50 YEARS OF IDEAS

in health care buildings

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Foreword

The Nuffield Trust has had a longstanding interest in hospitals and healthcare buildings. One of the earliest initiatives of the Nuffield Provincial Hospitals Trust, established in 1939, was a survey of hospital services. The Trust's original purpose was the co-ordination on a regional basis of hospital and ancillary medical services throughout the provinces. One of the key challenges was whether, if the various parts of the service were dovetailed together, completeness would be achieved. At the time it seemed fairly certain that there would be some gaps in the jigsaw. The first need was to discover their nature and their whereabouts. A survey of hospital services in a given area was the obvious answer. Ten teams (three appointed by the Ministry and seven by the Trust) naturally found good things and deficiencies in varying conditions in widely different areas. There was a unanimity, as monotonous in detail as it was startling in cumulative effect in the final conclusions of the report that the three main defects of the hospital service were:

- inadequate accommodation
- shortage and maldistribution of consultants and specialists
- lack of co-ordination

The reports of the survey were printed and published as Blue Books by HMSO. 'Their undeniable value in that whatever future hospital policy might be decided upon, they provided the first and only national statement of present conditions.'[1] Gordon McLachlan, in his *History of the Nuffield Provincial Hospitals Trust*[2], claims that the Blue Books, which together became the Domesday Book of Hospitals, was the basis on which the regionalisation of hospitals was provided for in the 1946 National Health Service Act. Furthermore 'it is not too exaggerated to claim that the Trust in its early days, working in association with the Ministry of Health, had the pre-eminent influence on the way in which hospitals are now regionalised, which was perhaps the first major step in the rationalisation of our health service resources'.

The Trust followed its interest in the hospital survey in the 1950s by sponsoring an investigation jointly with the University of Bristol of five years' practical and theoretical research into the design of various departments in hospitals and into ways of organising work in them. The work was predominately architectural and included observations on how much the physical circumstances were helping or hindering the provision of hospital and health care.

This publication revisits the history of hospital building in the year following the celebration of the 50th anniversary of the NHS. It is also an important contribution to aligning the themes identified in the Nuffield Trust Series No 1, *Redesigning Health Services*[3]. Appropriate settings for care and future developments require that we redesign our health services to meet the needs of the 21st Century rather than merely reorganising them. We are on the verge of a major technological change in health care, resulting from developments in genomics and infomatics. This will have huge implications in terms of clinical practice and expectations of patients.

Physical settings for care, including hospitals and health centres, should also be priority areas for developing best practice and re-establishing the UK as a leader in appropriate buildings for appropriate care. NHS Estates and its equivalent in the family of health services in the United Kingdom have a key role to ensure that health policy and health care practice can be translated into suitable buildings and that form follows function.

John Wyn Owen, CB

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Authors' Preface

In celebrating the 50th anniversary of the NHS the Medical Architecture Research Unit (MARU) wished to make its own contribution related to the buildings that had been conceived, designed and built for health care in that half century. MARU obtained support for developing this initiative from John Wyn Owen of the Nuffield Trust. Four of us, - Rosemary Glanville, Susan Francis, Ann Noble and Peter Scher are all architects with a passionate interest in and enthusiasm for the design of buildings for health care. Although none of us were in practice in 1948 when the NHS began, our collective experience and commitment has been long and deep.

Our text focuses on key ideas that we see as being influential in healthcare building design in the UK over the last fifty years, with an emphasis on the hospital. In this overview there is no intention to give a detailed chronological account of the NHS hospital building programme or to cover every health building type other than hospitals. We are fully aware of many important contributions that could not be included in this brief outline, but we do include many references to background texts.

Within a UK contextual framework of changing ideas and knowledge in medicine, architecture and building, society and health care policy, four viewpoints have been developed: The role of research and development; the impact of the systems and standards programme; the interaction of theory and practice; and a review of current ideas about health building design.

By mapping the past our overall aim is to be poised to think about the future in a more informed way.

A cknowledgements

We wish to thank John Wyn Owen, John Weeks, Raymond Moss, Howard Goodman, Richard Burton, Tony Jones and Margaret McCutcheon, for their expert comments and support; and Simon Lee,Tony Fawcett and Paul Conway for their assistance in design and production.

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CHAPTER 1

Introduction

The Context

The creation of our National Health Service was a giant leap for the people of this country, and its fifty year span is rightly being celebrated and assessed. Over the fifty years, that universal service, free at point of use and paid for out of taxation, has required and obtained new buildings, large and small, throughout the UK and like all our buildings they have been shaped by ideas. In this study we want to identify the driving ideas and trace their links to the hospitals and other health care facilities of the NHS. We believe these links to be very profound and frequently unrecognised but they are the shaping forces underlying what architects and health care 'clients' have been creating.

So our theme is ideas, their origin, their introduction into the NHS and the designing and realising of its buildings as we see and use them today. For our working classification we see the ideas that shape health care buildings as originating in four broad areas that together cover a field wider than the confines of the NHS or even health care itself.

The first of these sources is the practice of medicine in the widest sense. The discovery of antibiotics was a great boon and indeed provided life-saving measures in the treatment of infection. However their widespread use has led to the emergence of drug-resistant bacteria and the alarming increase in hospital infection. Ways of combating this problem have had some influence on design. The emergence and rapid development of organ transplantation is another obvious example of a new demand on both the design and the provision of facilities in such areas as the emergency and operating departments.

Secondly the architects of hospitals and health care buildings are architects first, not simply specialist health care designers. Ideas arise about the provision, the design and the construction of buildings of every type and of all types and are the constant currency of our discourse and work. Inevitably these architectural and technological ideas inform our approach to health care buildings. The introduction of ideas about industrial production, prefabrication and modular coordination were first applied in Britain to the post-war building programmes for schools and housing but quickly became key drivers when the NHS assessed its need for buildings and initiated a major design and construction programme of its own. Hospitals contain spaces with very complex and intense demands for control of the physical environment. Therefore architects had to consider the use of air-conditioning, deep planning and natural and artificial lighting control originating in other building types and, very often, in other countries.

The NHS and its buildings belong to and are meant to serve society and this is our third source of ideas which powerfully determine the work of all designers. The Consumer movement, strongly impelled by Ralph Nader in the USA, has grown and spread to change attitudes here, including attitudes to health care. The nation, beginning to recover from a shattering war and its shortages, was on the whole grateful for the new promise of a universal health service and expectations did not extend beyond basic facilities. The idea that people who were ill and in need of care were entitled to standards at least as good as those in their own homes and perhaps, because of war damage and neglect, somewhat better, is now one of the key drivers of provision and design. Additionally attitudes to enterprise and innovations in fund-

50 Years of Ideas in Health Care Buildings

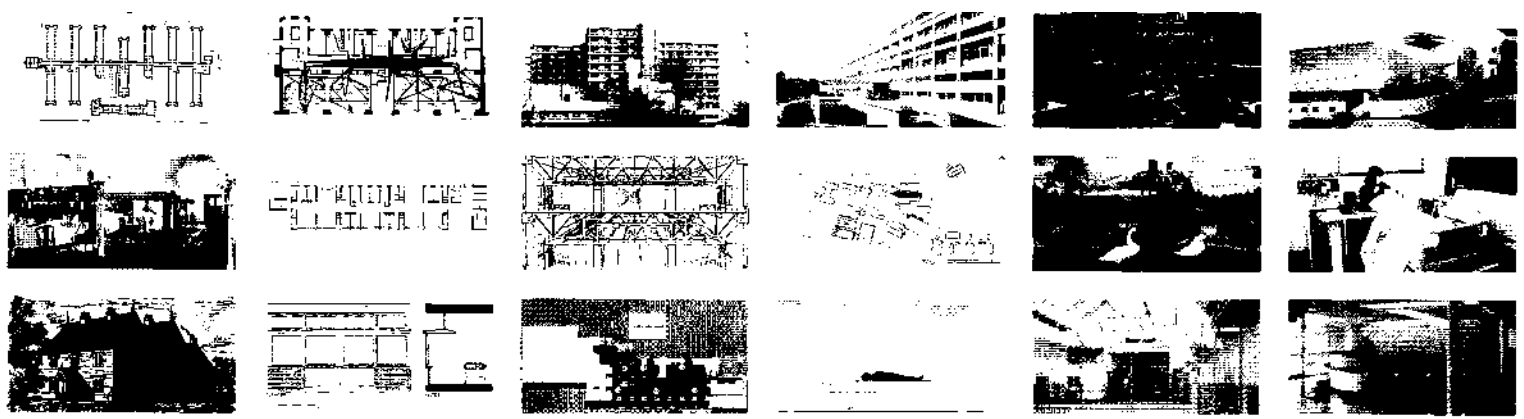
	in the 1940s	1950s	1960s	1970s	1980s	1990s
Ideas in medicine	World Health Organisation Antibiotics. Kidney dialysis.	Open heart surgery. Kidney transplant. DNA Structure.	Drug resistant bacteria. Hospital infection. Early ambulation.	Progressive Patient Care. Intensive Care Units. Ultrasound.	Open transplants. CAT. scans,	Mental health. Mental handicap. Geriatrics.	Day surgery. Care in the community. A.I.D.S. and H.I.V.	Medical IT. RET. and M.R.I. Greening of medicine.	Human B.S.E. G.M.O.'s Human Genome. Tele-medicine.
Ideas in architecture and building	The modern movement.	Industrial production. Prefabrication. Modular co-ordination.	Design research Nuffield investigation. Physical environment.	R.I.B.A.plan of work. Low rise v high rise. Systems theory.	M.A.R.U. Designing for the disabled. Multi-discipline teams.	Deep planning. integrated service Ron an point. Racetrack wards.	Alexander's: "pattern l Northwick Park Indeterminate Architecture.	The atrium. Wall-climbing lifts. Post-modernism.	Retrofit. High-tech design. "A Vision of Britain"	U Inch's supportive design Healthy living centres.
Ideas in society and people	Postwar housing, education, health, employment. Welfare state.	"Festival of Britain" New towns. Local health centres. Co-operation.	"The Death and Life of Cities".	Consumer movements. "What's Wrong with Hospitals?"	International oil crisis. Finite resources. Environmental issues.	"Winter of Discontent" Arts for Health. Low energy Buldings.	Distrust of Professionals (accountability). Design and build. Competition.	"League tables" Retail outlets in public buildings.	Growth versus sustainability. Millenium fever.
Ideas in health care policy and the NHS	Universal access to free healthcare. The NHS national and regional structures.	Friesian's automated hospital design. The D.G.H. The Hospital plan.	Research development Guidance. Greenwich D.G.H. Traffic flows.	Best buy Hospitals. Harness. Community Hospitals Nucleus.	Reassessment of the hospital plan. D.R.O.C. Space utilisation.	The NHS Estates Agency. Surplus and under-used estates.	The NHS reform. Fundholding. Patient-focused care 'philosophy'.	P.F.I. Primary care led NHS. Rationing and the safety	
NHS buildings for health care									

Figure 1 50 years of ideas in health care buildings

ing, as well as expectations of convenience in many routine daily transactions, have led to the acceptance of providing retail outlets in public buildings. All these ideas affect in varying degrees the design of many parts of health care buildings.

The fourth source of ideas driving the design of health care buildings is the continuing development of health care policy and management in the NHS, directed by government itself. As project and design teams perform their day-to-day work management ideas sometimes appear to be the *only* ideas driving the process. They may certainly be the most urgent but as our examples from the other three sources show, they are rarely the exclusive ideas at work. The most important example here is the idea of official design guidance within the NHS. With the evident need for a large and continuous programme of creating health care buildings, multidisciplinary professional teams employed within the service researched and tested many aspects of design. The results, published in a wealth of documentary guidance, became the virtually obligatory design requirements, setting standards in the detailed provision of space, equipment, levels of expenditure etc that were applied uniformly throughout the UK.

Examples from the four sources offer a fascinating insight into the connection between ideas, conceived and realised outside the field of health care building, but having decisive, tangible outcomes within it. In the first fifty years of the NHS there have been a great number of these and in what follows we will set out our own account of the transformation of ideas and their outcomes in built form.

This comprises four viewpoints: the impact of an early research agenda, the impact of the systems and standards programme, the links between theory and practice and a review of current ideas.

These views are possible with hindsight; but do not bestow the benefit of foreseeing the future. In the popular media and even in serious professional conferences and publications we are regularly offered scenarios of health care in the future and the buildings it will require. It is not our intention to add to them. By tracing links over fifty years between ideas and health care buildings we hope to provide practitioners with a deeper understanding of their professional roles as architects and 'clients' and of the interplay, up to now, of ideas, theory and practice.

The Fifty Years

The sheer volume of activity in health care building and design in the last fifty years is almost too great to describe and even to summarise it would be tedious. So in attempting to *comprehend* it we chose to concentrate on the *ideas* that have driven all this activity. But ideas are difficult to isolate (and anyway grow and multiply as they gain currency) and each of us may place ideas in our own unique hierarchy of importance. Even so we believe we have found a more understandable as well as a more interesting history than a chronological account.

This is illustrated in the Diagram, *50 Years of Ideas* at the beginning of this section. Using the evocative shorthand of our 'trade' and media jargon in trains of 'bubbles', it illustrates in a very compressed form the ideas from each source and their approximate sequence as they fed into the five decades of NHS building design and construction.

The Opening Decades

A new survey of the architecture and design of English Hospitals from 1660 to 1948[1] subdivides the building type into General Hospitals, Cottage Hospitals, Workhouse Infirmaries, Hospitals for the Armed Services, Specialist Hospitals, Hospitals for Infectious Diseases, Mental Hospitals and Convalescent Homes and Hospitals. Apart from those of the armed forces and those of all types in the independent sector, buildings designed for seven of these distinct varieties formed the inherited building stock of the newly-formed NHS in 1948. It was within this hotchpotch of buildings, old and not-so-old, that modern post-war medicine was initially to be practised.

