built for the limited sum of £150, but excluding several small items such as builders profit, cartage, and water supply, which in the ordinary way would run into another £50 or £100". The Builder reported, "The bubble of the Cheap Cottages has been pricked. Those built at Letchworth for £150 would have cost more if built by an ordinary landlord" (13). One builder admitted "We built them here for that, but we are not going to do it anywhere else" (14), while another builder named Wright appeared at the Bankrupcy Court at Luton through the Exhibition. His cottages at £180 had actually cost £230.

In contrast to the other entries, the cost of the Henman & Cooper cottages was only £100 each and these were sufficiently arresting in concept to warrant the publication of their plans in The Architectural Review Vol. XVIII (15), but the adjudicators had ruled out their entries because "the walls were one brick thick and the bedrooms simply recesses". However, H. Kempton Dyson who wrote the review, was more percipient than the exhibition judges, for he thought that "the idea of allowing a bed-recess is worthy of consideration, because in no other plan has any arrangement been made to provide for the living room being used for sleeping purposes using only an arrangement of folding doors". The economic and social awareness inspiring the designs of Henman and Cooper was noted by the County Gentleman (16) and

13. The Builder, 20th March, 1906 p.310
14. The Builder, 3rd November, 1906 p.502
15. The Architectural Review, August 1905 p.108
16. St. Loe Strachey Op.Cit. p.45



The Welwyn Garden City Cheap Cottages Competition, 1905.

Single cottage and pair of cottages by Henman and Cooper.

by Councillor James Cornes who was on the exhibition organising committee (17). Both published Henman's own comment, "The object of the architects is the provision of healthy, self-contained, economical dwellings for the working poor, giving the minimum amount of accommodation necessary in a compact form, so that the rent may be low and the labour required in keeping the dwellings tidy and clean may be easy. The dwellings with one bed recess would supply the wants of a married couple without children or with a young child or two, an unmarried woman, or an elderly couple. The dwellings with two bed recesses would suit a married couple with young family, or with only boys or only girls. The dwellings with three bed recesses would serve for a married couple with children of both sexes. When required the bed recesses would be provided with bedding accommodation as in ship's cabins but kept clear of the wall around. It must be distinctly understood that these dwellings are for the working poor only, those who can pay but a moderate rent for a self-contained home, the hope being that if a reasonable proportion of similarly small, self-contained dwellings were erected in town and country, the herding together of families in larger houses, not properly adapted as separate dwellings, might be diminished, and one phase of the housing problem might be solved. In designing the cottages, the exterior has been treated in the simplest manner to suit internal requirements, in the belief that straightforward simplicity is most appropriate for the purpose. Such dwellings are not intended to compete with houses for the well-to-do working classes. As long ago as 1876 Mr. Henman dealt with this subject in a paper he read to the Cleveland Institute of Engineers and was published in the Institute's transactions, but those who interest themselves in

17. Cornes J. Op.Cit. p.124

the housing question too often fail to regard the matter from anything but a sentimental standpoint. They fail to realise the real requirements of the working poor, and it is our opinion that the matter must be attacked from the lowest standard because the well-to-do working man can take care of himself. It is the slums and slum dwellers who must first be properly provided for".

But allowing for the terminology of the times, Henman had introduced an element of realism into the exhibition. The controversial £100 cottage was well built : It still stands in Exhibition Road now renamed Nevill's Road. It has lasted well and is the same in appearance as when originally built except for the addition of a larger kitchen. The bedroom recesses have been enclosed by the present occupant.

William Henman's Housing and Town Planning Schemes.

According to a paper read to the Birmingham Architectural Association in 1905, (18) Henman first visited Birmingham in the year 1871, staying occasionally for a night or two during the time that he was engaged in designing the West Bromwich Town Hall. He could not have arrived at a more opportune time. In 1870 Joseph Chamberlain had been elected to the Birmingham Council and within three years was to become Mayor of the Borough. Under his dynamic leadership the area adjoining the Town Hall was being cleared of dilapidated buildings to make room for a Council House, the foundation stone for which Chamberlain laid in 1874. (19).

Beyond the central area, stretching in a North-easterly direction where the town pushed outwards towards the coal and iron resources of Staffordshire, Birmingham presented a tangle of housing and industry resulting from the problems associated with rapid and haphazard growth. The land between Aston Street and Coleshill Street had been developed to form streets surrounding "Upper Gosty Green" (20) a favourite preaching site of Wesley and Whitfield, while to the west of this lay St. Mary's Square and Snow Hill where the elder Matthew Boulton had originally established his home, workshop and warehouse. By 1870 however, the working convenience by which a manufacturer housed his

18. The Builder, 4th March, 1905. p.240. "The Future of Our City". Paper by W. Henman to Birmingham Architectural Association.
19. Although the Second Improvement Act of 1861 had empowered the Corporation to raise loans leading to the acquisition of the Council House site, 11,450 square yards for £3,300 covered with old houses and shops, nothing had been done.
20. Developed by Henry Bradford in 1767. The first road being Bradford Street.

workmen around him had ceased as masters prospered and moved out to live in the pleasant suburbs of Edgbaston, Moseley or Handsworth. Thus pockets of erst while activity had fallen into decay : back-to-back courtyard developments of the most basic kind nudged the Georgian Old Square and degenerated into "rookeries" within a mile of the city centre. Faced with this situation, Chamberlain used the powers provided by Richard Cross's Artisans' Dwellings Act of 1875 to authorise the demolition and redevelopment which resulted in the cutting of a main thoroughfare, Corporation Street. The attraction thus presented to an aspiring architect who had already completed his first provincial town hall, to participate in the reconstruction of the commercial core of a city was strong. In 1877 Henman was engaged in the building of the council offices and library at near-by Handsworth and by 1879 having won the competition to provide similar buildings at Aston, he established an office in Birmingham and began a practice in his city of adoption lasting for 33 years. (21).

His marriage to Elizabeth Pearmain took place in 1882 and he chose a site in Edgbaston at the Chad Valley end of Westfield Road to build a group of five private houses, substantial family residences of three storeys, one of which, "Hollington"(no.130) he occupied with his bride. These houses show that Henman's ideas in domestic design were well in advance of his times. He eschewed the conventional narrow entrance hall and steep stairway in favour of shorter easier flights to rooms opening off half-landings : he opened out windows in his designs to admit sunlight wherever possible, and incorporated structural cupboards and storage spaces. Basements were also utilised in an exciting manner,

21. Henman's first office was at 37, Waterloo Street.

' Hollington ' 130, Westfield Road, Edgbaston.

doing away with dark cellars and devising lighted appartments suitable for a child's playroom or an artist's studio.

Ten years later, land bordering Harborne Road to the rear of his house became available and he designed his second home "The Cottage" Yateley Road in 1892. By this time Henman had absorbed many of the new ideas in domestic architecture advanced by Arts and Crafts designers. In 1890 the Congress of the National Association for the Advancement of Art had been centred at Birmingham, where addresses had been given by C.R. Ashbee, W. Bidlake, Aston Webb, Arthur Mackmurdo and other leading figures. (22). In 1892 William Lethaby designed "The Hurst" Four Oaks, Sutton Coldfield.(23). Henman's "Cottage" though smaller, shows several Arts and Crafts features. It blends closely into the sloping site, broad roofed, presenting a horizontal row of regular rectangular windows with an asymmetrically placed doorway giving the impression of domesticity rooted in the English past. By 1909, almost at the culmination of his career, Henman designed a third and larger house "Dingwall" in Farquhar Road, Edgbaston a select residential district close to where Aston Webb and Ingress Bell had just completed the new University buildings for Birmingham (1900-1909). The tall brick walls and groups of semi-circular arched windows are reminiscent of a Norman Shaw façade. He occupied this house for only three years prior to his retirement to live at Chelmsford in 1912.

Henman applied his wide experience of ventilation to the requirements of dwelling houses. He was the

22. The Architect, 7th June 1890. p.327.
23. Completed in 1893, demolished 1960.

author of the "Ventilation" section in the large two-volume work Modern House Construction published by Blackie in 1899 (24) and written by specialists in the various fields of construction. He experimented with the use of oil of peppermint to detect the direction of air currents within a house, and demonstrated the importance of the positioning of the fireplace in relation to the door of a room - including the side on which the door is hung. He provided his houses with suitably-placed openings in the upper portion of the rooms as a means of gaining ventilation without draughts (25).

On moving to Birmingham Henman took an active part in the architectural and artistic life of the city, regularly contributing papers at meetings of the Birmingham Architectural Association, his most important addresses being on ventilation (1883), improving the Birmingham city centre (1884), terra-cotta versus stone (1887) and developments in hospital design (1902). He was elected President of the Association in 1894 and served for three years. In 1898 Birmingham was chosen as the venue for the Sanitary Institute Congress at which Henman was selected to be president of the Engineering and Architectural section. On this occasion he delivered addresses on "Hospital Planning in Regard to Plenum Ventilation" and "Modern Sanitation". (26).