The development and use of antibiotics was already having a great impact on hospitalisation and many new techniques and therapies were introduced that were rapidly to become routine e.g. blood transfusion. It was evident that suitable hospitals were needed with departments designed appropriately for the new specialised medical and surgical practices. But if departmental specialisation was one consequence of ideas coming from medicine it also became clear that it could have disadvantages. Patients with complex or multiple conditions or injuries might need several specialist diagnoses and treatments; and some of the most dramatic achievements in medical research and its application were obtained by multidisciplinary teams of medical specialists working closely together. Specially designed departments, all needing immediate contiguity with each other quickly[2] became the challenge for hospital designers.

In Primary Care the pre-war experiments at Peckham and Finsbury were the important ideas that informed the drive to develop Local Health Centres but the organisation of Local Authority and GP health services was loose compared with the hospital service. Comparatively few were developed and they were given a lower priority for much of the first half-century of the NHS.

In architecture and building during the opening decades the ideas and models of 'mainstream' modern architecture as propounded by the still very active 'pioneers' (le Corbusier, Mies van der Rohe, and, especially, Walter Gropius) and their pre-war British followers (Maxwell Fry, FRS Yorke and others) were adopted enthusiastically by the post-war generation of architects reconstructing a new, Welfare, state. To serve the new ideals of high-quality housing, education and health care for all, the ideas of industrial production, prefabrication and modular co-ordination, which had been so impressively employed in the recent war effort were introduced and developed as essential to our rebuilding programmes. In this climate of ideas the Automated Hospital concept demonstrated impressively in the USA by the Canadian hospital consultant, Gordon Friesen,[3] was hugely influential, most notably in the design of the Ministry's architects' flagship development project for Greenwich District Hospital.[4]

While public housing and education were services evolved from legislation with well-established pre-war traditions of specialist design and operation by local authorities the new NHS had to start from scratch with its major building programme awaiting its priority. The Nuffield Provincial Hospitals Trust was therefore supremely important in filling the gap between the foundation of the NHS and its resourcing. In doing so the initial multi-disciplinary Investigation and the

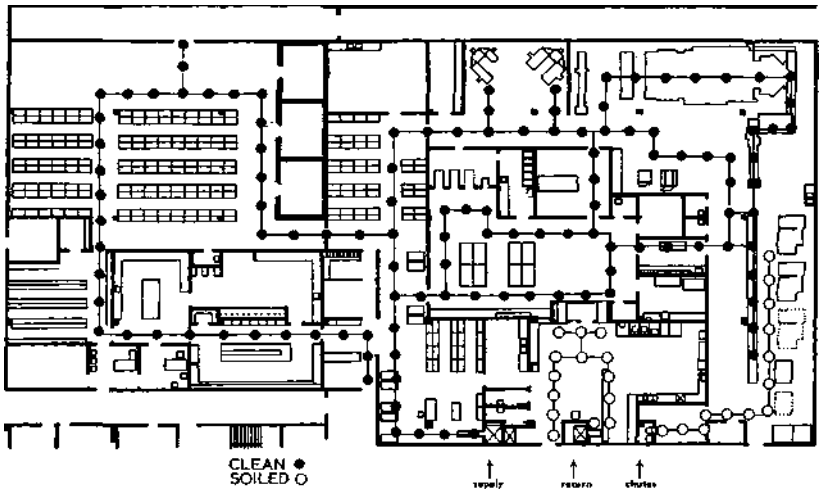


Figure 2 Gordon Friesen's Automated Hospital Concept

Nuffield Foundation's studies that followed it generated many of the important ideas that informed health care building design from the mid-fifties onwards (see page 51).

The Sixties and Seventies

In the two decades following the establishment of the Hospital Buildings Division at the Ministry of Health (1959) and the announcement of the Hospital Building Programme (1962) there was an explosion of ideas, initiatives, designing and building activity. The way in which the architects at the Ministry of Health set out to manage this huge endeavour is assessed in Section 3 below. The time-lag between the introduction and application of ideas in health care building design and their realisation in operational facilities is very substantial. While at the start of this period the first few new NHS hospitals had appeared, the everyday practice of architects involved was enriched by debates about high-rise and low-rise; racetrack wards and peripheral bed areas; interstitial service floors; and automated supply systems, etc. few of which they had ever seen in operation. However by the end of the seventies this adventurous and exciting environment for designing resulted in full-size working demonstrations of most of these ideas for the NHS.

In 1961 the work of the Nuffield Foundation's Division of Architectural Studies (which succeeded the Nuffield Provincial Hospital Trust's Investigation) ceased. Considerable research and development continued to be pursued by the many architects and their co-professionals at the Hospital Buildings Division pursuing Departmental policies. Independent academic research work was re-established in 1965 with the creation of the Medical Architecture Research Unit at the Polytechnic of North London and also at the Bartlett School of Architecture in University College London to which Llewelyn Davies and John Weeks had moved from Nuffield. While there they developed hospital planning ideas based on analogies with village and town planning and the importance of the street, using the term 'Indeterminate Architecture' (see page 44).

However as early as 1955 the impoverished quality of much new building was evident, especially of those built for the brave new world of post-war public services, from council estates to post offices which were, by this time, strongly detested by their users[5]. In *The Death and Life of Great American Cities* published in the UK in 1962, Jane Jacobs had shown that even with the best new modern architecture the quality

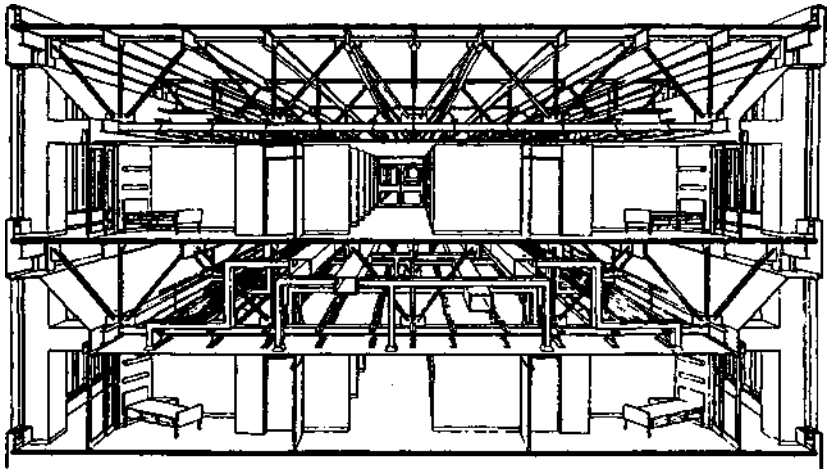


Figure 3 Interstitial Space

of life could go down as well as up; indeed it went down disturbingly more often than not. In the USA and in Europe the Consumer Movement was developing and acquiring considerable force, and the users of hospitals and other health care facilities began to make their negative experiences heard in the media. *What's wrong with hospitals?* was published in 1964.[6]

An official report in 1969[7] broadly supported the idea of the District General Hospital (DGH), on which the then heavily committed Hospital Plan was based. However, it recommended reducing the number of DGHs by enlarging their catchment population and by making provision within them for geriatric, psychiatric and mental subnormality services. In the early seventies the idea of the Community Hospital[8] was introduced into official NHS thinking.

By the mid-seventies changing circumstances, of which the oil crisis of 1973 was the most dramatic, began to eclipse Britain's post-war vision built on idealism and generosity. In a public statement in 1975, David (now Lord) Owen, the Secretary of State for Health, said that the hospital building programme was completely out of control[9] and there was an over-riding need to control and reduce expenditure within the NHS, especially the capital expenditure needed for developing health care facilities. The 'Nucleus' hospital programme was developed as a result of this.[10]

The Eighties and Nineties

Economic considerations continued to dominate the NHS during the eighties with some political preference for replacing the universal health service with private health care financed through personal insurance, with a low cost 'safety net' public service.The report of 1982, *Underused and Surplus*

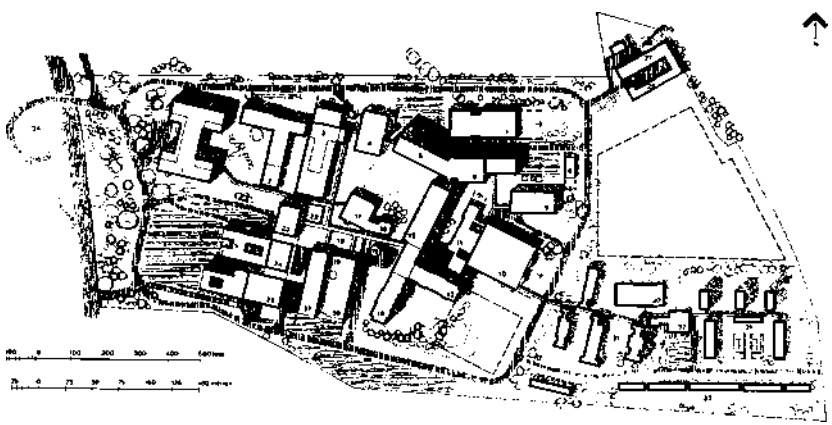


Figure 4 Northwick Park Hospital

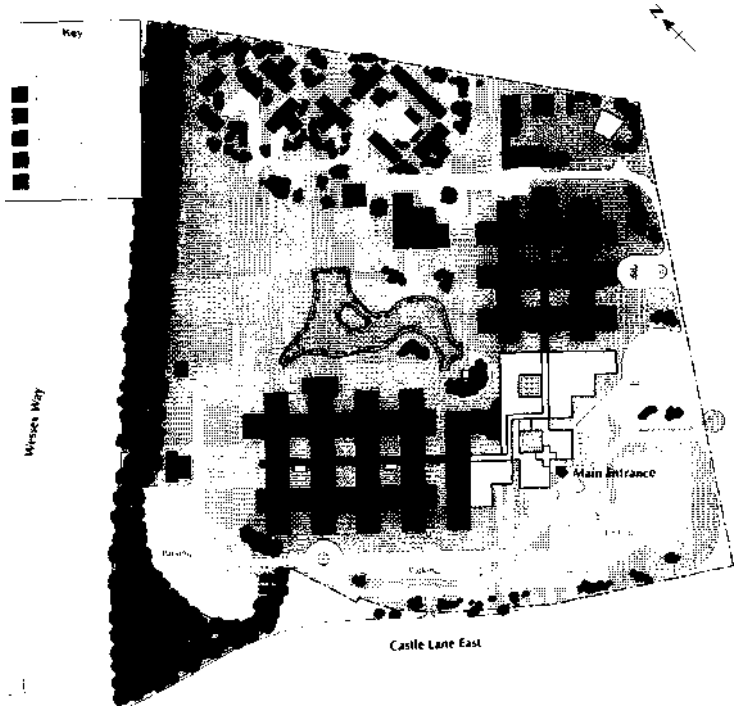


Figure 5 Nucleus Hospital Layout

Property in the NHS, led to the sale of NHS property, in order to release capital for new projects. To the same end *Designing to Reduce Operating Costs* (DROC) and *Space Utilisation Studies* were also promoted by the NHS during this period.

One effect of the 1990 NHS Reform (which created a split between purchaser and provider bodies) was to dismantle the central and regional system of professional planning of health services and their facilities. Within a decade the considerable

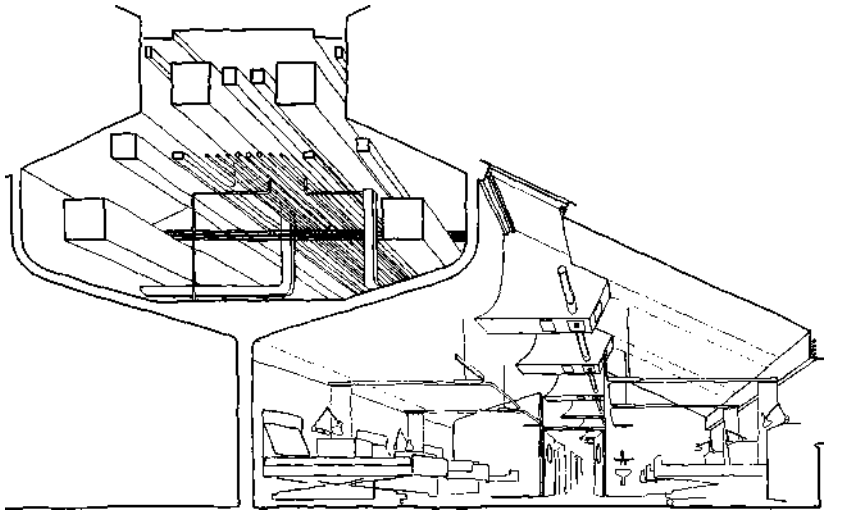


Figure 6 St Mary's Hospital, Isle of Wight

numbers of expert medical and service planners, architects, engineers and others specialising in health care provision were dispersed and most were lost to the NHS.

But other important effects were to become evident. The 'internal market' in health care introduced financial incentives to, and competition between, the new hospital trusts, concepts that were alien to the original spirit and purpose of the NHS. It was expected that competition would generate innovations in the provision and design of new hospital facilities. There is little evidence of this as yet and the government's currently preferred method of funding capital projects, the PFI, is unlikely to encourage new thinking unless it is to the guaran-

teed benefit of private finance[1]'. The idea of rationing health care has become explicit now and attempts have been made to introduce measures of performance in the health service.

The introduction of GP fundholding and the belated recognition by the NHS that primary health care services had been seriously neglected in comparison with hospitals has led to some imaginative and positive innovations in both organisation and provision[12]. The idea of a 'primary-care-led' NHS has entered discussions and may prove to be the most fruitful in terms of architecture and building for health care.

In the last two decades high-tech medicine has made very rapid progress powered by the astonishing developments in information technology e.g. for diagnostic imaging, telemedicine and bioinformatics. The completion of the international Human Genome Project early in the next millennium will provide the medical profession with an unprecedented understanding of disease. Despite this every period furnishes us with new diseases and health problems. AIDS, human BSE, food poisoning and the lifestyle illnesses - heart disease, lung cancer, obesity and so on - are the most recent reminders to every human being that the need for proper health care facilities will not diminish in the foreseeable future, although some experts would have us believe otherwise.

The discontent with the quality of post-war buildings that had first appeared as early as 1955 grew steadily and found a focus in a series of interventions by the Prince of Wales. They reached a climax with the publication (and TV broadcast) of *A Vision of Britain* in 1989.[13] Recent hospital designs were specifically criticised but one or two were also selected for approval and a link was made between a human-centred approach to design and the growing interest in holistic medicine'[4]. Environmental quality and a patient-focused architecture were ideas now beginning to enter architectural debate on health care buildings'[5]. Energy conservation and sustainability were also being taken seriously enough by this time to affect building technology and legislation.

These and other ideas are part of the setting for health care building design today (see Chapter 5). They seem significant now and their effects will be far-reaching but it is too soon to assess their relative importance or to identify their likely impact. What is evident from a review of the last fifty years is that the ideas that form the driving forces shaping the buildings where health care is provided are immensely important, unendingly fascinating and quite unpredictable.

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CHAPTER 2

Research: The Nuffield Studies and their Heritage

Introduction

In 1948 over 2,000 hospitals, previously run by county and municipal authorities and voluntary bodies, became the backbone of the newly created National Health Service. By giving the whole community free access to a GP the NHS enabled the hospitals to develop as a separate service. New hospital buildings were badly needed but at that time new housing and schools took precedence.

In 1949 the Nuffield Provincial Hospitals Trust had the foresight to set up an investigation into what hospitals the country needed. In partnership with Bristol University they initiated a major research study to underpin the vision of a universal free health service. The outcome in 1955 was the publication of *Studies in the Function and Design of Hospitals.* This profoundly influenced both ideas and research on health care buildings for the following 30 years.

The research team was a multidisciplinary group which included architects, historian, physician, nurse, statistician and accountant. The expertise of organisations such as the Building Research Station, the Fire Research Station and the Public Health Laboratory Service at Colindale was also brought into the investigation to assist in its specialist areas.

In the first systematic investigation into the environment of hospital buildings and of the organisation of health care delivery, the research team identified a wide range of issues where new information would contribute to the establishment of the knowledge base required for the huge enterprise of a national health service. They examined the needs of the patient and of the people looking after the patient in the three main areas of care; outpatients, inpatients and surgical intervention. Detailed studies were made of the environmental design for natural and artificial lighting, for noise, for ventilation, for colour and for safety in relation to the control of infection and the risk of fire. In addition they carried out a statistical analysis of the demand for hospital care as a means of forecasting the needs of the population a hospital was designed to serve.

Understanding the approach to this study is immensely valuable in itself. For each part of the work, the history and current context were examined in order to appraise the status quo and identify information gaps. Detailed studies were devised to collect objective data based on the importance of measurement not stated opinion, however expert. As well as carefully recording models of existing practice the team developed new operational models and designs to improve upon them, which were examined for comparison with equal rigour. These demonstration projects were designed and constructed to bring together all the findings and to provide a test bed for evaluation.

A clear view of the role of research in hospital design was presented. Within a framework where hospital design is required constantly to keep pace with medical and social change 'research can illuminate certain aspects of design; it can furnish information and can point to profitable methods of approach. It must never be thought of as providing definitive answers.'[2] This approach was extended to each experimental building which was designed as a synthesis of the various research study findings and the specific site, not as an ideal or standard solution.

The impact of the published investigations was far reaching.The NHS structure, with Regional Hospital Boards plan-

ning and executing hospital building developments, provided a framework for them to have national application. Those directly involved in hospital development projects were enabled to think without preconception about what was needed. In particular the analysis of workflow in hospitals was introduced and soon accepted as a rational approach.

Many of the ideas and findings are still relevant today but others have been overtaken by the enormous developments in technology and changes in organisation of the NHS. However, the study itself is a source book of information and of various research methods. Statistical analysis is demonstrated in the studies of demand for hospital services. Comparative studies were made of service delivery methods and technology applications and their consequences for design layout and the environment. The implications of changing clinical practice were developed through questioning and survey. Workflows and individual activity spaces were measured and analysed through observational studies, photographic analysis, string diagrams, space utilisation and performance studies. The demonstration projects provided an opportunity to evaluate all of the original findings in real working hospitals.

Figure 7 The Nightingale ward (1931)

The Studies

To establish the size of hospital required by a community's population a study for measuring the demand for hospital services was tested. Two case studies were undertaken of hospital provision to population groups of similar scale and structure and with similar employment patterns. The intention was to analyse in detail the whole recorded case load for one year using data taken from hospital records not from individual patient records.

Significant results were recorded such as how an average of immediate admissions of 50% covered marked differences for different specialities: 85% for general medicine, 94% for paediatrics, 59% for general surgery and 25% for ENT. Seasonal variations in demand were not as great as expected from studies of the contemporary emergency bed services in London. It was observed that changes in the waiting list over the year gave an indication of whether a department was meeting demand.

Changes in clinical practice may occur slowly and the impact on building design may not be apparent at first. For ex-

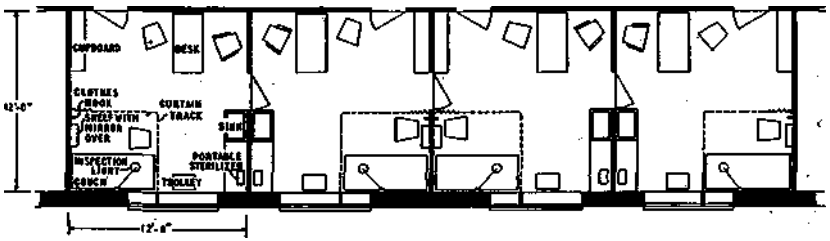

Figure 8 Four-roomed consultation suite of combined consulting and examination rooms

ample one manifestation of the growing practice of early ambulation for patients after surgery or an episode of illness, was the patient's use of the ward sanitary facilities. As a result of observation and consultation it was estimated that on some wards as many as 70 -90% of patients should be enabled to get up to use wc and washing facilities. The typical UK ward had too few sanitary facilities to support this practice properly.

A new practice was seen developing in the operating process - that of moving patients from the theatre first to a recovery room before returning to the ward. In the critical immediate postoperative period, complications could be prevented or treated by nurses with all the equipment needed such as oxygen and suction supplies at hand in a purpose-designed recovery room. This was a new activity space to be designed and located within the operating suite as part of the workflow. Up to that time recovery rooms were not generally provided in theatre departments.

Inefficiency in doctors' working practices was seen alongside changes in clinical practice. Studies made in outpatient clinics - partly, it appears, provoked by patients' complaints - led to a recommendation for improving the patients' experiences. A common pattern of provision was for up to four examination rooms beside each consultation room. After the initial interview in the consultation room, the patient undressed, perhaps in a cubicle and then waited for examination while the specialist consulted with other patients. It was found that patients could be waiting for 20 minutes before their examination. The survey of the utilisation of these examination rooms showed that for most of the time they were either empty or occupied solely by a waiting patient.

In another model the specialists used two rooms, a consulting room and an examination room. One patient at a time was seen and the doctor wrote up the notes "while the patient was undressing in the examination room. After examining the patient the doctor returned to the consulting room to record his findings while the patient got dressed. The most efficient example of this model had a second exit door directly from the examination room so the consultation with the next patient could start while the first patient dressed.

Consultation with medical opinion was taken on the desirability of the unbroken consultation session. Some doctors, both physicians and surgeons, were persuaded to try this method of working and it was found that they could see more patients in a session and felt less fatigued. This led to a recommendation that the pattern of work should change.

Similarly patterns of nursing work were changing with ideas flowing in from abroad. In Denmark small nursing teams looked after groups of twelve patients in an administrative unit of 78 beds. In the UK the pattern of nurses' work was predominandy based on job assignment whereby a nurse undertook one procedure for all patients on a ward, rather than on patient assignment where a nurse looked after a group of patients.

New activities were identified which required their own dedicated space. Treatment rooms on wards were proposed following a study of cleaning routines. It was common practice that there should be time for the dust to settle after sweeping, to prevent cross-infection when dressings were done. As the rounds began at 9.00am, this led to very early ward cleaning which awoke the patients. Treatment rooms on wards were proposed to alleviate this and reduce cross-infection.

Nurses had been responsible for sterilising instruments etc in the ward sterilising room. An alternative to this was seen in a comparative study of practice both in the US and Europe where the provision of a central sterile supply department (CSSD) was adopted. Its advantages were to centralise the provision of expensive sterilising equipment and to supply all parts of the hospital, ie wards, opd, and theatres with material of a guaranteed standard of sterility. However, at that time it was not thought practicable to include theatre instruments in a central service because of the number of instruments that would be required.

Two schools of thought were seen in UK ward planning at this time. The more prevalent was the traditional Nightingale ward with the nurses' work rooms on a short corridor at the entrance to a large bedspace with beds on either side between the windows. There were also a number of examples of ward layouts, derived from the Rigs Hospital in Copenhagen, where smaller patient bays or rooms were arranged on a corridor with ancillary rooms opposite. The bed was always arranged parallel to the window wall and the bay might house four or six beds.

The new culture of provision of beds in bays and single rooms raised the question of the proportion of single rooms to be provided. Medical opinion and nursing practice were surveyed on categories of patients who should be nursed in a single room. This resulted in five criteria for selection and a need for 20-30 % of beds to be in single rooms.

The distribution of space between bed areas, nurses' work areas and circulation areas was compared in 6 wards in the UK, France and Scandinavia. There was more space per bed in the corridor wards, but these plans were more compact and the walking distances for nurses were shorter. The provision of ancillary rooms was not found to be consistent.

Observations of typical patterns of movement showed the nurse constantly going from bed area to ancillary room to collect the supplies and equipment needed for a patient pro-

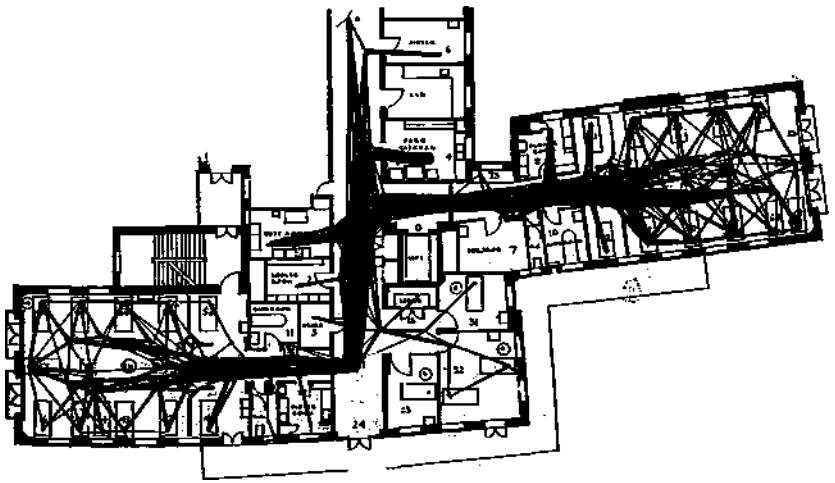

Figure 9 String diagram showing the pattern of movement of a nurse during a complete tour of duty

cedure. The first studies of this were the famous string diagrams which recorded a nurse's walking pattern for a session on duty. This analysis showed that the utility rooms should be close to the bed areas.

To determine the appropriate size for individual spaces, more detailed study of ward activities was made through visits, observation of activities and workflow analysis. For example, activities such as bed making etc were filmed. This was done with a time clock visible and grid markings on floor and wall to show the measure of the space used. Filming was undertaken in two hospitals with nearly identical results and the typical seven foot spacing between bed centres was confirmed as an adequate minimum.

Detailed observation of work in the operating room was combined with analysis of plans marking the actual position of equipment in use. Together with users' views on the adequacy of space provision, this led to a proposal for an optimum size for the operating theatre of 20 ft square.

Providing a suitable environment in each hospital department required a number of studies on daylighting, artificial

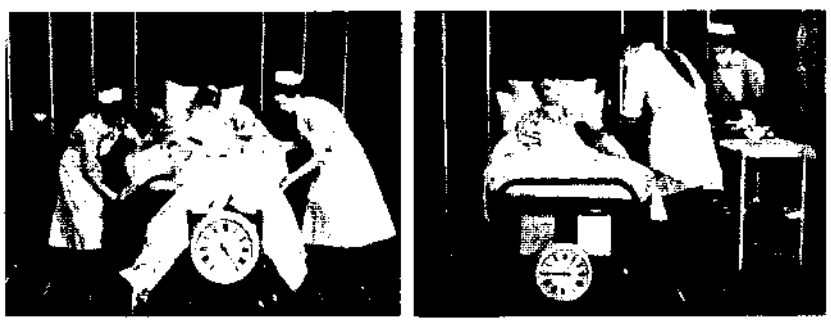

Figure 10 Observation and measurement of bed making activities

lighting, colour, noise and ventilation. The proposed new pattern of bed provision in the Rigs style ward, either two or three beds deep, posed the challenge of providing visual comfort for those near the window, while admitting sufficient light for those at the back of the bay. Models of the ward for the Larkfield demonstration project were tested in an artificial sky and the investigation team developed the 'daylight factor' as a new measurement. At significant points in the ward this measure took account not only of the hitherto conventional sky factor as used in studies for post-war schools but also the reflected light from all surfaces. Of the three factors measured, the effect of ceiling height, the effect of window design and the contribution of walls, floor, ceiling etc the latter, and especially the floor, made the greatest contribution. Studies with the model showed that windows down to the floor gave the best light at the back of room, while windows in the centre of the window wall gave more protection to beds nearest to it. A horizontal baffle at the window was devised which reflected light to the back of the room. Consequently the team were able to demonstrate that the huge areas of glazing, then commonly found in new schools, were not needed in wards.