Despite Henman's energetic participation in professional discussions, the securing of commissions

24. Sutcliffe L.G. (Ed). Modern House Construction, London, 1899, pp.167-224.
25. The Architect, 2nd February 1900, p.77. Reviewed the book, "Of utmost importance to all who design or erect buildings".
26. The Builder, 1st October, 1898 p.312.

by outsiders arriving in Birmingham was not easy. It was not that barriers were deliberately presented, but that the borough was proudly parochial. The designing of the Board Schools, (27) for instance was undertaken (very creditably) by the well-established local firm of Martin and Chamberlain who were responsible for the construction of Joseph Chamberlain's house at Highbury (1879), the Chamberlain Memorial (1880), the Birmingham School of Art (1883) and other important buildings, libraries, and the Telephone Building (1896) their terra-cotta masterpiece. When their total of Board Schools reached 30, a vigorous protest followed from the Birmingham Architectural Association (28), but 41 schools were eventually completed. Yeoville Thomason the Birmingham architect who designed the Council House (1874) and Art Gallery (1885) was particularly well placed for a lucrative Midlands practice, being descended from Sir Edward Thomason who had been trained as a button maker and medalist by Matthew Boulton and had achieved wealth and fame from his Newhall Hill Manufactury. J.A. Chatwin, also the son of a button maker and pupil of Barry, had cornered most of the church restoration work including St. Martin's (1875), Aston Parish Church (1879) and had added the chancel to St. Philip's Cathedral Church in 1883, but Jethro Cossins who came from Somerset had managed by the sponsorship of Josiah Mason to design Mason College (1875-80) and William Henry Ward, born in Scotland who came to Birmingham in 1865, had secured the commission to design the Great Western Arcade in 1875. His pupil Oliver Essex founded a local firm and designed much terra-cotta work in Flemish Renaissance style in

27. Pall Mall Gazette, 8th May, 1894. "In Birmingham you may generally recognise the Board School by its being the best building in the neighbourhood."
28. The Architect, 4th June 1883. p.402.

Corporation Street and elsewhere including the Technical College in Suffolk Street. It was generally by dint of architectural competitions adjudicated by reputable names such as Waterhouse that outsiders were able to secure a footing, notable examples being the winning of the Victoria Law Courts by Aston Webb & Ingress Bell in 1887 followed by Henman's General Hospital in 1892.

In February 1905 Henman turned his thoughts to "the possibility of the city of my adoption being made more convenient and beautiful". His ideas, entitled "The Future of Our City" were presented to the Birmingham Architectural Association and aroused so much interest that the paper was published in October 1905. In it he stressed that good street architecture was not money wasted since it attracted good business; dignity of appearance brought prosperity. He questioned the veracity of the claim that Birmingham was "the best governed city in the world", (29) there was much need for improvement : Broad Street for instance was muddy and smelly and provided a poor access to the "best" suburb of Edgbaston. To transform this area stretching westwards from the city centre, his advice was to "make wide and straight your streets for the day of the plebean tram and lordly motor", but the mere cutting of wide streets would not alone secure a handsome city - the planning of streets, together with their architectural embellishment needed comprehensive treatment. Corporation Street had been a fine scheme partly spoilt by the limitations of the Artisans' Dwellings Act. Looking to the future, Henman envisaged that as manufacturing continued to leave the city centre, with workmen

29. In Chamberlain's own words, Birmingham had been "parked, paved, assized, marketed, gas-and-watered and improved - all as the result of 3 years of active work". Briggs A. Victorian Cities, London 1968. p.231.

following, the opportunity to create a "city beautiful" would emerge. "As the sound of the hammer on the anvil ceases, there must be cathedral chimes. In streets deserted by the mechanic must reside many students of a renowned University". His drawing shows a wide Haussmann-like boulevard extending from the Town Hall around which a lattice of right-angled roads lead to principal buildings : a new cathedral, a large banking, insurance and mercantile centre, spacious shops, a "Grand Hall of Literature, Art and Science" to replace Bingley Hall, and new University buildings on the site of the Crescent. (30). Henman concluded that inspired leadership by itself was insufficient to found the new Birmingham : the collective will and energy of all citizens were needed to overcome the obstacles to the achievement of a worthy city. The timid and hesitant would fail future generations of Birmingham citizens just as in the same way Wren's plan for the rebuilding of London had been frustrated by "jealousies, delays and craven landlords".

It was a paper closely reflecting the idealism of the "City Beautiful Movement" which had received impetus from the Chicago Exposition of 1893, where civic design based on clean, axially-planned streets affording long vistas of public buildings in "the crusade against ugliness" (31) had wide influence as the setting for the World's Fair. Henman's forward-looking plan did not materialise : it was brought

30. The Architect, 8th July 1898. p.20. It was established that the new University for Birmingham should be sited at Edgbaston, but Henman considered a city centre site more appropriate.

31. The slogan of J. Horace McFarland, the leading lay apostle of the "City Beautiful". Quoted by Wilson W.H. The Rise of Modern Urban Planning, London, 1980, p.171.

forward by the Public Works Committee only to be rejected by the City Council. Extensive goods yards and the old canal wharf and warehouses formed an immediate physical barrier, the Council no longer found enthusiasm to repeat the Chamberlain achievement and a large block of buildings was allowed to be erected, stretching from the Curzon Hall which had been built for the purpose of the annual Dog Show and extending across the end of Paradise Street forming a dangerous corner which remained a menace to public safety. (32).

Henman's hope to furnish plans for the development on the eastern side of the Town Hall in 1900 also brought disappointment when his design for a large Central Exchange building to cost £100,000 received second premium although it was recommended and illustrated in The Builder. (33). He was however, successful in receiving commissions to design three of the larger city centre buildings, all of which were designed after he had taken Thomas Cooper into partnership. The office building at 85-87, Cornwall Street at the rear of the Council House, originally built as a surgery for J.E. Parrott, was completed in 1899 in a Renaissance style typical of the façades seen in Belgian towns. Twin bay windows extend upwards through the frontage emphasising verticality. The windows are spanned by attractive balconies and finished with brief stone pillasters. Henman was no supporter of the unified classical style of civic architecture such as was seen at the Chicago Fair : he considered variety an essential element, and this building, while blending by its red brick and stone construction with its neighbours, is distinctively different and adds

32. The Birmingham Mail. 17th March, 1917.
33. Chapter 8.

85, Cornwall Street. 1899.

An unusual city centre façade.

enhancement to the thoroughfare.

Also of strong Renaissance influence in its regularity of window pediments is the grey granite Scottish Union Insurance Office in Colmore Row (1902) (34) surmounted by twin cupolas above its square side turrets which are decorated by twin horizontal bands of narrow red stone. This building is close to W. Lethaby's Eagle Insurance building (1900) and complements its Arts and Crafts features. A deep semi-circular bay window at the second storey of Henman and Cooper's building however appears to disrupt the balance of the composition. The third building, the Midland Hotel opposite New Street Station (1903) was not entirely new because some portions of the original shell of the former building had been incorporated, but the interior was newly designed and extended to contain 170 bedrooms at a cost of £90,000. A particular feature of the work was the extensive use of Sicilian marble, particularly in the impressive entrance hall and main staircase. (35).

Despite his interest in extensive town planning schemes and the designing of large buildings, Henman retained his concern for the decent housing of the working man. In 1905 while engaged in somewhat Utopian city planning he was also immersed in the Letchworth Cheap Cottages Competition, and with a zeal reminiscent of William Morris, he put forward a model scheme entitled "Housing the Working Classes" by which he hoped to transform the status and the life style of

34. Near to the Council House and Lethaby's Eagle Insurance Building. Henman's Scottish Union Building is now the Birmingham Information Office.
35. The Builder, 5th September, 1903. p.254.

The Scottish Union Building, Colmore Row. 1902.

Now the Birmingham Information Office.

the Birmingham Artisan. He maintained that the speculative builder could no longer satisfy the massive demand for rehousing, and that the state should therefore help to provide the financial means. All that was necessary was to "trust the people". The state should provide funds at 3% per annum over a period of 35 to 40 years for the worker to buy and own his home. "Nothing strengthens the character or conduces to the well being of communities as the owning of property . . . . the working classes should be invited to state their own requirements". Banks could advance money for schemes approved by Local Authorities and the state would refund this outlay in conformity with the 3% individual loan and thus hand to the occupiers the management of their own houses.

Henman gave an example of the feasibility of his scheme by using figures for the outskirts of a Midland town :-

1. Roads and plots laid out at 250 square yards per house.

2. Presuming that 50 houses can be built, costs would be :

Land, plus road building	£1,400
50 houses at £175 each	£8,750
Expenses	£ 350
Total cost	£10,500

Income.

50 houses at average rental of 5s 6d per week	£715	per annum
Deduct for rates, taxes, upkeep	£250	
Net income	£465	per annum

Interest on £10,500 at 3% is £315.
This leaves a balance of £150.
- Which is sufficient to redeem the capital outlay in about 35 years.

The banks were to finance the undertaking temporarily and then on completion the state would purchase the property at the amount of certified cost and subsequently let the house to the tenant on a hire-purchase system with the bank acting as trustee. A committee of tenants elected annually would undertake gratuitously the general management of the property and receive rents to be handed immediately to the bank, where accounts for individual dwellings would be kept - interest on money paid in during a three month period to be allowed the bank for services rendered. The bank would pay all interest due to the state annually and also after paying rates etc., the balance of funds in hand. Provision was included in the scheme for tenants leaving the district to transfer accounts elsewhere.

By this scheme Henman claimed that working men would be properly housed and eventually become freeholders of their own houses, furthermore money would be expended and circulated to the great benefit of the building trades. He concluded that it ought to be possible for the state to provide the capital and "to entrust the housing of the people to the people". The feasibility of the scheme, written shortly before Henman's retirement in 1912, was never tested, and the subsequent disturbances of war destroyed the elements of security and stability necessary to activate it.

This apparently utopian solution to the problem of housing in low income urban areas has virtually re-emerged after seventy years as a possible means of alleviating the deprivation seen in Brixton and similar districts. Once more, self-help and community enterprise rather than bureaucratic funding and

supervision is suggested as a policy for activating a scheme of reconstruction and rehousing. Mr. Ted Watkins from Los Angeles (36), whose work for the Watts Labour Community Action Committee alleviated much of the distress caused by the American race riots of 1965, when advising on the Brixton problem of 1981 quoted the record of his committee : "Making use of a federal government subsidised rent programme, the committee has devised a plan whereby poor families pay a rent of not more than one quarter of their income for 20 years, at the end of which they own their own homes."