At the time little consideration had been given to noise control in hospitals: either as to what noise levels were acceptable or the measures to take to control noise levels. Measurement showed the corridors and utility rooms (with their bedpan washers) to be the chief sources of unwanted noise. At Larkfield three strategies were demonstrated: controlling noise at source, with silent door closing mechanisms; fibre runners on bed curtains; providing sound absorbent treatments and finishes with resilient cork floors; and structural measures.

Sound absorbent ceiling materials were sent to the Public Health Laboratories for testing for infection risk.

Risk of cross infection was a serious concern and recorded incidence of infection was compared with observation of nursing practice. A lack of hygienic routines was observed in ancillary rooms due to poor provision of accommodation and lack of storage. Clean and dirty work was found to be going on side-by-side in nurses' work rooms. Bathrooms were seen to be used for cleaning/sterilising procedures such as washing bed mackintoshes and were frequently used as store rooms. Food, medicines and specimens were held in one refrigerator in the ward kitchen and unhygienic washing up arrangements were also observed.

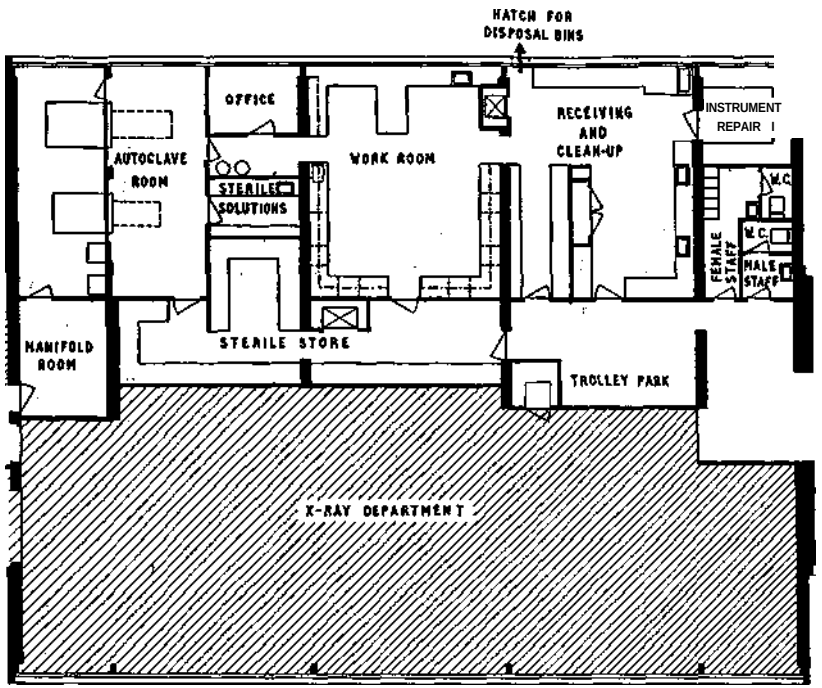

Figure 11 Musgrave Park ward

It was accepted that nursing procedures were paramount in the control of infection so ancillary accommodation and equipment must be designed to enable, not inhibit, nurses' work. In particular clean and dirty activities had to be physically separated. The new terminology was adopted of 'clean' and 'dirty' utility rooms, to replace sterilising and sluice rooms and ensure understanding of this distinction in the activities.

The risks to patients in case of fire were investigated in a joint study with specialist organisations such as the Fire Research Station. An analysis of the risks in moving patients to safety in a fire led to recommendations for dividing the building into fire compartments and a two-stage evacuation process, the first to be horizontal movement. Safe space should be provided in any department adjacent to a ward to receive patients on their beds. The concepts of high life risk and high fire load departments were introduced.

The Demonstration Projects

The final stage of the studies was to bring together the different findings and synthesise them in design projects which could be built and used to test the new arrangements. Two demonstration wards were designed and built at the Larkfield Hospital in Greenock and at Musgrave Park Hospital in Belfast.

At Larkfield Hospital the ward was planned to be a cul-de-sac to ensure tranquillity. The 32 patients were arranged in two groups of 16 beds, each with a nurses' station. To cut down walking distances the ancillary rooms were placed in the middle between the two groups of beds. The day room was also placed in the middle to provide more nurse observation for the frail. The beds were arranged in three bays with four beds and four single rooms, close to the nurses' station for observation from the window in the door, unobscured by the en-suite wc. Subsequently at Musgrave Park, the bed group was expanded to twenty beds and the three bed deep bed bay giving a group of six beds was introduced[3].

The nurses' station, a small unenclosed area near both patients' rooms and ancillary rooms, was also a Nuffield innovation, though it was common in the USA. It formed a working area for staff for preparing medicines, telephoning, writing reports and charts etc and was designed and furnished appropriately.

To encourage early ambulation and reduce bed pan use to a minimum, each bed bay had its own wc with access through a ventilated lobby. One bathroom and two washing cubicles were provided for each 16 or 20 beds. Clean and dirty hoists were provided for the supply and disposal of food, sterile supplies etc.

At Musgrave Park Hospital the design for a new operating theatre unit based on recommendations from the investigation was demonstrated. This followed the careful examination of a mass of technical data and specialist reports from Europe and the US on the effectiveness of different lighting systems, ventilation, air sterilising and movement,

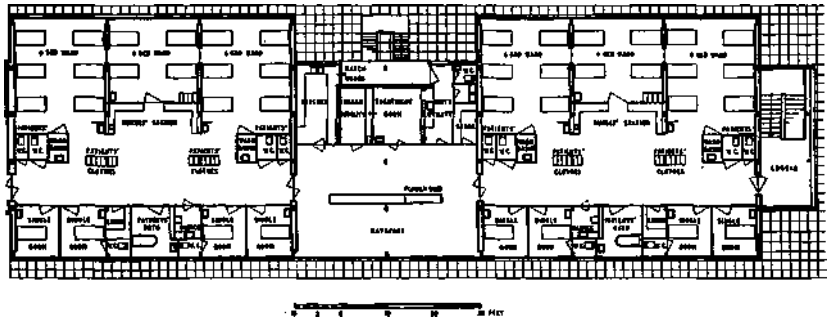

Figure 12 Plan of experimental CSSD

equipment, colour and finishes, particularly for the actual operating theatre. This information was brought together with workflow analyses to design the project at Musgrave Park which comprised a twin theatre suite and the first central sterile supply department (CSSD) in the UK.

The principle of a workflow of receiving used goods, cleaning, sterilising and packing them for initial storage, was developed. Safe disposal of dirty waste and an instrument repair room were part of the process. Dirty and clean hoists served the operating suite above the CSSD which also served the whole hospital.

Recommendations of the study for the outpatient services were incorporated in the design of the new Nuffield Diagnostic Centre at Corby. The groups of four rooms each with a local waiting area and receptionist provide a contrast to the large waiting halls of previous outpatient departments. The rooms are separated into consulting and examination functions although combined consulting examination rooms interconnected in rows of four were recommended in the study findings.

The studies and the demonstration projects were very influential and widely adopted in planning and design within the new NHS. The demonstration projects gave planning teams the opportunity to observe many completely new ideas in daily practice and to form their own judgements about local adoption.

Hospital Buildings Division

The valuable example of the Nuffield work was followed by the establishment of the Hospital Buildings Division at the Ministry of Health, with a remit for research and development. This group had a multidisciplinary background. The role of nurse planning became established and a tradition of a strong working partnership between architects and nurses was developed. Since then this group has led research and development and has carried out investigations and built demonstration projects supported by published research and evaluation studies. Some of this went into official design guidance for the whole NHS. The Hospital Buildings Division also commissioned studies from individual architectural practices and academic organisations such as Medical Architecture Research Unit (MARU) to support their ongoing research and development programme.

A shared vision for the future hospital building programme was intentionally developed. Some short courses on the planning and design ideas were led by the Nuffield team to spread the knowledge through the group of senior NHS architects who would take forward the building programme.[4]

The multidisciplinary approach to the Nuffield investigations led to the adoption of multidisciplinary planning teams for hospital planning since that time until recently. A training research group was drawn together by MARU to study multi-professional decision making in planning[5] and a training programme devised and established.

The Nuffield research methods became the mode for future studies, but emphasis was placed on function rather than on environmental quality. Many comparative studies were commissioned on the functioning of hospital departments, on whole hospitals by department and on whole hospital support services. There were studies of workflow and working practices such as flexibility in outpatient departments[6]. The findings of many of the studies commissioned were fed directly into the Health Building Note Guidance.

Figure 13 St Thomas' Hospital Wards Study, MARU

Providing for flexibility, growth and change was a constant theme in many studies. Tools and techniques for building evaluation and appraisal of existing buildings were developed and disseminated. Space utilisation and assessment of functional suitability became standard measures for estate evaluations.

Most research studies were sponsored by Government but occasional other studies were commissioned such as the ward evaluation[7] at St Thomas' Hospital, funded by the Special Trustees and undertaken by MARU. The working of the ward was studied as a whole organisation as well as the component parts. Three very different ward plans were compared in this evaluation. The patient population, the staffing and the operational policies were the same. The findings of this study showed that the building had a considerable impact on working practice and levels of staff and patient satisfaction.

Continuing the Tradition of Demonstration Projects

Designing and building demonstration projects for testing ideas and future evaluation became established practice in the Hospital Building Division. These projects were influential both as buildings and through the publications and discussions that accompanied them. The first two projects each looked at a particular department. An outpatient, accident and emergency department was built at Walton Hospital, Liverpool in 1961 and a hospital central kitchen and staff dining facility at Kingston in 1962.

By 1963 the Hospital Buildings Division was planning the whole hospital project at Greenwich. A very wide range of ideas were investigated and tested. For example, the project was used as a test bed for an integrated research and briefing method.[8] Analysis of supply and disposal needs and the development of a distribution system was another major study for this project.[9] Taking the horizontal hospital concept from Greenwich, two identical hospitals were built at Frimley and Bury St Edmunds, the Best Buy hospitals (see Chapter three). They were completed in 1974, and provided a comparative test bed for a series of evaluations and publications.[10]

Prototypes were also developed for the subsequent Harness and Nucleus Hospital Building programme (see Chapter 3). A prototype Nucleus ward was built at Pinderfields Hospital in West Yorkshire. An extensive evaluation of this ward was undertaken by MARU as part of a series of ward evaluations. It was not published, but the findings were incorporated into the modifications of the Nucleus ward design.

Figure 14 Entrance to Best Buy Hospital. West Suffolk Hospital

In the 1980s there were two projects of note: The Worcester Development Project for psychiatric provision looked at new patterns of care for psychiatric patients, replacing care in large isolated mental illness hospitals. A range of provision was developed for inpatient acute care, outpatients, day care and so on. A standard psychiatric department was designed which could be added to existing district general hospital sites, "with wards and a day hospital. The wards providing for both sexes, envisaged progressive patient care. A number of reports and pamphlets were published evaluating aspects ranging from service need to delivery patterns to detailed design.[12]

The more recent demonstration projects have focused on energy saving measures, with two low energy hospitals built in the south and north of England (see Chapter five). A number of reports have been published on the energy saving achievements."

Work also focused on Designing for Reduced Operating Costs (DROC) which highlighted the concept of whole life cycle costing and the role of design in this.

Medical Architecture Research Unit (MARU)

On the basis that much of the needed research and development work to support the health building programmes should be undertaken in an academic environment, MARU was established at Southend School of Architecture in 1964 and later moved to the Polytechnic of North London. The initial grant for research studies was given by the Nuffield Provincial Hospitals Trust. MARU undertook research and evaluation studies that had direct application for designers of health buildings, covering all building types and a number of planning tools and techniques were developed. A central concern was the widest possible dissemination of information through published reports, reports not formally published, seminars and the development of the postgraduate teaching programme into a formal course in 1972.

The Heritage

The Nuffield studies set a standard for objective research and many of the findings have become part of our basic knowledge still relevant today. For example, there has been no substantial change in the provision for inpatient nursing care or for outpatient care until very recently. For some aspects, such as operating theatre departments, although we have passed through a period of great technological and operational change and the findings may no longer apply, the method and unusual objectivity do.

The investigation's methods are unchallenged and should provide models to be used in devising studies for the issues of today. The appraisal of history, analysis of current practice, carrying out specific studies using measurement and statistical analysis, formulating recommendations and building demonstration projects for testing ideas need to be applied to a wide variety of problems. This practice, initiated by Nuffield and taken up by the Hospital Buildings Division of the NHS has been influential in producing changes of culture across the NHS. Seeing new working practices in a new environment can change aspirations, but the tradition has faded and the expertise has not yet been renewed

The Nuffield studies were predominantly about function,

solving the problems identified at the early analysis stage and continuing to address them in detail. Workflow study was a major concern of the investigation and was new in health services and health care, as was an interest in environmental physics at that time. This mode of analysis has not been challenged and today is re-emerging as 'process re-engineering', the vogue word for new, more efficient patient and staff workflows that are part of a Business Plan: this may bring new design requirements.

Some attention was given to the patient's experience in the Nuffield studies, with the concern about glare from the window facing the patient's bedhead in the Nightingale ward and the inability to see out of windows from the beds. There was an emphasis on the patient's physical comfort in all the investigations of the physical environment. However, studies on the perceived quality of the environment were not given the same emphasis

Perhaps the most important lesson is the way that objective information and knowledge were presented in a non-prescriptive way using the individual study descriptions and the analysis of demonstration projects. The intention throughout the investigation was not to produce ideal or standard solutions but to form a synthesis of the recommendations and the specific site in the designed outcome.