36. The Observer, 6th December 1981.

CHAPTER 8.

PREMIUM-WINNING DESIGNS NOT COMMISSIONED FOR CONSTRUCTION.

-oOo-

Even after Henman had established a reputable practice in the Midlands, his participation in competitive designing in the wider, national field continued. In many cases, where second or third premiums were awarded, the adjudicator's comments were not recorded in press reports, so that very little indication of these designs can now be deduced, but in the competition for the new Manchester Infirmary which was assessed by Sir John J. Burnett and won by Messrs Hall & Brooke, the report published by The Builder of 2nd April 1904 (1) indicated that although Henman and Cooper had designed for compactness - "a simple block plan with a single main covered way, having four principal pavilions on each side", it had also been laid down that "the instructions to the architects contained a clause to the effect that the Board had decided against the Plenum System of Ventilation and that heating must be by hot water radiation and open fire places".

Under these circumstances, Henman and Cooper, while attempting to gain the benefits in communicative convenience and fuel-saving from a Plenum designed building, had raised doubts concerning the adequacy of "natural" ventilation demanded by the pavilion lay-out. Their design was considered unsuitable because "the eight principal pavilions have Y-shaped wards which occupy great width and seriously reduce the air-space between the buildings".

On several other occasions it must remain a matter of speculation as to whether Henman's design was completely at fault or whether other aims and longer-term objectives had been overlooked by the adjudicators.

1. The Builder, 2nd April, 1904. p.356.

This would certainly appear to have been the case concerning the rejection of the Henman and Cooper cheap cottages at Letchworth. Although these were ruled out because the bedrooms were considered "merely recesses", Henman by means of his entry, was making a serious social statement, namely the need to achieve the difficult balance between the Arts and Crafts cottages designed by architects of repute, which although tastefully simple in appearance, were in reality considerably more costly to build than the advertised competition limits, and the provision of a decent minimal cottage to solve the disturbing and persistent problem of providing housing at low enough rents to accommodate the poor. In this respect he was working within the tenets of Raymond Unwin who, in Cottage Plans and Common Sense (2) had given his opinion that "a desire to imitate the middle class home is at the bottom of the modern tendency to cut the cottage up into a series of minute compartments. It is wasteful and unhealthy and nourishes snobbery in reverse". In re-opening the living room, Henman reduced costs to £100 per cottage and offered a serious and realistic alternative to slumdom.

Another possible misjudgement took place in Birmingham when Henman's very forward-looking design for a church was passed over, despite protests published in The Builder (3) by correspondents who considered the method of assessment at fault. The competition, limited to seven entrants, was for the Old Meeting Trust" Congregational Church in which the design by Henman and Beddoe had been created specifically to meet the

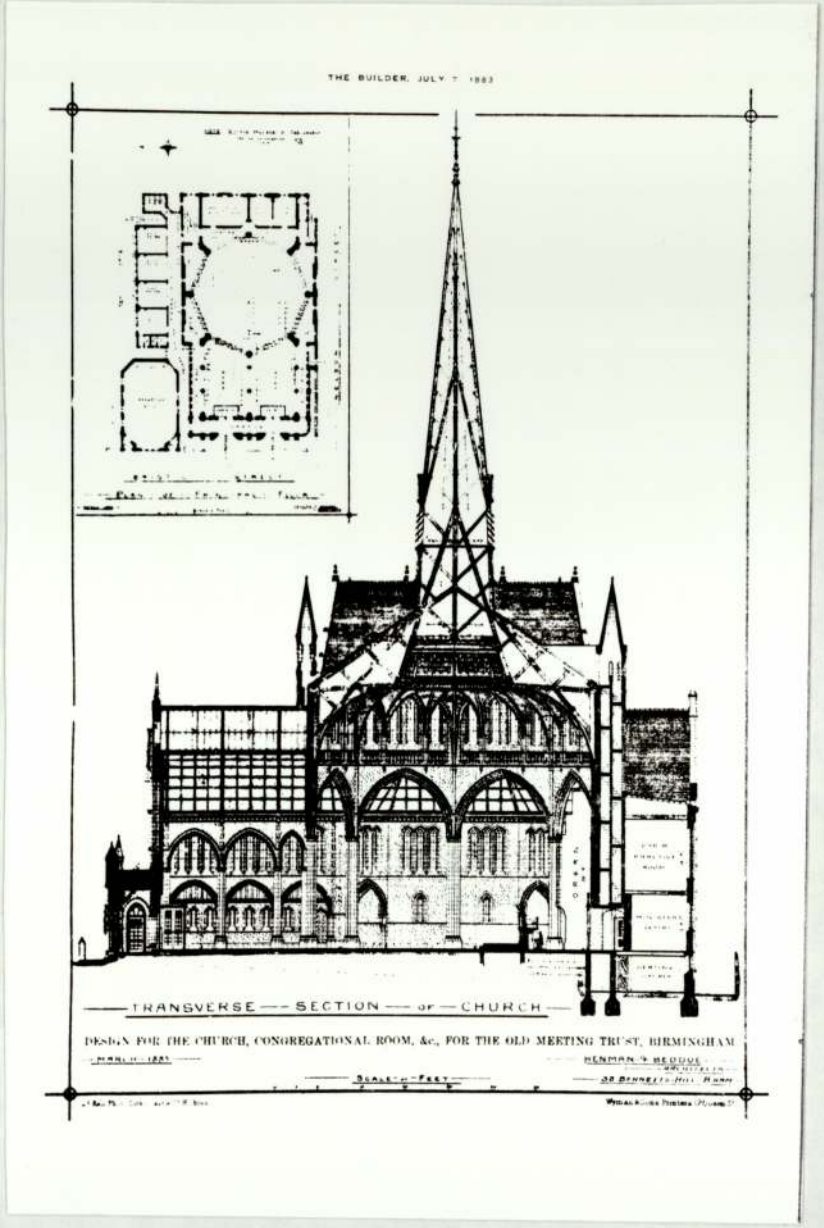
2. Quoted. Creese W.L. "Plans and Common Sense" in The Legacy of Raymond Unwin New York 1967. p.65.
3. The Builder, 7th July, 1883. p.10.

DESIGN FOR THE CHURCH, CONGREGATIONAL ROOM, &c., FOR THE OLD MEETING TRUST, BIRMINGHAM.

MESSRS. HEWMAN & BEDFORD, ARCHITECTS.

The Old Meeting Trust Church

A Controversial Design.



The Church Interior.

Section through the octagonal nave.

requirements of conventional worship. The conventional church plan was entirely discarded, and a central octagon formed the centre of the building, with aisles at the four cardinal points of the compass. The advantages of this arrangement were that the pulpit occupied a central position, though no one sat behind it, and the organ was placed where the best effect could be obtained.

The result of the competition appears not to have given entire satisfaction, for neither the promoters nor the competitors considered that the best design had received the first premium, and some degree of mystery surrounded the arrangements. The Trustees had employed "a well-known provincial architect" to assess, but "the notes sent in were not by the correct assessor" according to a letter of 14th July. (4). A letter the following week refuted this, claiming that a Mr. Worthington (presumably Thomas Worthington) had "inspected the designs in Birmingham personally and they were afterwards sent to his office for further examination". But only three of the seven designs were commented upon, and the winning architect had not complied with the requirements of the competition and had been obliged to modify his plan. The assessor's report had stated, "the west end of the nave and tower are capable of improvement," whereas the Henman and Beddoe design although placed third received warm commendation : "These drawings are admirably executed, and the design shows considerable ingenuity and originality, is well-studied throughout, and artistic in treatment". The Builder published the drawings with the comment, "some of our readers seem to think the report is really more in favour of this than the other designs". The

4. Ibid. 14th July, 1883. p.96.

church was finally built to the design of Jethro Cossins. (5).

An opportunity to design a large commercial building on an impressive site at the centre of Birmingham facing the Town Hall was almost secured by Henman and Cooper in 1898. (6). For some years there had been considerable controversy concerning whether to retain or pull down the 17th century Christ Church which was occupying a valuable site at the head of New Street but was considered to be of no interest or architectural value. Henman's plans provided an impressive tower at the corner of the site to take the place of Christ Church spire. Below this provision was made at ground level for thirty shops, above which was a large Exchange Hall with entrances from New Street and Waterloo Street and two floors of office accommodation above. The design published in The Builder of 25th June, 1898 (7) shows an impressive building of Portland stone in Renaissance style, but the plans by the rival partnership of Essex Nichol and Goodwin were granted first premium and printed in The Builder of 25th September, 1900. (8).

From the very beginning of his career Henman aimed for the highest. In his first year of professional life he entered the competition for Reading Town Hall, Free Library and School of Art. (9). First premium was awarded to Waterhouse, but Henman's entry received second premium - "his youthful appearance was the cause assigned why he should not be allowed to carry out his

5. Architect of many central city buildings including Mason College. Head of Cossins, Peacock & Bewlay.
6. The Builder, 25th June, 1898. p.615. published a double page illustration and description giving the impression that this was the winning entry.
7. Ibid.
8. Ibid. 25th September, 1900. p.270.
9. Built 1872-75.

designs," was the comment published in The Edgbastonia Magazine in a later account of Henman's career. (10). Premiums were also awarded to his designs for the Free Library and School of Art at Doncaster, (11) and for the School of Art and Scientific Institute at West Bromwich (1880), concerning which a private letter from Henry Ward C.E., Clerk and Superintendent Registrar of the West Bromwich Union contained the suggestion that Henman's entry had not been treated fairly. (12). The Halifax General Hospital project provided another early endeavour which received only partial success. This was revealed by Henman himself in a letter to the Birmingham Post of 14th March, 1892 in which he stated that the Halifax Hospital he had "designed nearly twenty years ago had been 'premiated' but insufficient funds had been raised and the project dropped". (13).