The Nuffield Investigation into the Function and Design of Hospitals posed the question 'what is the modern hospital?' for the new NHS. This same question may be put today. In the NHS there is no coherent research agenda or programme of research studies at present. This confirms a substantial break in what was an established approach. As well as falling behind on functional studies, the new ideas about health buildings that have appeared on the scene from the US and Europe are not being systematically or objectively examined. There appears currently to be an obsession with process rather than product, while there is no substantive basis of underpinning research for the current round of new PFI hospitals. It seems likely that the PFI process will discourage innovation and the new hospitals may not respond to the larger agenda of the community and the environment.

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CHAPTER 3

Systems, Standards and Standardisation

Introduction

On the establishment of the NHS the Ministry of Health had to address how to promote needed hospital developments, how to set the standards for design, how to achieve equity of provision, and how to monitor progress of developments.

Most of the substantial estate needed desperately to be repaired and maintained, as well as extended, modified or replaced. The fifteen newly-established Regional Hospital Boards were to be in charge of implementing any development programme and were starting like the NHS itself, without any previous experience of such a novel task.

A planned framework for development was set eventually with the publication in 1962 of the Minister of Health's Hospital Plan for England and Wales (and, separately, for Scotland). It advocated a series of District General Hospitals of 600-800 beds across the country, each serving a defined population. Departments were accepted as the suitable organisational unit for manipulating the briefing, design and physical spaces within these hospitals. The adoption of 'departments' as the primary units of hospital design and 'number of beds' as the basic unit for describing a hospital's size, set organisational and quantifying concepts for hospitals. These shaped most aspects of hospital design, management and organisation. For their hospital developments the Regional Hospital Boards were directly responsible to the Ministry of Health which approved the functional content, the design and the funding of capital projects.

To meet the need for disseminating information, controlling standards, establishing need for capital investment and monitoring project developments the Hospital Division established a programme to publish a series of Hospital Building Notes.

Building Notes

The first Building Notes (HBNs) were published in 1961. Their form and content changed over the years but the publication of new and revised Building Notes continues. They have informed and set standards for all NHS hospital developments. They have also informed and set standards for many hospital developments across the world. 'To Building Notes' Standards' frequently being an essential component of a brief for an overseas hospital.

There were three introductory documents:

HBN1 *Buildings for the Hospital Service*
HBN2 *The Cost of Hospital Buildings*
HBN3 *The District General Hospital*

and one for each Hospital Department. The format of the departmental Building Notes was:-

1 Scope
2 General consideration with diagrams showing working relationships of rooms
3 List of rooms
4 Description of rooms
5 Engineering services

Appendices: Schedules of Basic Accommodation with areas and numbers of spaces:

Particular requirements of the department
e.g. for the Accident & Emergency Department
and the method of calculating patient load in a 3 hour peak period.

Each departmental Building Note was also issued with a schedule of Departmental Cost Allowances in the form of 'Appendix E to Hospital Building Note No. 2' (see above).

This format changed over the years to include:

- operational policies and options
- workload studies
- workflow studies
- a range of sizes
- ergonomic information

A key concept introduced by Departmental Building Notes was the definition of each Department in terms of functional units. The definition of units for each department was, where possible, related to demand/usage or, if this was impractical, pragmatic, e.g. the number of beds for wards, the number of theatres for operating departments, the number of doctor sessions per week for an out-patient department, the number of mid-day meals for the catering department, one department for Medical Photography.

The cost allowances 'Appendix E' of HBN 2 were related to each Functional Unit.

Multidisciplinary steering groups were established at the Ministry of Health for each Building Note and, as the programme developed, research work was commissioned by the Ministry/Department to inform the guidance. These documents were excellent, pulling together the best available information in a concise, informative form with useful diagrams. They were published by HMSO at modest prices and were thus easily accessible to anyone.[1]

In addition to setting national standards, controlling costs and monitoring projects for the Ministry of Health the HBNs together formed an invaluable handbook for up-to-date hospital design. They provided authoritative and powerful design guidance for clients and designers alike, enabling them to progress designs swiftly and with confidence, and were used across the world to an extent that cannot be overestimated.

Best Buy Standard Hospitals

The first generation of new hospitals[2] which incorporated the planning and space standards and tested new ideas both looked, and were, very different from each other. As the cost of implementing the Hospital Building Programme began to climb in line with post-war growth and inflation all non-military public expenditure was put under growing pressure. For the hospital service both the provision of acute beds and the current areas recommended in HBNs for accommodation were forced to reduce. The number of acute beds was reduced from about three to two per 1000 of population and a smaller complete DGH hospital design of 550 beds was introduced by the Department early in 1967. This was known as the 'Best Buy Hospital' and was offered under the slogan of 'Two for the Price of One!'. The design adopted some of the ideas being tried at Greenwich Hospital (see page 23), that of peripheral bed areas and low rise buildings based on horizontal movement. The label 'Best Buy' came from the Consumers' Association. The hospitals were aimed at providing best value

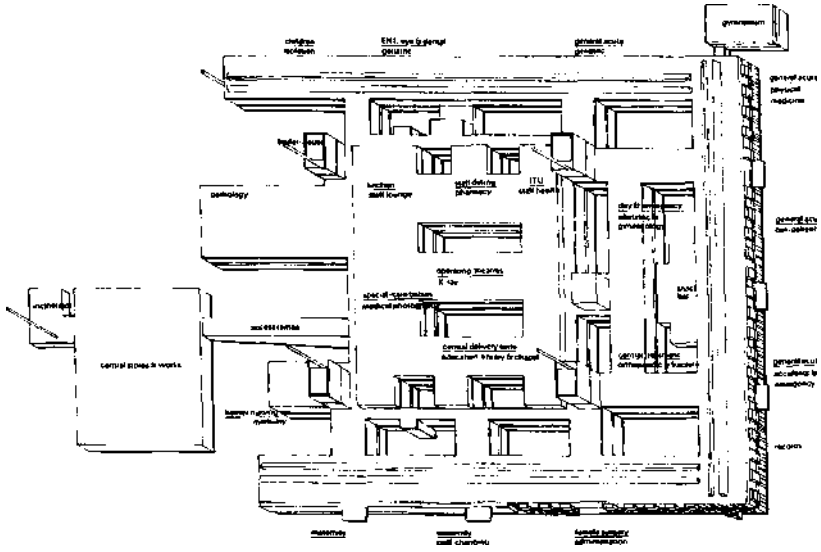

Figure 15 Plan of a Best Buy Hospital

for money interpreted as providing adequate facilities without being extravagant.The complete 'package' included whole hospital policies as well as the design.

The Mark 1 Best Buy Hospitals were two storey buildings; spaces were reduced and simple construction methods were adopted.[3] They were designed for sites which permitted a naturally-lit and -ventilated building form in landscaped surroundings. Some of the space provision proved to be inadequate in practice and the hospital design was only suitable for flat open sites. The standards were not applicable to existing hospitals which needed to expand or to replace existing accommodation and only a few Best Buy Hospitals were built.

The Systems Approach

In parallel with concerns about the overall cost of the Hospital Building Programme and the need to control and manage the costs of each development, there were a number of factors which combined to create a climate which promoted a systematic approach towards all aspects of the hospital building programme: service planning, briefing, designing, building systems, building components, equipment, management and procurement.

These factors, many of which were interdependent, included:

- the continuing need to meet the programme to provide a large number of new hospitals across the country
- the shortage of professionals experienced in the briefing, design and construction of hospitals
- the perceived need to simplify the building of hospitals, breaking the monopoly of specialised 'Hospital' design practices and builders, so that any reputable architect, engineer or contractor could be employed
- the government imperative to reduce the cost of NHS hospital buildings
- the need for accurate cost predictions and cost control of hospital projects
- the demonstrable successes of post-war schools building using standardisation, industrialisation and modular coordination. The Hertfordshire County Council's schools programme, directed by the architect William Tatton Brown, was an outstanding example of this. (Tatton Brown moved to become Chief Architect at the Ministry of

Health in 1959 and directed the Hospital Building Programme until 1971)
- the current work on building Systems being undertaken by the National Buildings Agency
- the emerging potential of computers to store and manipulate vast quantities of data for design and construction
- the experience of hospital maintenance and supplies departments being seriously hampered in their ability to function effectively because of the multiplicity of incompatible elements within hospitals

NHS Systems

In response to these various factors a number of systems were developed within the Hospitals Division in parallel with the HBNs. Most of them were known by acronyms and most of them published as guidance and catalogues as appropriate.

The systems most directly connected with briefing and design included:

CUBITH Co-ordinated use of Building Industrialised Technology for Hospitals which introduced performance standards and dimensional co-ordination.

MDB Manufacturer's Data Base, which succeeded CUBITH. Components were selected and tested to meet the requirements of hospital users. Manufacturers co-operated in this and hospital developments were required to use compliant products.

ADB Activity Data Base, which is a systematic approach to briefing and design based on identifying all of the specific activities and their functional requirements needed to meet a defined hospital department service need. The structure of the base is composed of: 'A' sheets which summarise room requirements.'B' sheets which feature an activity and its spatial, equipment and engineering requirements and which identify the procurement route for each item. (This, in theory at least, enabled the cost of any proposal to be established as soon as the brief was known.) 'C sheets which were loaded standard room layouts, incorporating the requisite 'B' sheet activities, were not published in a neutral form but were issued as project specific sheets as these became available from projects. 'D' sheets listing further equipment requirements were also project specific. Only the A and B sheets are issued as guidance. The A and B sheets were originally issued within the NHS in A4 volumes which were user friendly and easily accessible but presented problems for updating. The database was subsequently computerised and licences to use it can be purchased. The implications of the ADB system on design is discussed later in this paper.

DBS Design Briefing System. This is a series of documents for use in conjunction with Building Notes to help in specifying user requirements for a departmental design brief. Each of the documents provides a checklist which guides a project team through the consideration of organisational and planning options and generates a list of activity spaces or rooms. At one stage some were issued jointly with the departmental Building Note.

CAPRICODE was the name for the Department of Health and Social Security Capital Projects Code which provided

'the mandatory procedural framework for managing and processing NHS capital building schemes'. Initially six HBPNs (Hospital Building Procedure Notes 1-6) were published. Every step of the process for every participant was set out precisely, with reference to all the other material in HBN, HEN, MDB and other forms for the further control of the building design and construction. This control and management was generally very effective, but with such a system deviations in practice were sometimes necessary. The procedural system evolved over the years and is now in the form of the Capital Investment Manual (CIM) and its updates.

The Oxford Method

In parallel with the development of the systems, construction systems and standard buildings were developed. The Oxford Regional Hospital Board set up a multidisciplinary team with the aim of reducing design and construction time while setting improved standards of hospital planning for ever-changing clinical practices. They devised a modular, prefabricated building system known as the Oxford Method. Integrated engineering systems and the use of standard details, documentation and specification was the approach adopted. This was in 1963, anticipating similar conclusions reached at the Diisseldorf International Planning Congress in 1969.

The first prototypes were erected in 1964 and by 1969 thirteen projects had been completed in the Oxford Region, fourteen were under construction and five major schemes were in various stages of planning. The Oxford Method was a very successful system that was applied to District, Community and Psychiatric hospitals and to many specialist units. The system was also used for schools, an office block and for a number of army hospitals. In Italy INSO S.P.A. (Systems for Social Infrastructures)[3] were licensed to use the system and used it to build large hospitals (at Brescia and Cremona). The NHS continues to derive income from the licence.

The Oxford Method seemed ideal for the application of computer aided design techniques which were under rapid development in the early 1970s and this came about under the acronym OXSYS in 1971. The system integrated design, production and construction data with detailed building performance analyses and the first computerised three dimensional modelling system for hospitals. OXSYS was a joint development of the Region, Applied Research of Cambridge and the National Research and Development Corporation. It was used by the Region until 1987/88 when it sold its interest in the system.

Standard Hospital Departments

Towards the end of the sixties the Department of Health designed standard hospital departments for maternity units and psychiatric departments. During this period a number of the Regional Hospital Boards developed their own individual standard departments. The hospital programme benefited from work developed in the Regions and there is a view that much of the driving force for the programme came from pioneers operating at Regional level.

Harness Hospital System

In 1969 the Department's Hospital Buildings Division was developing a new system in an attempt to obtain a synthesis of the best current ideas in hospital policies, planning, building technology, environmental services design and dimensional co-ordination. This was more flexible than the standard whole Best Buy Hospital as it was intended for developments in a wide range of locations, with variable functional content and encouraged proper development control planning of hospitals.

The Hospital Building Division joined with the Regions, each utilising a specialist area of expertise, in preparing a range of standard operational policies and designs for standard departments. These had to conform with strict dimensional and modular co-ordination, with specified zones for structure and services. The floor to floor height was 4.5m and the overall width of each building module was 15m. These were interspersed with courtyards. The maximum height envisaged was four storeys. Each department was linked to a major hospital communication route which was also the distribution route for mains electrical and mechanical services. The name Harness was derived from the wiring 'harness' in cars.