In 1885 Henman's projected designs for the Municipal Buildings at Swindon were awarded third premium, (14) as also were his plans for the Technical College, Suffolk Street, Birmingham in 1893. (15). Nineteen entries were adjudicated by J. Murgatroid F.R.I.B.A. (16) of Manchester, and once again Essex, Nichol and Goodman won first premium with Martin and Chamberlain receiving second.

10, 11, 12. Mentioned in private correspondence in the possession of Mr. D. Wortley (grandson) but no further details available.

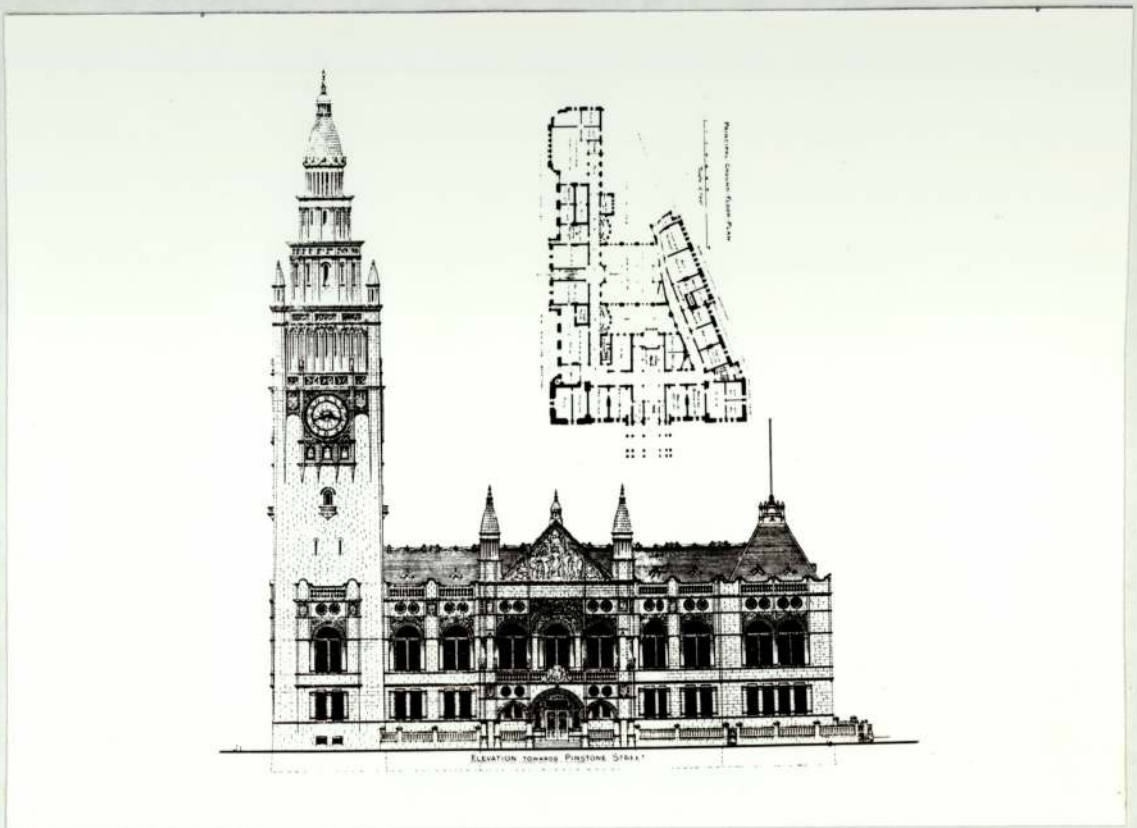
13. Birmingham Post, 14th March, 1892.
14. Listed in the architect's handwriting. No details.
15. The Architect, 4th July 1893. p.22.
16. Mills and Murgatroid designed the Royal Exchange Hall, Manchester, 1874. A theatre has been built within the interior.

The Sheffield Town Hall Competition.

The competition for the Sheffield Town Hall in 1890 attracted widespread interest. It was adjudicated by Waterhouse who, from a final selection of six designs chosen from a very large number of entrants, selected that of E.W.Mountford for first premium. (17). A public exhibition of all the drawings was held subsequently, and the comment in The Builder (18) of 6th February that "only 83, or less than half the number of unsuccessful competitors have allowed their drawings to be exhibited publicly" indicates the size of the original response.

Although Henman's design was not selected in the final six, it was of sufficient merit to receive a special double-page reproduction in The Builder (19) of 26th April, 1890 and such favourable comment as "The Council Chamber is not approached from the principal stairs direct, but placed further in the rear and reached through its ante-room which gives access to committee rooms. These are on the church yard front and therefore in their right place, being sunny and quiet. "It is a happy arrangement that connects the Council Chamber with the committee rooms directly". The report then follows with a less favourable comment, the validity of which is questionable, namely : "The elevation shows an unnecessarily lofty and heavy tower at the principal corner which owes something to the Birmingham Law Courts, but is, on the whole, not

17. E.W.Mountford (1855-1908) Designer of Battersea Polytechnic and Public Library (1890) Battersea Town Hall (1892) and Central Criminal Courts, Old Bailey (1900).
18. The Builder, 6th February, 1890. p.76.
19. The Builder, 20th April, 1890. p.167.



Henman's entry for the Sheffield Town Hall Competition.

unpleasing." Apart from the brief correction that no such tower exists on the Birmingham Law Courts building by Aston Webb and Ingress Bell which was nearing completion in 1890, but can be seen across Corporation Street over the Methodist Central Mission Hall, it may be noted that Mounford's winning design has the same lay-out externally as Henman's, with an even taller tower at the same principal corner of the building.

In Henman's report explaining the considerations governing his design he makes the point that although he intended to provide an effective dominating feature to mark the building as being of an important municipal character, "the near proximity of the tower of St. Paul's church with its dome-like termination precludes the introduction of a dome as the principal feature of the new building. As the smokey atmosphere of Sheffield gives a dinginess to buildings severely classical in design, and the minute details of later Gothic and Renaissance styles are quickly marred thereby, I have adopted a free treatment, Romanesque in character, in order to secure boldness of the former combined with the piquancy of the latter". In this respect Henman's thinking ran parallel to Mountford's whose design also has very freely mixed English, Flemish and French elements, but is more ornate.

CHAPTER 9.

CONCLUSION.

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The study originated from a visit to view West Bromwich town hall on the occasion of its centenary in 1975. The existence of a rudimentary form of air ducting posed the question of who was responsible for the scheme of heating and ventilation. Investigation showed that the work of William Henman had found no mention in any published account of architectural movements from 1870 except for one unflattering discussion of his Belfast hospital. Clearly the inference to be drawn was that Henman made no innovation in terms of architectural style and was not closely associated with, nor had worked in team with, those whose names were linked subsequently with design trends.

At all periods the architect has had to combine the scientific mind with that of the imagination, but the connection was at its weakest during the Ruskin-dominated years when Henman was born, when engineering and the sciences were regarded by purist architects as applicable only for bridge building and factory construction. During his career, however, the boundaries of architecture were being inevitably extended by inventions and by dynamic structural experiments using reinforced concrete and by the introduction of such far-reaching social amenities as mains electricity. His bias towards engineering placed Henman among a new generation of architects who, while originating the overall design of a building and applying a trained eye to its purpose, proportions and materials was also a collaborator with specialist engineers covering the complexities that new inventions and techniques were introducing increasingly. Some of these, like Henman, were based in the provinces where the value of their work at the time was not generally known or appreciated. Ellis of Liverpool provided in his Oriel Chambers (1865) a slender cast iron skeleton supporting plate glass panels to form a commercial building which anticipated the movement towards lighter

and higher structures (1). John Brodie, City Engineer of Liverpool designed a block of tenement flats (1904) consisting of prefabricated concrete slabs, each room being constructed in the form of a dovetailed box (2). The flourishing of commercial architecture extended the range of inventiveness. By the commencement of Henman's career in 1871 the heavy duty hoists used in English warehouses had been developed into passenger lifts in America (3), posing the concomitant problem of ventilating buildings of increasing height and occupancy - a perplexity shared by Henman in pursuit of the principle that air should not circulate from ward to ward in hospitals.

The question of whether Henman was an innovator must be faced. Evidence from this enquiry indicates that while he did not originate the idea for using plenum ventilation at the Birmingham General Hospital he made use of his experience there to analyse in detail the requirements of what he considered to be the ideal hospital environment. He published the results of his enquiry well in advance of other designers in the field, at the same time stressing his conviction that only when the best plan arrangement had begun to clarify itself should the architect think in terms of outward appearance. In this Henman's priorities were right, and he foresaw that the practice of architecture, as it moved into the twentieth century, could best succeed in the form of efficient and imaginative co-ordination of the services of many specialists acting as a team from the earliest stages.

1. Peter Ellis (1804-1884). Oriel Chambers, Water St. Liverpool.
2. Chapter 6.
3. The Equitable Building, New York (Gilman & Kimball with G. B. Post consulting engineer) was the first commercial building with a lift.

He was surely an innovator in the sense that his application of plenum at Belfast was a new one : a new solution to a particular problem. His "ideal" hospital has not dated in essence : its principles are still used when circumstances demand and when finances permit. There are more than fifty completely air-conditioned hospitals in North America for instance, though no evidence of a link with Belfast has emerged.

Although Henman, lacking stylistic originality, has not been placed among the most influential architects of his time, he displayed many of the qualities that propelled other Victorian architects to prominence. As with William Burges (4) for example, he was never satisfied with designing a mere building : the interior decoration, furnishings, design of stained glass and other detailing all received his creative scrutiny. The cast iron filigree features in West Bromwich Town Hall were to his specific design, the stairway ballustrade at Handsworth is unique to the building, and similarly the art nouveau railings surrounding the Aston Library have fortunately been preserved as a welcome feature in the present scheme for urban renewal. His designs, whether Gothic, Neo-classic or domestic Tudor Show sensitivity to local site and needs and give the impression that they were not slavish reproductions but rather his own creative antidote in reaction to the realities of the industrial society which he served. In Birmingham among the Victorian buildings so far spared from destruction by Council or developer, Henman's are now highly regarded : those at Aston and Handsworth, steam-cleaned to mark their centenaries, have emerged from their grime to become distinctive landmarks once more.

4. William Burges (1827-81) Designer of Castel Coch 1875.

Among his contemporaries in Birmingham it is evident that Henman earned high regard - as indicated by his election as President of the Birmingham Architectural Association on the Council of the R.I.B.A. Perhaps his decision to move to Birmingham in 1879 came too late to allow him enough scope to establish a large-scale local practice since by then many of the more prestigious public and commercial buildings had been completed. The burst of activity following the cutting of Corporation Street, the remodelling of the administrative centre and the development of the New Street railway station area had already established the reputation of many Birmingham-based architects. By 1880 Martin and Chamberlain had not only secured the building of the Board Schools but had also designed private homes for prominent Midlanders such as Highbury for Joseph Chamberlain, Berrow Court, Edgbaston for Alderman J. Kenrick and Park Grove, (5), Harborne for John Jaffray besides the Chamberlain Memorial, Chamberlain Square (1880-82). J.A. Chatwin, besides dominating the Church of England rebuilding had designed Bingley Hall and Lloyd's Banks in Colmore Row and Temple Row. No evidence has come to light that Henman attempted to gain access to the non-conformist design field following his failure to secure the Old Meeting Trust project, and the brothers Ewan and James Harper did much of the work for the Methodists, including their Central Hall in Corporation Street.

The main shopping arcades, in which Henman might have exploited his skill in the sensitive employment of iron work, were built to designs by W. H. Ward, a Scotsman who came to Birmingham in 1865 and had completed the

5. An interior from this house, "The Harborne Room" is now in the Victoria & Albert Museum, London.

Great Western and Central Arcades by 1874 and 1881. Oliver Essex, a local architect trained by Ward, became head of the influential team of Essex, Nichol and Goodman who provided commercial buildings in the Old Square and also Assembly Halls at Digbeth, Moseley and Kings Heath. Other buildings on principal sites were already secured by Yeoville Thomason (Council House and banks in Colmore Row), Jethro Cossins (Josiah Mason's College) and J.J. Bateman (Queens College and Queen's Hospital).

It does not appear that Henman competed for the Victoria Law Courts - a principal building which eventually influenced design trends and spread the popularity of terra-cotta in Birmingham, or if he did so, his concept was not thought good enough to be included in the preliminary competition in which the Birmingham Post reported that "of the five sketch plans considered of sufficient merit to be drawn up, two were from local architects" (6). In addition to local commissions therefore, Henman's horizons, like those of the well-known names in London, ranged as widely as the architectural competitions allowed, but it would seem that by remaining in the Midlands a wider reputation eluded him.

From time to time the Henman brothers assisted each other : William was associated with Charles when the latter designed the Town Hall, Law Courts and Free Library at Croydon in 1892, and during the last few years of their careers, when William became greatly handicapped by severe deafness they became joint architects for the Metropolitan Asylums Board. Working in association they won second premiums for

6. The Architect, 21st August, 1886. p.54. The two local architects were William Doubleday and J. R. Nicholls.

the Hendon Asylum and the extension to the Bristol Royal Infirmary, also a third premium for Park Hospital, Hither Green, London (7).

Patronage might have furthered Henman's career. If Joseph Chamberlain, who was actively interested in the inception of the Birmingham Hospital had become Prime Minister, perhaps commissions of a monumental character such as those enjoyed by Aston Webb might have come his way, but the indications are that a utilitarian rather than a fashionable approach influenced Henman's outlook. He may have decided that he lacked the qualities required for London circles although he presented papers of a technical nature to large and influential gatherings.

One significant indication of the unpretentious nature of the man himself is conveyed by another family reminiscence that although he designed the public memorial fountain to John Dodgson in Stockton-on-Tees (8), his own grave at Widford near Chelmsford was, in accordance with his instructions, marked only by a plain oak cross on the understanding that such memorials in his view should last no longer than the weathering of the wood.

7. Listed in the Obituary. Journal of the R.I.B.A. 14th March, 1917, p.223.
8. In 1890. Reported in the Essex Weekly News, 16th March, 1917.

APPENDIX 1.

CHRONOLOGICAL LIST OF WILLIAM HENMAN'S MAJOR WORKS.

(a) In partnership with J. W. Alexander.

Dates		Location of Drawings or Published Information.
1871	North Ormesby Cottage Hospital (Additions).	Closed 1981. Documents at Cleveland County Archivist, Middlesbro'.
1871-1875	Stockton Exchange Building	Building News 6/12/1872 The Builder 7/12/1872.
1871-1875	West Bromwich Town Hall	Building News 27/10/1871.
1872-1874	Denmark Street Board Schools, Middlesborough	Demolished 1975. Documents at Cleveland County Archivists, Middlesborough.
1872-1873	Norton Board School, Stockton.	Building News 2/5/1873.
1873-1874	St. John's C.E. School, Middlesborough	The Builder 28/11/1874.
1873-1874	Brynmawr Board School, Llanelly.	The Builder 1/3/1873.
1873-1875	Aberdare Board School, South Wales.	Building News 28/2/73 & 16/7/1875.
1876	Norton Church (Restoration	Building News 3/6/1876.
1879-1880	High Street Board School Wednesbury	The Builder 22/2/1879 Wednesbury Herald, 13/11/1880.
1879-1880	St. John's Church, Stillington, Yorks.	The Builder 4/10/1879 Durham Advertiser 2/7/1880.

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(b) From the Commencement of Henman's separate Midlands Practice.

Dates		Locations of Drawings or Published Information.
1876-1880	Handsworth Council Offices and Public Library.	The Building News 10/11/187 The Builder 1/12/1877
1879-1880	Aston Manor Council Offices and Public Library.	The Builder 4/10/1879 Building News 13/8/1880.
1881-1884	West Bromwich Infirmary	The Builder 2/4/1881 The Architect 18/10/1884.
1880-84	Droitwich Brine Baths	The Builder 4/5/1917.
1882-1883	The Gilstrap Library, Nework-on-Trent.	The Builder 10/6/1882 Nework Adviser 12/8/1883.
1884	Erdington Board School, Birmingham.	The Builder 10/5/1884.
1884-1885	Royal Midland Home, Leamington (Additions)	Leamington Spa Courier 24/1/1885.
1887-1890	West Bromwich Union Offices.	The Builder 16/4/1887.
1893-1895	The Smallwood Hospital, Redditch	The Architect 10/5/1893 Birmingham Gazette 27/5/1895.
1892-1897	The Birmingham General Hospital.	The Builder 19/3/1892 The Architect 29/1/1897.
1901-1903	The Royal Victoria Hospital, Belfast	The Builder 21/12/1901 The Architect 10/5/1901.
1896-1897	Handsworth Technical College	The Builder 16/10/1897
1897	The Guest Hospital, Dudley (Additions)	Dudley Almanac 1898-1901.
1898-1905	Electric Light and Power Station, Handsworth.	Descriptive Booklet. Birmingham Ref. Lib. LS/34/7.
1900	85 - 87, Cornwall street.	
1902	Scottish Union Insurance Office, Birmingham	Birmingham Information Office, Colmore Row.
1904	Greenbank Hospital, Darlington (Additions)	Darlington Health Council Archives.
1905	Ramsey Cottage Hospital Isle of Man	Ramsey Admin. Committee Cumberland Road, I.O.M.
1907	Stockton and Thornaby Hospital (Additions)	The Builder 12/11/1907 (Closed 1945).
1910-1912	Noble's Hospital, Douglas, Isle of Man	Manx Museum, Douglas I.O.M.
1903	Midland Hotel (Redesigned)	The Builder 5/9/1903

Date		Location of Drawings or Published Information.
1910	Malvern Hospital	The Builder 9/6/1911. Malvern Gazette 2/6/1911.
1911	Stratford-upon-Avon Hospital (Additions)	Records Office, Henley Street, Stratford.

APPENDIX 2.

PRIVATE HOUSES DESIGNED BY WILLIAM HENMAN.

(From a list in the architect's handwriting. Dates unknown).

(a) Designed in collaboration with J. W. Alexander:

Mr. J. Dodgson	-	"Hartsborne", Middlesborough.
Mr. A. Kitchen	-	Great Ayton, Yorkshire.
Mr. J. Appleby	-	Gratton, Middlesborough.
Mr. W. Dennington	-	Stockton-on-Tees.
Mr. S. Richmond	-	Stockton-on-Tees.
Mr. E. Swan	-	Middlesborough.
Mr. E. Williams	-	Middlesborough.
Mr. J. Richardson	-	Middlesborough.
Mr. J. Mills	-	Newham Hall, Middlesborough.

(b) In Birmingham:

Mr. A.L. Middleton	-	"Belverdere" Harborne.
Mr. C. Harding	-	Edgbaston.
Mr. F.A. Lines	-	Edgbaston.
Mr. H. Hope	-	Edgbaston.
Mrs. E.J. Marston	-	"Parkfield" Knowle.
Miss Jolley	-	Edgbaston.
Miss Shelton	-	Edgbaston.
Mr. H. Barber	-	Edgbaston.
Mr. H. T. Timmins	-	Edgbaston.
Mr. E.H. James	-	Four Oaks.
Mr. P.J. Jones	-	Edgbaston.
Mr. E. Morton	-	Edgbaston.
Mr. A. Crosbie	-	Edgbaston.
Mr. W. Ansell	-	Wylde Green.
Mr. G. S. Malliet	-	Great Malvern.