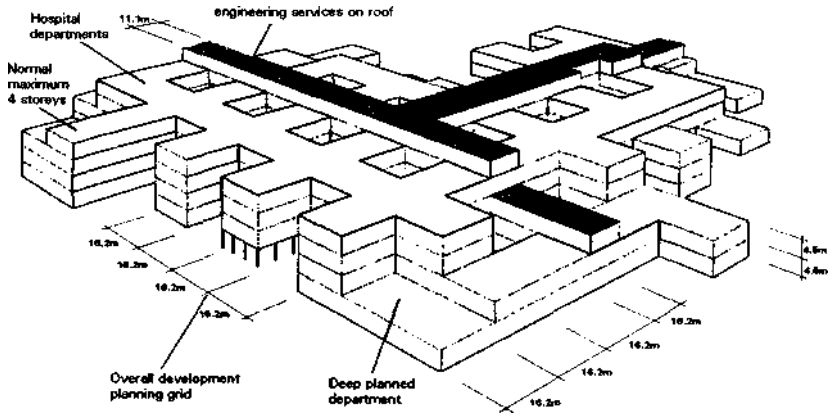

Figure 16 Diagram of a Harness Hospital System

Using the established CUBITH and MDB system, efforts were made to standardise as much as possible. Specialist groups tackled the design of, for example, internal subdivisions, suspended ceilings, storage units and sanitary assemblies and installations. Prototype building components were developed and tested.[4]

The system offered an impressive facility for sound development control planning. A project team could arrive at a workshop organised by the Department with an agreed functional content for their hospital and some information about a site. Using the Harness system they could produce several development control plans with known viable departmental layouts and select a preferred one within two days, confident in the knowledge that their hospital could then be built to a very high standard in terms of both design and construction and with known costs.

Seventy major hospitals were being considered as Harness developments but with the economic recession following the oil crisis of 1973, all capital funding was severely restricted, and only two whole Harness Hospitals were built.[5] However the use of the Harness system as a means of illustrating and teaching the principles of development control planning continued for many years.

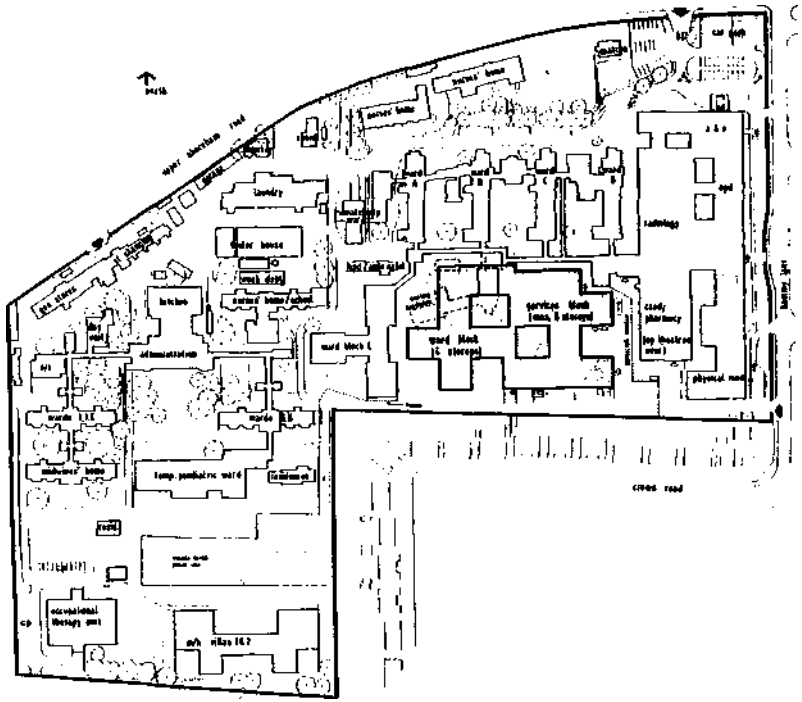

Figure 17 Development Control Plan (DCP) using Harness Departments

The Activity Data Base Approach to Briefing and Design

The Activity Data Base of A and B sheets, together with the Building Notes, was a key design and briefing tool. It is therefore important to consider its benefits and limitations, not just in terms of its original intention but in terms of its current availability and utilisation. From an operational policy for a department, a schedule of activity spaces (A sheets) can be derived which describe the overall function of a space (room) and define each in terms of a number of activities (B sheets). To do so it breaks down user requirements into component parts which can be drawn, specified, measured and costed: defining activities in terms of equipment and engineering requirements. It undoubtedly goes a long way towards ensuring that the right type and amount of equipment is provided in a room. In the hands of experienced briefers and designers and used with Hospital Building Notes it is a very useful timesaving tool; its use can also ensure that no equipment is omitted or mis-sized. The ADB is a valuable tool but not a means of designing or of meeting user requirements and it has some limitations:

- It is assumed that all user activities can be broken down into manageably sized components and that an activity can be defined in terms of the equipment required for it. In some cases this is not so. For example, it proved impossible for hospital laboratory activities, where long runs of benches with access to shared items of equipment cannot be broken down into smaller components, but need to be considered as a whole area. There is no means of incorporating process or flow sequences of activities into B sheet format. Ironically the more specialised, more complex and more technical activities, with which non-specialists will be least familiar, are the most difficult to express in this manner.
- Despite early attempts to include the space required by the people carrying out the activity in the B sheet data this was not achieved, so B sheet space requirements have no direct reference to the space required by the users themselves.

- It is only the user requirements that can be seen, drawn and measured that are included in the data base. Intangible requirements such as observation, control, management and efficiency cannot be represented in this way.

Hospitals, hospital departments and many individual rooms operate as a series of complex inter-related systems. Understanding these systems and their inter-relationships is essential to producing good designs which can work satisfactorily at all the necessary levels.

C sheets are room layouts that combine A and B sheets. Inevitably these sheets must be project specific so stand outside the system. However, considerable room layout information for spaces that occur frequently is set out in the four volumes of HBN 40 Common Spaces.

The ADB is an invaluable tool for controlling clients in finalising their brief, for providing the engineering services designers with the information they need early enough in the process to design and size their systems efficiently, and for managing the budget.

The need for good reference material which is regularly evaluated and updated is axiomatic. The idea of creating a data base of the scale of the NHS ADB was ambitious and achieving it is impressive. That it should prevent completely functionally unsuitable spaces being built is reassuring, but it seems likely that its existence has enabled, if not encouraged, hospitals to be seen as a collection of rooms and their contents - not as a complex whole for which many intangible elements are as significant as the easily measured and costed components.

Nucleus Hospitals

Although the 1974 financial crisis halted the hospital building programme the need for new hospital developments remained. When the programme was resumed it was under strict Treasury rules. These were met by the Hospital Buildings Division in the standard Nucleus hospital departments project. Unless an exceptional gap in hospital services was identified all new developments and major extensions were to be restricted to a nucleus of departments costing no more than £6m (May 1975) but capable of expansion to serve any unmet needs when capital was available. Thus the modestly sized, low cost hospitals came into being as the 'Nucleus' project.

The Department's experts devised a standardised hospital briefing planning and design system with standard operational policies and standard department plans. The standard element is a cruciform block plan of about 1000m^2 called a 'template' which can sit over, below, or above any other template. Each template abuts a main circulation corridor - the hospital street - as in the Harness system. Between the standard template blocks courtyards are formed (similar to the Harness hospitals). The stringent financial requirements required all schemes to achieve great economies in capital and running costs. This was achieved by reducing space provision, sometimes to below established standards, by planning all departments to fit within the standard template and, sometimes, by assuming that the whole hospital policies and departmental practices would be those requiring the minimum of space. CAPRICODE (see p. 37) made it mandatory that every client authority had to consider the Nucleus sys-

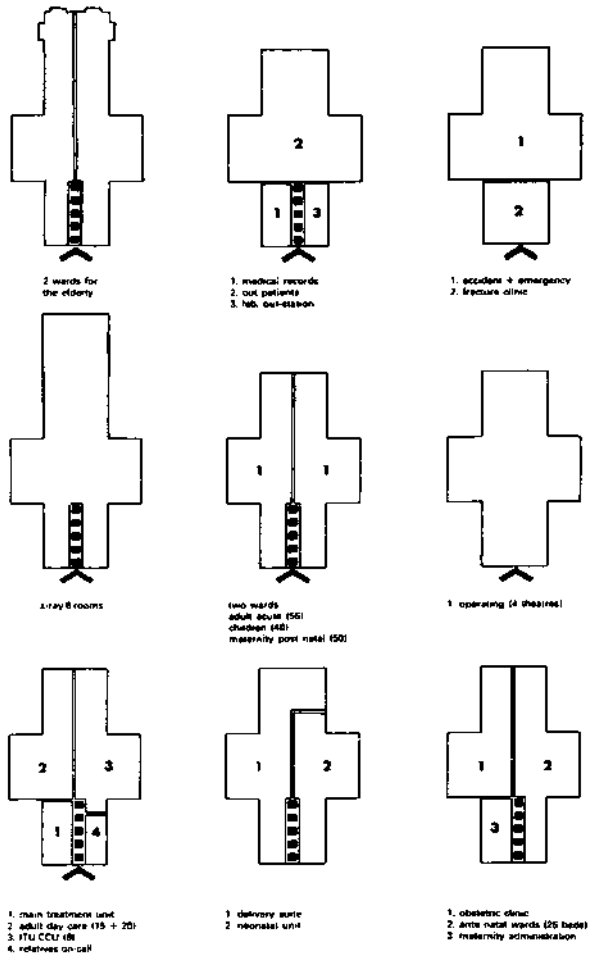

Figure 18 Typical Nucleus Departments

tern and if rejecting it had to give a clear justification. More than 130 standard Nucleus schemes have been built in the UK. The introduction of the Nucleus programme speeded up the process of obtaining approvals for hospital projects very considerably and also avoided a number of errors that had occurred in the past.

With Nucleus, three principles of hospital design which had been fundamental to designing NHS hospitals were lost, the first being that the established service need of the local population should define the functional content of the hospital; Nucleus hospitals were built that were smaller than needed to meet the known service requirements. The second was the importance of designing a hospital for its specific site, taking account of matters such as orientation in locating specific functions. The third was the design of spaces appropriately sized for their function. The flexibility that the system offered "was that of being able to add and subtract whole 1000m^2 standard templates. There was a ready made plan for most hospital departments to fit into the fixed outline, together with operational policies. Model sets of construction and engineering drawings were also available for Nucleus.

An important consideration of any building system which imposes a template is the basis on which the template is sized. The basis on which the Nucleus template was established is not documented but three factors can be observed. The size of the template corresponds with the maximum size of a fire compartment as adopted by the Home Office. The width of each building block provides courtyards which offer the possibility of natural daylight and natural ventilation (although this is not always realised in practice). The width of each building block was deemed to be adequate for the most critical departments such as operating theatres.

The Nucleus standard layouts were designed by experienced architects and nurse planners who had to make the best

use of the space permitted by the cost limitation. Hospital staff and patients can adapt to using whatever space is available if given no alternative. However, there are strong and conflicting feelings about the relative success or failure of the Nucleus Hospital Project.

Conclusion

The scale of the need to promote hospital developments, to set design standards, to achieve equity of provision and to monitor progress of developments meant that the introduction of a systems and standards programme was inevitable. Devising and implementing the process which moved from the identification of hospital service need to a successful development and design brief by codifying functional content and operational policies, was an important achievement. The systems and standards programme enabled the implementation and management of a large programme of hospital developments to be achieved, and as such was a model solution and the envy of the world. However, by their nature, systems and standards have some limitations. They start to obsolesce from the day they are issued and so can obstruct progress and innovation, particularly as the rate of change of patterns of illness, health care and medical technology increases. They are also open to unthinking and ill-informed application by unskilled users.

The predominant focus of briefing and design on analysis of the functional activities has meant that account is not taken of equally important factors which cannot be expressed or costed in the same terms. Factors such as privacy, convenience, comfort, management, organisation and quality of the environment are not included. A clear distinction needs to be drawn between a systems and standards programme and standardisation of hospital design: it has been shown that standardisation led by financial considerations is not necessarily compatible with implementing desirable standards.

Key achievements of the systems and standards programme have been the generation, collation and widespread dissemination of design guidance through the Hospital Building Note and Health Technical Memoranda Programme and an emphasis on the crucial importance of sound development control planning. It has enabled the implementation and management of a large programme of hospital development to be achieved. Its legacy is one of both tried processes and a significant building stock. Even in the context of the adoption of radical new procurement processes the intent and achievements of these programmes provide both points of reference and valuable lessons for the future.[6]

Notes

1. In 1968 the price of HBN 4 (Ward Units) was 5s.6d. Currently HBN 4 is in two volumes priced at £125 each.
2. Lister Hospital, Princess Margaret Hospital Swindon,Wexham Park Slough, Northwick Park and Greenwich
3. West Suffolk Hospital, Bury St Edmunds and Frimley Park Hospital in Surrey.
4. A subsidiary of Nuoro Pignone,Agip Petrol and SNAM in the ENI group
5. East Birmingham Hospital 1972.
6. At Dudley and Stafford.

CHAPTER 4

Theory and Practice

Before the NHS

The practice of designing specialised health care buildings arose as a consequence of the development and progress of modern medicine which has been accelerating since the early nineteenth century. The belief in getting fresh air into wards seems first to have been expressed by John Aikin in 1771 and a century later the Sanitarian movement was in full spate. The battle against the 'miasma' that spreads disease was joined, most famously by Florence Nightingale in her work, her lobbying and her books.

The outcome of this 'theory' in the practice of architecture was the pavilion ward and its arrangement in an overall plan. Its form was established, refined and developed by architects over a period of more than half a century of intensive hospital building all over Britain and a considerable number of such wards are still in use today, here and in many other parts of the world.[1]

In the early part of this century however many other ideas were being interpreted in design practice e.g. air-conditioning, modern anaesthesia for surgery, small bed groupings and single-bed wards, radiology and the various strands of the modern movement in architecture. Examples of innovation in design can be found resulting from such ideas as these. But what we now include in the term 'health care buildings' would encompass many which arose in the past out of charitable, legislative and other initiatives in response to major problems - e.g. workhouse infirmaries, infectious diseases hospitals, lunatic asylums, cottage hospitals, etc.[2] Other social and architectural theories fed into design practice for these types in addition to the contemporary ideas for general hospital design. The epidemics of tuberculosis and the theories about the positive effects of sunlight led to the designs for sanatoria with their characteristic single-banked, south-facing, balconied wards.