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(Precise addresses not given. Private papers in the possession of Mr. D. Wortley, Grandson).

APPENDIX 3.

CASES: CIVIC BUILDINGS.

The career of William Henman was built, as was that of many other aspiring young architects, on competition - a method by which almost all the important public buildings of the time originated. In this activity he worked under speed and pressure, showing at the same time a breadth of design approach which indicates that he was well-versed in contemporary developments in architectural design emerging during the final quarter of the nineteenth century, and was able, when it was necessary to discard the Gothic influences he had received in training and during his service as illustrator for Edmund Sharpe.

During the early years of his career in Birmingham, Henman designed civic buildings for three neighbouring boroughs, all within five miles of each other, and completed within seven years between 1875 and 1882. All three commissions were won as a result of strong competition, and each one, although fulfilling similar Council administrative requirements, is completely different in appearance from the others. These were the Town Hall at West Bromwich (1871-75) and the Public Offices with Free Libraries at Handsworth (1876-80) and at Aston (1879-80).

The design of the West Bromwich Town Hall is strongly in the High Victorian Gothic style, that of Aston shows Jacobean characteristics in keeping with the historic Aston Hall nearby, while at Handsworth Henman's interest in the Elizabethan and English Vernaculor revival emerging after 1860, is demonstrated by the imposing Tudor style tower surmounting the building.

West Bromwich Town Hall.

During the hundred years from 1750 to 1850, West Bromwich had grown from a small rural community into a thriving town with a population of 52,295; its meteoric growth resting on the smelting of iron. The iron-masters, led by Reuben Farley, initiated the town hall project, and cast iron forms a principal feature of the interior design. A hospital designed by the Birmingham partnership of Martin & Chamberlain had already been completed by 1871, and two civic buildings, a town hall and a free library, were now envisaged as a focal point for the town and an embodiment of the pride of the local community. (1)

The Choice of Site.

Unfortunately, West Bromwich had no eminent point on which to perch the town hall, and no square, for it had developed along the line of the London to Holyhead turnpike road improved by Thomas Telford in 1779, but a site opposite Christ Church was purchased for £2,078 in 1871, intended for town hall, library and a covered market in an area of 3,787 square yards. The town hall received precedence of site at the corner of a road junction with the High Street, the basic requirements being a large central assembly space surrounded by offices : the entrance and staircase being suitably grand for civic processional purposes.

Thirty designs were submitted for the town hall competition, the adjudicator being Ewan Christian, who at that time was consulting architect to the Diocese of Lichfield and had restored several Midland churches. A report published in The Builder (2) stated that the

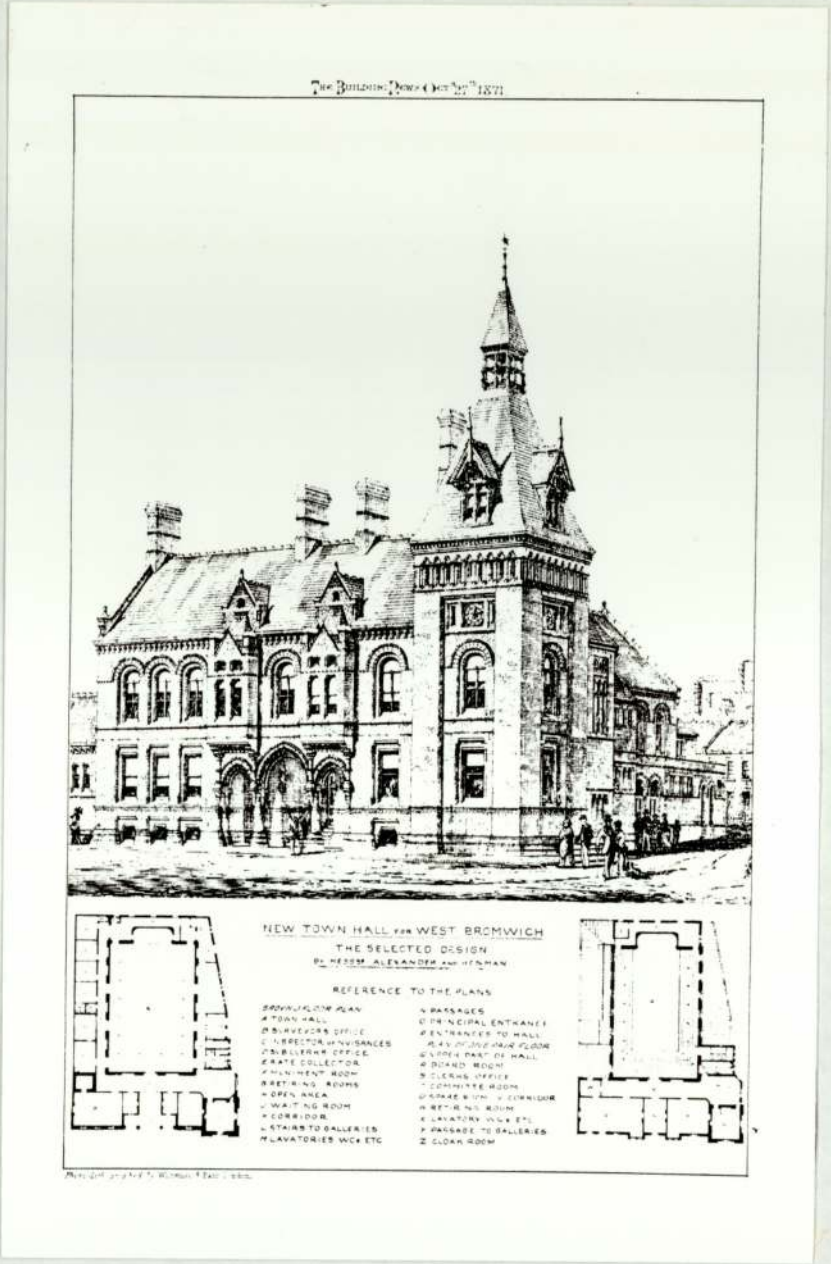
1. Dates of the Official opening ceremonies.
2. The Builder, 17th June, 1871. p.471.

first premium had been awarded to Alexander and Henman, a tender from Messrs. Trow & Son, builders of Wednesbury for £8,500 being accepted. As the cost of the building had been strictly limited by the Local Board, it was necessary to use materials of an inexpensive nature. Pressed red brick, terra-cotta and a small quantity of stone were used, but although modest in scale, Henman's design still functions well after more than a century of use. The Gothic tower which firmly terminates the building at the corner of High Street and Lodge Road is still an imposing feature despite neighbouring office blocks, its attractive balcony, having no function except as a monument to civic pride and confidence a century ago, now provides a pleasant relief from modern rectangular forms. The tower was intended to carry a clock, but funds ran out.

A small drawing from The Building News (3) of 27th October, 1871 shows how the most was made of limited resources. The main hall is 81 feet by 48 feet the roof of which is carried by cast iron arches supported by twelve iron pillars, making an attractive and functional use of the iron aesthetic natural to the town of West Bromwich. Corridors on the South side give access to the various local government offices, the main entrance from the High Street is by a flight of steps 12 feet wide leading to a triple archway of pointed architecture.

The original premium-winning design published in The Building News (4) shows a clock tower rather lower than the more slender feature Henman finally built.

3. The Building News, 27th October, 1871. p.304
4. Ibid.



West Bromwich Town Hall.

The competition design of 1872.

West Bromwich Town Hall.

Final design of the Tower.

The original design was shorter than the present building : it had a frontage of 130 feet facing the High Street. It was conveniently planned and harmoniously composed, using traditional red brick with stone dressings. The tower was the main external feature, and was also 130 feet and thus the front elevation of the building fits into a square, at the centre of which is the triple-arched main entrance. The tower, being the main dramatic element, stands slightly forward and could be seen from far away in former years. Both the vertical and horizontal elements of the facade are subtly emphasised by pattens in the brickwork, by the vigorous use of the mouldings which link the windows, and also be tracery and colouristic textures of materials used. The influence of William Butterfield is much in evidence : polychromy resulting from the use of stone, terra-cotta, patterns of tiles, and different colours of brick. Henman's town hall thus displays the typical Victorian joy in experimenting with materials and in the ransacking of former architectural styles, for the decorations of the facade are taken from Gothic, Greek, Romanesque and Byzantine elements, while the Victorian love of symbolism and historicism speaks with quiet restraint from the limited range of sculpture at the main entrance.

Immediately below the weather vane of the tower, a spirelet protects a wooden belfry lantern with Greek-patterned cornice which acts as the ventilation outlet. Below this, the blue tiled roof is broken by dormer windows and next, a colonnade of red terra-cotta columns set in stone pedestals and crowned with trefoil arches encircles the whole tower - clearly intended as the distinctive feature of the tower to which are added just below, two stone balconies, purely ornamental, supported by a row of nine closely-spaced corbels.

At the main entrance the group of three pointed arches, chevron bordered, emphasise the Gothic nature of the building and are reminiscent, on a much more

West Bromwich Town Hall : High Street Entrance.

modest scale, of the triple-arched entrance to Waterhouse's Manchester Assize Building.

The arches are supported on stone columns with foliated capitals from which spring carved heads in Medaeval costume representing the months of the year.

This is the work of John Roddis of Aston, who had trained and worked with Peter Hollins, a Midland sculptor of note, whose public statues such as Robert Peel (1855) and Sir Roland Hill (1870) were features of the Birmingham City landscape.

Moving across the twin-corbelled windows above the entrance arches is a decorative band of blue brickwork which is taken right across the front of the building.

The aesthetic character of the interior of the hall is determined by iron, used with elegance as a decorative as well as a structural material. Architecture and engineering combine to provide an inner space of lightness and transparency.

Nine slender cast-iron columns extended along each side and rising from them in regular rhythm is a succession of filigree cast-iron arches spanning the roof. Each arch is composed of four identical cast segments bolted together, the pattern having been designed by Henman. There are 46 segments altogether, ten of them supporting the apse-like end of the hall housing the organ.

The columns serve the triple purpose of supporting, in addition, an arcade of smaller arches with pleasing geometrical patterns, and also the side-aisle arches which are cast with foliated panels.

The engineering of the quadruple joint at the head of each column is particularly striking : a

triangular housing holds all four units, and the round-headed securing studs form a decorative feature. In the ceiling are longitudinal ducts forming an integral part of the cast iron decoration which also serve their functional purpose of allowing stale air to reach the tower ventilator.

The interior iron work was executed by Messrs Trow of Wednesbury, a family concern of two brothers who were builders and a third, an iron founder Alderman Joseph Trow, who owned the Brunswick Iron Works where the casting was done.

The devices designed for the heating and ventilation of West Bromwich Town Hall show beyond doubt the extent of Henman's interest and concern for the interior environment of his building.

Here can be seen an innovatory device involving rudimentary warm air ducting that shows the architect well in the forefront of contemporary thought. His device not only worked well at the time of installation but still functions at the present time - though modern radiators have replaced the original coils of hot water pipes.

The hall was mainly heated by under floor hot water pipes taken round three sides of the hall and enclosed in cast-iron troughs covered with ornamental gratings - quite an orthodox method of heating at this time, but in addition to this, in recesses arranged around the interior walls, coils of pipes were inserted which compelled the air entering the hall by openings provided for that purpose to pass over the pipes and so become slightly warmed. By this means it was hoped that cold draughts would be avoided.

Handsworth Board Offices and Library.

Two miles to the South of West Bromwich, along Telford's turnpike in the direction of Birmingham lay the Borough of Handsworth where in 1876 the old Waggon and Horses Inn was demolished to provide the site for the new Local Board Offices and Free Library. Henman's design incorporated both requirements under one roof in a building strongly reminiscent of an Elizabethan manor house. The plan is in the form of a letter "E", though with truncated projections, with a square tower and the main entrance at the centre projection, the two outer wings housing the library and the Council Chamber. The front elevation is therefore perfectly balanced in outline, though the fenestration is adapted slightly to conform to interior requirements. Elizabethan grid windows with stone mullions are a feature of the balanced composition, yet the hint of Gothic carving at the tops of the Council Chamber windows and the pointed archway at the main entrance show Henman's tendency to integrate eclectic detailing into the composition. Other examples can be seen in the terra-cotta bandings stretching across the two wing gables : these serve to balance the sturdy verticals of the central tower which is furnished with a viewing parapet above which the clock tower, half-timbered with Tudor windows and tall chimneys, stretches upwards.

Within, the centre of the building originally contained offices for the local council officials. The character of this section is also mixed. Triple Gothic arches of marble give access to the vestibule, but beyond that the interior returns to Elizabethan echoes. A large grid window illuminates the stairway, the glass of which is decorated with a floral and twining leaf motif giving perhaps an early hint of Art Nouveau. Over the library which occupies the South wing, is a large assembly room with an impressive hammer beam ceiling, the curved brackets pierced and carved.

Handsworth Board Offices and Library. 1880.

Central Clock Tower. Tudor and Gothic elements.

Handsworth : The Library Wing.

Adjoining is a large reading room the walls of which are arcaded with wooden arches of early English shape. A similar large room in the opposite wing of the building was the Board Committee Room. This has linenfold panelling and the original heating equipment consisting of "batteries" of nine inch cast iron hot water pipes in groups of six and each ten feet long, may still be seen.

Throughout this building can be seen Henman's response to the growing movement towards a "Free Style" architecture based on a blending of English styles from the past introduced in an endeavour to find a fresh, distrinctive national style. He appears to have been working in the mode of thought introduced in leading works by George Devey, Anthony Savin, Norman Shaw and William Lethaby. Having completed his Gothic Town Hall at West Bromwich - influenced no doubt by his senior partner and the need to satisfy the predilections of Ewan Christian as competition adjudicator, he never again designed in completely Gothic manner.

Twenty nine designs had been submitted in the competition for Handsworth (5), first premium of £50 was awarded to Alexander and Henman, second was Walker of London and third, Wykes of Birmingham.

Aston Public Offices.

In June 1878, Joseph Ansell, writing as Clerk to the Local Board of Aston Manor, approached George Edmund Street F.R.I.B.A. to serve as adjudicator for the competition to build Public Offices, Free Library Fire Station and Baths (6). A site had been bought on

5. The Building News, 10th November, 1876 p.468.
6. Located at Birmingham Ref. Library. Local Studies Department.

a slight rise overlooking the historic Aston Hall at the junction of Albert Road and Witton Road.

Street's reply was not encouraging : "I am not very fond of advising as to competitions, and if I am sure that my advice will be followed. But if your Board wish me to do so I will report upon the plans sent in for Aston Public Offices. My fee would be one hundred guineas. Friday 5th July is the first day on which I am at present free".

Joseph Ansell was not discouraged. Ambitious for the success of the project and proud of his native Aston, an invitation was then offered to Alfred Waterhouse who accepted, and the design "Economy" by Henman was chosen. The resulting building owed much to Ansell's enthusiasm. He was born at Gosta Green in 1841 where his father carried on the business of a maltster. Educated at King Edward's School Birmingham he trained as a Solicitor. The family business prospered and moved to Aston where Joseph Ansell was married in 1863 to Ann Pears, the daughter of a papier mache manufacturer. They took a house in Lichfield Road, Aston and played a prominent part in local affairs. In 1868 when a Bill was introduced into Parliament to incorporate Aston into Birmingham, Ansell vigorously circularised the Lords, who rejected the Bill, so securing a reprieve for Aston.

The design, which was published in The Builder (7) of 4th October, 1879, shows Henman's sensitivity to the requirements of the site. The building, of red pressed brick and stone dressings, is restrained neo-Jacobean

7. The Builder, 4th October, 1879 p.1105.

PUBLIC OFFICES AND BATHS FOR ASTON, WARWICKSHIRE. THE SELECTED DESIGN.—MESSRS. ALEXANDER & HENMAN, ARCHITECTS.

Aston Manor Council Offices and Public Library.

The original premium winning design of 1879.

Aston Manor Building : the contracted design

Aston Manor Council Building. 1880.

The Free Library Wing.

in deference to proximity with Aston Hall, trees from the park of which are seen to the right of Henman's drawing. The two principal frontages carry prominent Baroque gables which harmonise with, but do not copy, those of Aston Hall itself. A hexagonal corner turret with a Baroque cap connects the two facades in the original design a lofty clock tower with Renaissance features completed the composition. Unfortunately, the prize-winning design was never built. Its cost had been estimated at £22,000, but a serious depression in local trades prompted agitation from an organisation known as "the Ratepayers' Union" which forced the Local Board to curtail the project. Only the Public Offices, containing certain rooms allocated for the Free Library were built. Henman dispensed with the tower and shortened the main facade, the corner turret now becoming the dominant feature.

It was a successful adaptation. The site is triangular, the road junction being approximately 80°, many of the rooms were designed with irregular-sided walls to gain maximum accommodation for Board officials on the ground floor. The main entrance to the building, in Albert Road has a Romanesque arch with carved leaf motifs in stone headed by the coat of arms of Aston Manor. The inner vestibule is reached through an oak doorway with a Queen Anne fanlight of delicate wrought iron decoration. Two marble pillars form newel posts for the winding stairway leading to the principal upper rooms, and this is lit by a large neo-classical window. A patterned tiled floor is reached, having at its centre a large twelve-sided plate glass panel let into the floor. This is a key element in the interior design of the building for it serves a double purpose by providing a source of light and a decorative feature in the ceiling of the library reading room below it, while immediately above it is a twelve-sided glass pyramidal dome admitting sunlight and thus transmitting it downwards through the entire building. This device, together with the curving stairway, gives unity to the irregular

interior and emphasises the flow of space from one level to another.

The Board Room, which occupies the prominent position on the second floor, incorporates the corner turret with its five-sided apse-like window, the walls being irregular to follow the line of the road junction. Heating was by the Perkins system of cast iron hot water pipes, since removed, but the original Tobin tube inlet ventilators can still be seen.

Another feature still preserved from Henman's original conception are the ornate railings surrounding the building. These are of wrought iron with spirals of twining tendrils in the Arts and Crafts tradition.

The Gilstrap Library, Newark

This was a gift to his native Nottinghamshire town from Sir William Gilstrap who had been in business there as a maltster before settling at Fornham Park, Suffolk in 1862, where he later became High Sheriff. He chose an impressive site on Castlegate, a main thoroughfare of the town, with the ruins of Newark Castle as a background, with the historic Ossington Coffee Tavern nearby on one side and Beast Market hill on the other - the rent from the ancient cattle market being allocated to library funds.

The foundation stone was laid on Whit Monday 1882 and the library was opened on 26th July, 1883, (8) Henman being assisted in the work by H.Beddoe, a fellow member of the Birmingham Architectural Association. Henman's

8. The Newark Advertiser, 1st August, 1883. p.2.

design shows sensitivity to the siting. In view of the ruined castle,a lesser architect might have been tempted to design in a Romantic manner resulting in an architectural parody, but Henman's solution is in restrained Vernacular style based on Elizabethan architecture with large, mullioned grid windows and just a hint of crenellation at the entrance and over the principal bay. The building is entirely of Brighouse stone with the addition of Ancaster dressings, and the large central doorway of carved oak is surmounted by the borough coat of arms and those of Sir William Gilstrap carved in stone by John Roddis of Aston.