What we now call primary care was the subject of various medical/social theories, of which G. Scott Williamson's Peckham experiment is the most famous. This theory was realised in built form in the Pioneer Health Centre of 1935, designed to a more radical programme than any subsequently tried in Britain. However, architects in Britain had few other opportunities for exploring ideas in health care building design until well after the end of the second world war, by which time the most significant idea of all - the National Health Service - was put into practice.

At the beginning in 1948 the existing stock of health care facilities was inadequate and self-evidently unsuited to the practical implementation of the theory or rather, the vision, of a National Health Service. This vision required facilities for comprehensive health care and the prevention of sickness at every level - individual, family, community, district and national. The organisation, design and construction of the new facilities demanded nationwide planning and implementation in support of the medical programme. Theory and practice were at once to be put to the test.

The Nuffield Contribution

If there was a 'theory' at the basis of the Nuffield studies it was that, by adopting the approach and methods of rational enquiry, architecture would develop as effectively as had manufacturing industry, agriculture, medicine, planning and economics. Already, in the inter-war years, these had demonstrated powerful achievements which were dramatically and rapidly augmented by the

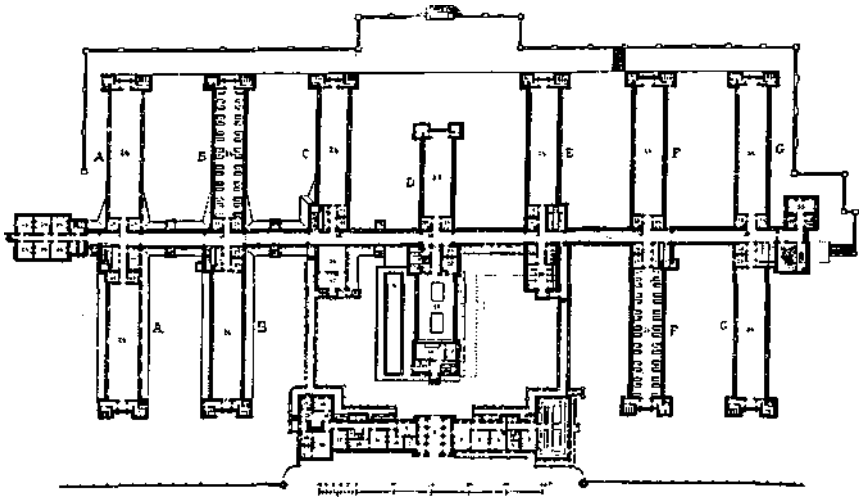

Figure 19 Hospital layout: Pavilion Wards

exigencies of fighting the second world war. The design and construction of buildings, as conventionally practised, was little affected by similar ideas or imperatives. Having languished between the wars, by 1948 the architectural profession and the building industry hardly existed and both were seen to need not simply renewal, but fundamental redesign.

The building industry was already grappling with the need for innovation in the urgent post-war housing and education programmes. Nuffield, directed by the architect Richard Llewelyn Davies, concentrated on an approach to design applied initially to hospitals but appropriate to all building types. Instead of built form being conceived, discussed and appraised *only* by architects, unquestioned by 'laymen' uninitiated in the mysteries of the art, it was to evolve from the analysis of organisation and functions to be accommodated. Designs were to be justified as optimal in measured comparisons with the range of possible alternatives, including historic ones. By implication all 'subjective' values were ignored or rejected.

Elements of this way of thinking were not new in themselves but the Nuffield team's demonstration of it was overwhelmingly impressive (see Chapter 2). The 'Theory' was summed up most succinctly in Llewelyn Davies' famous dictum - 'Deeper knowledge, better design'. And of course it was an approach readily applicable to the implementation of the large scale social programmes of reconstruction which were becoming the political norm in Europe, west and east. These could rely upon long-term investment both in the planned flow of production and in building up, retaining and developing the professional and technical expertise required for its success. Its application was less suited to single building projects, however large, and the influence of Nuffield in the USA's entrepreneurial health care culture, for example, was negligible. Fifty years later the context for health care buildings in the NHS has changed dramatically in the direction of the entrepreneurial model whose attitude tends to be 'Deeper knowledge, so what?'

From the late 1950s onwards ideas from Design Theory[3] were having a major influence in architecture. Design evaluation began to be introduced as part of the process of systematic architectural practice.[4] Using the analogy of the case history in clinical medicine the Nuffield architectural team contributed to this development in a published report on their Musgrave Park Unit[3] . Throughout the succeeding years a significant number of evaluative studies of health care designs have been made but their impact on theory appears slight.

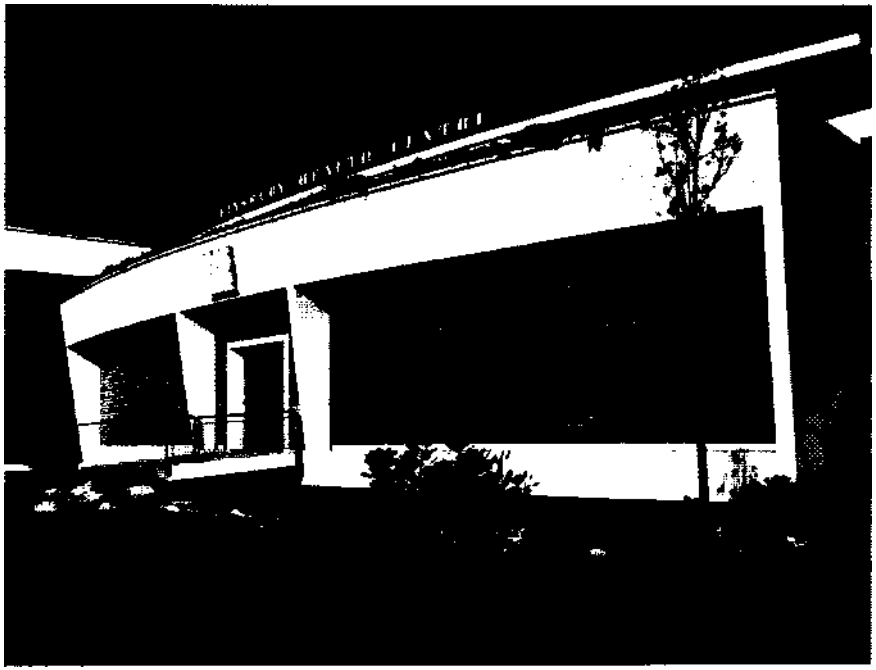

Figure 20 Finsbury Health Centre

The Nuffield Provincial Hospitals Trust made one other new contribution to theory in our field in the early 1960s. This was the development of Professor Thomas McKeown's concept of 'the Balanced Teaching Hospital'.[6] The theory was that:

> *hospitals of the future should be large hospital complexes each wholly serving the hospital needs of the population depending on it. These should replace the varied separate hospitals for the acutely ill, the chronically ill, the mentally ill and those suffering from 'special diseases' which we have inherited from an unplanned past. One such hospital should provide all the beds and outpatient clinics and all the attendant services that its population requires.*

The Nuffield study applied the concept to the Queen Elizabeth Hospital, Birmingham, and Llewelyn Davies, by then Professor of Architecture at UCL, was commissioned to join the study and develop the architectural implications. Although McKeown's scheme proposed solutions to some very urgent problems in the NHS at that time, it was little discussed and did not engage the Ministry of Health or its architects who, by then, (1963-1965) were rapidly gaining power and strength and their own sense of direction both political and architectural.

Development of Theory and Practice

At UCL the Nuffield leaders Llewelyn Davies and John Weeks were joined by Peter Cowan in continuing the exploration of an aspect of hospital design that had always been in their sights at the Nuffield Foundation. This was the consideration of the size and growth of individual hospitals and of the effects of change.[7] The problems of large hospitals were manifold from inception of the brief to completion of the building and thereafter through the life cycle of the facility. At that time the government's hospital building programme had committed the NHS to large District General Hospitals as the main element in the delivery of health care and many were being designed and built throughout the UK.

Supported by Cowan's impressive original research on the growth, change and ageing of buildings, a theory was formulated based on the separation of interdepartmental communications and service elements from the different hospital departments. Each of these was to be connected to the 'hospital street' for people and supplies and to its corresponding channel for pipes, cables and other services. Beyond the connection each department

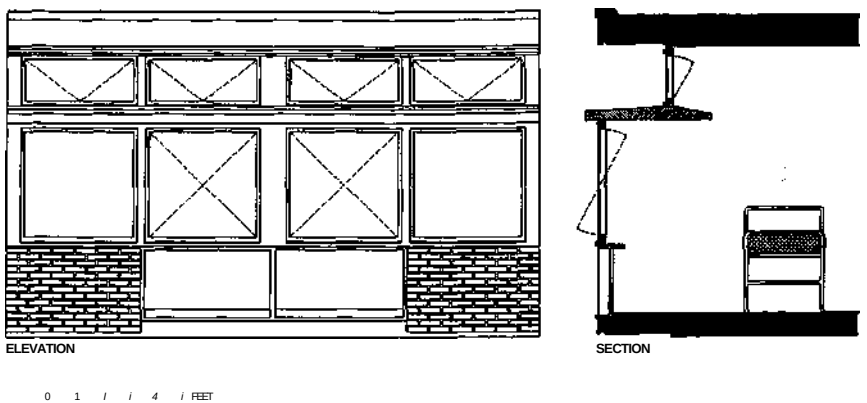

Figure 21 Elevation and section of the windows in the experimental wards at Larkjield Hospital

was to be designed as a relatively independent building with its own appropriate built form and with a 'free end' for future enlargement and change.

This new theory was presented by John Weeks in a lecture 'Indeterminate Architecture' at the Bartlett School of Architecture in 1964.[8] The theory was demonstrated in practice by his firm's fully developed design for the new Northwick Park Hospital, Harrow, which was then at the working drawing stage. Its construction began in 1966 and it received its first patients in 1970.

Meanwhile the architects at the Ministry of Health had developed a model for the design of a large hospital very different from Northwick Park. The contrasting advantages and disadvantages of 'high-rise' and 'low-rise' hospitals had been under discussion among hospital designers since 1955. Nuffield's architects had carried out a study comparing a multi-storey design for Wexham Park Hospital Slough, with a single-storey layout.[9] With 296 beds and potential for adding another 100 the low-rise was decisively advantageous - no expensive bed-lifts, ground floor wards with individual gardens, windowed main circulation areas, cheaper, easier and quicker to build than the multi-storey scheme.

However for larger hospitals, or for very restricted urban sites, low-rise hospital development presented a daunting challenge. The architects of the Ministry's Hospital Building Division took up the challenge with impressive determination, developing an 800 bed district hospital in three storeys. Their approach was to exploit the best new technology in building and engineering in providing for the latest in hospital services.

At the time many new technical developments were being applied in medicine, in hospital management and in building and engineering technology that were changing individual hospital departments, for both clinical and supporting services. Many originated in the USA, for example progressive patient care and the introduction of the new concept of the intensive care unit, the use of mechanised supply and communications systems, central sterilising of all clinical supplies and the need for more air-conditioning to combat hospital infection, the automation of x-ray film processing, etc.

By examining the impact of all these, both at the departmental and the whole hospital scale, in several cases by means of pilot projects, the Ministry was able to provide informed guidance and to progress beneficial change for the whole of the hospital building programme which was gathering pace in every region of the UK. The Ministry took the opportunity to incorporate as much of their new-found expertise as possible in the practical demonstration at Greenwich District Hospital[10] which began construction in 1966, the same year as Northwick Park, and completed its first phase in 1969.[11]

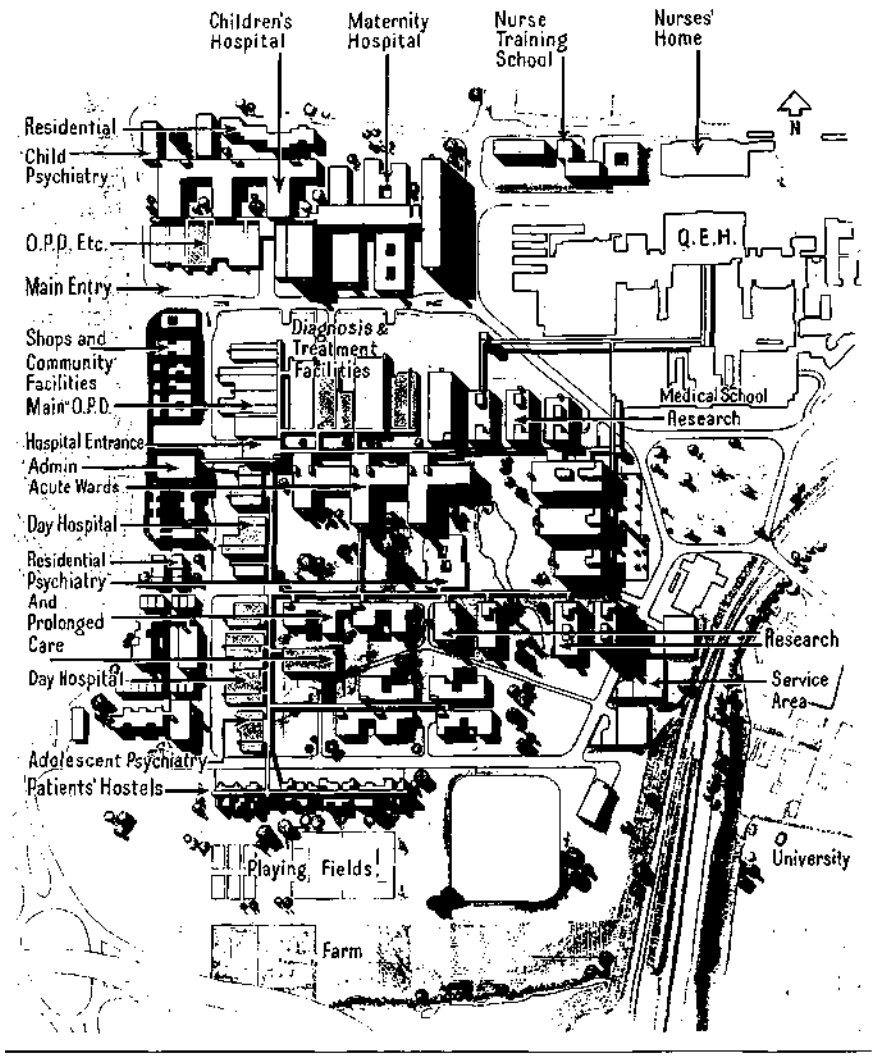

Figure 22 The Balanced Teaching Hospital

Significant elements of the theory supporting the design for Greenwich were dedicated to enabling the departments and their usage within the building to be changed with relative ease in the course of its life. These aims were in common with those of John Weeks at Northwick Park but, unlike that new hospital on a 61 acre (28.7 ha) greenfield suburban site with ample space for growth, Greenwich was the redevelopment of an existing hospital on a $7^1/_2$ acre (3.04 ha) restricted urban site with very limited possibilities for growth. Two important new ideas for enabling change were the peripheral bed areas and the interstitial floors for environmental services, the latter being enabled by the use of very long-span structural bays supporting aerated concrete slabs. No internal partitions were structural, so providing maximum flexibility for room layouts and services, initially and during the life of the building.