The building is largely cuboid in general outline, and the interior space is arranged systematically around a central entrance hall providing easy access to all rooms. The three carved gables of the hall provide a hint of Early English architecture as though to express a token of affinity with the castle, and this is further emphasised by the ceilings of the main rooms, which are lofty and supported by moulded wooden beams giving a coffering effect, the beams terminating in a carved wooden border with blind arcading along the walls, thus giving an overall"historic" effect.

To heat the building, Henman chose a system installed by R.R.Gibbs of Liverpool, whereby warm air from hot water pipes rose through cast iron grills at floor level taking the place of wooden wainscoting round the room. All rooms were filtered with Tobin ventilators in the outside walls, stale air being taken up through ornamental metal grills in the ceilings to tunnels communicating with the turret on the roof.

Electric Light and Power Station Handsworth

A scheme to build an electric power station to provide street lighting and other facilities was initiated

by Handsworth Urban District Council in 1898 (9). It was resolved that the engineering work should be done by Sir Alexander Kennedy and partner, and Henman and Cooper were appointed to design the generating station.

The position chosen was on the site of the old mill pool owned by Edward Rushton in 1756 which had passed into the ownership of Matthew Boulton. (10). It was within a few hundred yards of the Council Offices on Soho Road and adjacent to the railway station, where a special siding was connected so that coal could be delivered directly to the boilers. The building was designed with a temporary end to allow for future extension eastwards. It was on 9th October 1905, the lower floor consisting of boiler room, pump room, battery room, stores and engineer's offices : the upper storey accommodated the meter room, drawing office and committee room. The group of buildings was compact and well-articulated, the louvred gables of the boiler house were surmounted by twin ventilating turrets with Portland stone bandings, the whole composition being dominated by the chimney shaft. Apart from the chimney proclaiming the utilitarian nature of the site, the remainder was designed to be in keeping with the residential surroundings. The large dynamo hall was placed centrally to mask its bulk and the office buildings, placed round it, presented a facade of regular gables and windows of 'Queen Anne' flavour.

9. Descriptive booklet on the occasion of the opening ceremony located at Birmingham Reference Library Local Studies Department. Ref. L.S.34.7.
10. Mackwood F. Handsworth Old and New. Birmingham. 1903. p.42.

The Stockton Exchange

The design for the Exchange building was an early commission won by the partnership of Alexander and Henman. Extensive re-shaping of the town centre in recent years has swept this building away, together with many more, and apart from a glimpse from indistinct newspaper illustrations (11) no record of its appearance has been traced in Stockton. This may be because its frontage is so small, consisting of a stone entrance of only fourteen feet, that possibly it had little interest as an architectural feature in the High Street.

The interior contained a spacious hall and many additional facilities, and the competition to build it was won under somewhat fortunate circumstances for the partnership. When the competition was announced in the Architectural Press, a letter to the editor of The Building News (12) of 2nd August 1872, published under the title "Northern Niggardliness" complained that the Stockton Exchange Company was charging competitors ten shillings for each copy of the tracing of the proposed site, thus forcing competitors to help finance the cost of the premium prize money of £50. The result was that only eight sets of drawings were received and selectors chose three for final scrutiny. At this point, it was realised that there was insufficient money to fund the original scheme and competitors were asked to re-submit revised plans. Only Alexander and Henman together with one other local competitor, a Mr. Adams responded to this,

11. Middlesbrough and Stockton District Evening Gazette, 6th February, 1873.
12. The Building News, 2nd August 1872. p.440.

and finally the partnership was granted the commission to build, the prize money being offered to Adams as consolation.

What can be discerned from extent records (13) indicates that it was a three storey building, the frontage showing three Gothic windows at the two upper floors and an ornamental balustrade at the top with a small pointed pediment. In the entrance vestibule were two small shops and the ground floor provided twenty one commercial offices above which was a large assembly hall. Other facilities provided were dining, billiard, reading and other club rooms.

By 1910, the Exchange Hall had been converted into a silent picture palace, the entrace pass to the penny seats, printed with an illustration (14), provides an indication of what the entrance looked like. The Building served as a Cinema until 28th February, 1937 when a fire broke out and destroyed the interior.

13. The only record held by Cleveland County Library is a sketch illustrating an article dated 6th February, 1873 in the Middlesbrough and Stockton District Evening Gazette.
14. Located at Cleveland Reference Library, Stockton-on-Tees.

APPENDIX 4.

CASES: ECCLESIASTIC BUILDINGS.

The Church of St. John, Stillington, Stockton.

This is a small, modest church of red brick, pleasantly proportioned with Gothic archway at its entrance porch, lancet windows at its East elevation but Romanesque clevestory windows set in pairs along the nave. A stone roundel window lights the North transept and the slender bell tower, though standing separate from the nave, is pleasantly articulated within the main grouping and composition of the building. Its reticulated louvres round the belfry compartment give the tower a hint of Arts and Crafts flavour. Altogether an eclectic composition.

According to an entry in The Builder (15)of 4th October, 1879, the cost of the church was only £3,196 (quantity surveying being in the charge of Charles Henman) so it is not surprising that decoration is limited to simple stone banding.

What part William Henman took in its conception is in some doubt because in 1879 he was in Birmingham and occupied with the problems of the Aston Municipal Building but perhaps the report in the Durham Advertiser (16) when the church was consecrated in 1880 which refers to the hot air plan of heating being adopted, may indicate Henman's contribution.

In outward appearance, St. John's resembles William Butterfield's well-knownlittle church of St. Paul at Hensall, Yorkshire (1854) (17), built for the

15. The Builder, 4th October, 1879 p.1121.
16. Durham County Advertiser 2nd July, 1880 p.8
17. Dixon & Muthesuis, Victorian Architecture, London 1978 p.206.

Ecclesiastical Society, so closely as to invite the comment that Mr. Ewan Christian could hardly have failed to have praised its design.

APPENDIX 5.

CASES: EDUCATIONAL BUILDINGS.

The Technical School, Handsworth.

In 1896, the Handsworth Urban District Council passed a resolution to provide for technical education, and a letter from the Chairman, Henry Ward was sent to the Handsworth School Board on 18th April urging it to form a Technical Committee. The new Technical School was opened on 18th September, 1897 (18) as a commemoration of Queen Victoria's Jubilee.

The choice of both site and architect for the building was predictable. William Henman, when designing the Handsworth Council Offices on the main Soho Road had made provision also for a Fire Engine House, implement sheds and stables for twelve horses behind the main building and public library. There was a further area behind these buildings which made a suitable site for the new Technical School which would have a frontage on Goldshill Road.

In keeping with the trend of the times, Henman decided to design in an overall flavour of the "Queen Anne" style. The regular facade of five Greek-pedimented gables has a main entrance situated below the central one. It is semi-circular and decorated with six Doric half-pillars of stone stretching from a brick balustrade and stonework steps. Classroom windows are regularly spaced along the frontage, the upper ones arched in an adaptation of Renaissance style.

18. The Builder, 16th October, 1897 p.311.

The interior is axial with a longitudinal corridor, but the design is not formal, provision being made for the differing requirements of scientific and craft activities. On the East side of the entrance hall are the general office, library and committee room, two large classrooms and Principal's room. On the West side are further classrooms and laboratories. The main staircase leads from a vestibule having a stone archway supported by three marble pillars. Ventilating and heating was carried out by William Key, the builders were Hortons of Brierley Hill and the original electric light power was supplied by Tangye's gas engines.

Handsworth Technical School : 'Queen Anne' features.

APPENDIX 6.

The Listerian Anti-Septic Practice.

The surgical practice, which had a direct influence on Henman's placing of the wards and operating theatres at Belfast, was described in papers by Lord Lister published in The Lancet, March-April, 1875, entitled "Recent Improvements in the details of Anti-septic Surgery". His biography written by Rickman Godlec (1), a nephew who worked as a member of Listers operating team, has the following first hand report.

"The method demanded rigorous self-discipline and attention to detail. Its object was to 'destroy once and for all any septic organisms that may have been introduced', and thus to prevent infection from ever starting in an incision or accidental wound. Every source of bacterial infection was eliminated in a step by step routine.

Before operation the staff had to select the instruments the Chief preferred, wash and polish them, and lay them for half an hour in a 1 in 20 solution of carbolic. Surgical sponges, which were elsewhere used to mop blood off the floor, were similarly washed and sterilized. The operating table, of scrubbed deal, was covered in towels wrung out in the solution. Next the nurse set a bowl of antiseptic lotion for the surgeon to scrub his hands, and pinned a clean huckaback towel over his waistcoat; cap, mask or gloves were still unknown. While the patient inhaled the chloroform, she purified

1. Godlee R. Lord Lister, London 1917 p.283.

the skin round the site of operation with carbolic lotion and covered it with towels wrung out in carbolic. If any instrument, sponge or towel was laid aside, even for a moment, in the course of the operation, it could not be used without re-sterilizing. Sterile catgut ligatures eliminated a prime source of infection. The most famous piece of Listerian apparatus was the high-pressure spray, 'for providing an antiseptic atmosphere' around the incision. In practice its effect was described by an assistant with barely suppressed emotion. 'A huge cloud of fine spray could be produced, enveloping the patient and all those engaged in the operation and capable of filling a room with a dense, damp and pungent mist, so that the occasion often became a trial of physical endurance'. Mercifully a smaller model was available for dressings, which were also carried out with full antiseptic precautions. Lister refused to hand over a surgical case to a general practitioner until healing had taken place and all danger of infection was past (2). By the use of this method, dressings could safely remain unchanged for as long as a week, with great saving of fatigue and pain for the patient.

2. Mauton J. Sister Dora, London 1971 p.365.

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