The friendly rivalry between the two groups of expert architects seemed to require each to produce - from start to finish - a new hospital that put their important and far-reaching theories into practice. By the early 1970s the NHS had, in Greenwich and Northwick Park, two quite different full-scale operational models of international importance for all aspects of hospital design. Yet judging by the great majority of subsequent hospital designs in this country their influence appears to have been slight, although Greenwich influenced the MacMaster Hospital in the US and Northwick Park influenced some hospitals in Canada and Australia. Britain's leadership in the field has since been dissipated.

There is no one simple explanation for this. A large number of reasons suggest themselves, of which perhaps the most telling is the failure to obtain feedback from these experiments through rigorous and independent appraisal of the practical outcomes in comparison with the theoretical predictions and claims of their

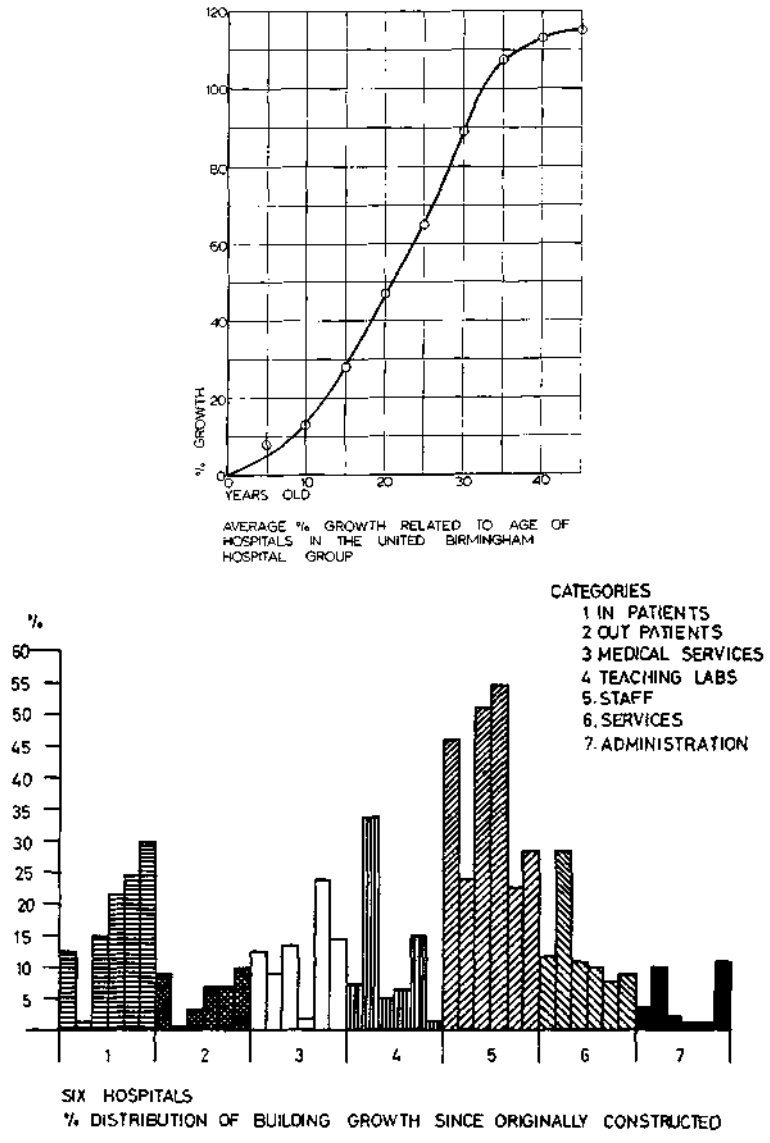

Figure 23 Studies of Growth and Change in Hospitals

authors. As noted earlier, some case studies and evaluations were made of the Nuffield work and the Ministry of Health obtained a good deal of detailed assessment by a variety of means. The Regional Hospital Boards (which later became RHAs) contributed much feedback and, with the Ministry, provided ongoing funding and support that established the Medical Architecture Research Unit.

The NHS hospital building programme was reaching its peak in the mid-1970s when the government was panicked into admitting that the programme was completely out of control financially.[12] As a result the will and the resources for developing theories in health care building design or testing expensive development projects in practice were rapidly to be withdrawn from the NHS. Instead standardisation was seen as the only means of achieving economy although it had originally been but one of the architects' strategies for obtaining high quality building for the new NHS. The drive for standardisation reached a climax in 1975 with the imposition of the 'Nucleus' programme for virtually all new NHS hospital development. By this time the main purpose of standardisation was to strengthen central control, to reduce capital spending.

However one last example of theory and its outcome in practice was to issue from the Department of Health (the Ministry as was). The low energy hospital study was commissioned in 1979 and made available in 1982. The 1973 fuel crisis together with growing world-wide public concern about the effects of global warming and pollution were having their impact on building design and technology and on legislation. Since hospitals and other health care buildings consumed a significant amount of energy, and thus NHS revenue spending, the Department had a

strong financial incentive to implement design measures to reduce energy consumption - providing any concomitant increase in capital cost attributable to the measures was so modest as to be acceptable to the Treasury.[13]

The study required a hospital to be designed that would consume only 50% of the energy used by a conventionally designed hospital delivering an identical service to the NHS. Although no built example of a Nucleus hospital was completed until 1983 a model of current conventional design was defined using the standardised Nucleus system. The model's theoretically calculated energy usage then became the datum for the study team to design a Nucleus low energy hospital.

Using this model's theoretically calculated annual energy consumption as a datum the study team (a group of independent professional firms, collaborating with the Department's own architects, engineers and cost planners) designed a variant Nucleus hospital requiring only half the energy usage of the datum. The results of the study were embodied in the new St. Mary's Hospital, Newport, Isle of Wight (architects: Ahrends Burton Koralek) which was opened to patients in 1990. A second low energy hospital study was commissioned and made available in 1987 which set a higher energy savings target - 60% - and it was applied to the design for a new hospital in the north of England, where the climate is much more severe and the building's energy demands greater than is the case at Newport. This too was built, at Wansbeck in Northumberland, and opened to patients in 1993 - the last demonstration in practice of the original commitment of the NHS to formulating and testing theoretical proposals in the advancement of health care building design[14].

The NHS 'Reform' of 1990 aimed fundamentally to alter the

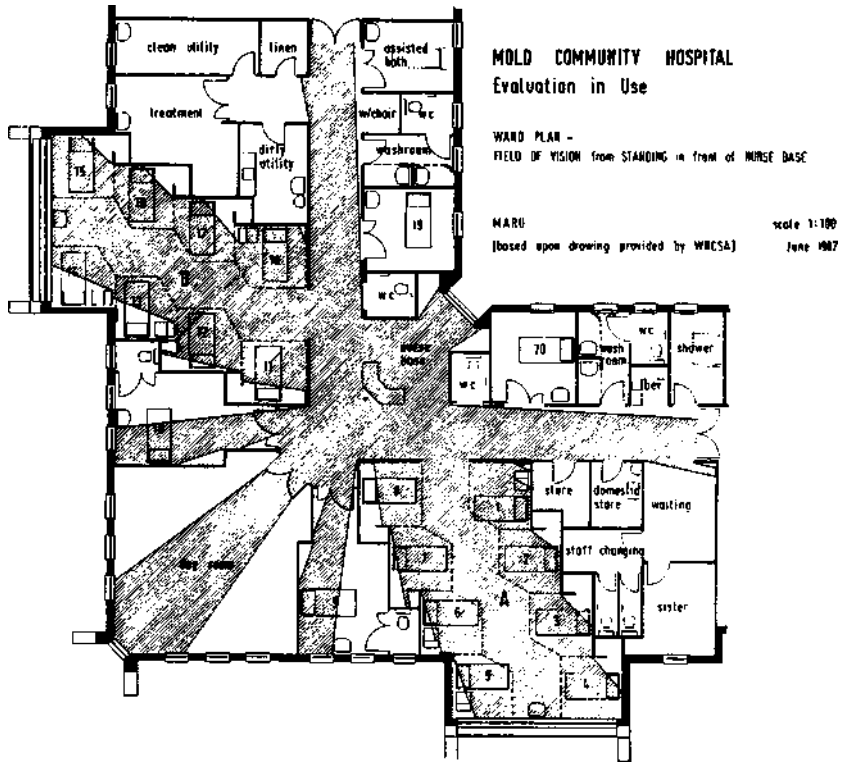

Figure 24 Evaluation of Mold Community Hospital, MARU

service, setting up quasi-independent hospital trusts in an 'internal' market to deliver hospital and community health care. In the reforms the RHAs were to be eliminated, but before this came about some were involved in the endemic speculation about future change. Among these was *Shaping the Future* a review of acute services produced by the South East Thames RHA, and hitching onto the reform bandwagon, numerous fashionable papers were published on the 'hospital of the future'. They were superficial and hurried, lacking any solid basis in professional exper-

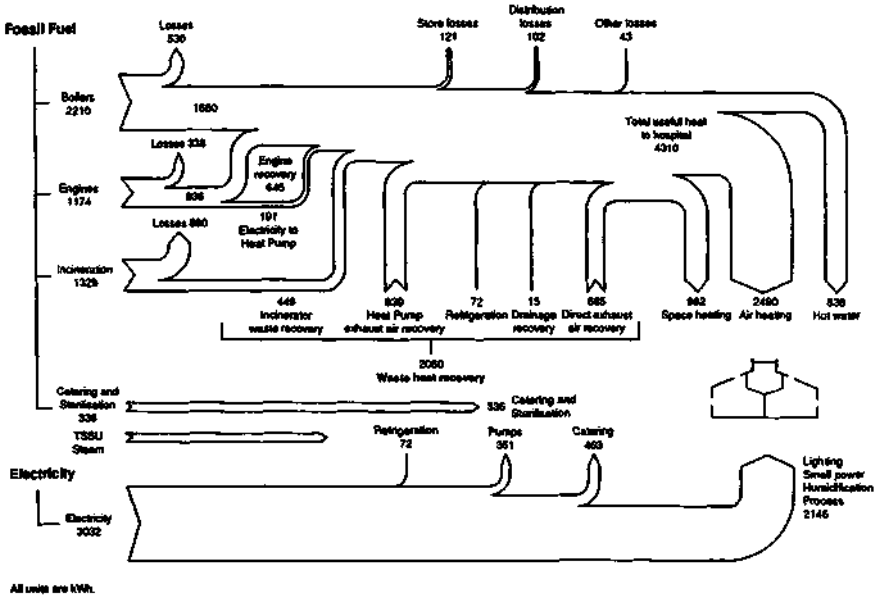

Figure 25 Low Energy Hospital schematic of energy flows

tise and independent research; the reform of the NHS cannot be said to have advanced any coherent theory in the field of health care buildings. In practice however there is some evidence that the relaxation of hitherto inflexible policies and procedures has produced some buildings - most notably in primary care, community care and mental health care - that are innovative in both function and design (see chapter 5).

Outside the NHS, with its effectively total control of UK health building the only other theoretical work originated in the USA. Patient-focused care appeared in 1990[15] and was reviewed by the NHS Estates Agency (as the Architects' Department became on 1st April 1991) in a Facilities Note published in 1993.[16] As the review showed the theory is nebulous, the terms patient-centred and patient-focused being applied without precision or consistency to concepts, operational systems, protocols, hospitals and even 'philosophies' (see Chapter 5).

However, patient-focused, patient-centred and, more recently, human-centred approaches are all manifestations of a variety of dissatisfactions and pressures, economic, technical, social and cultural, arising in health care practice that in sum challenge all theories. The increasing experiences of patients, staff and visitors of the health care buildings had been felt to be negative.To put it bluntly people did not like the external appearance, the interiors, the finishes, furnishing, colour and lighting schemes, the endless corridors and complexity, the smells, the noisy ambience and so on. Although much of this dislike was just, its causes were varied and complex, and included matters outside the control of designers e.g. poor management, insensitive staff practices, neglect of elementary repair and maintenance, and sheer lack of adequate resources throughout the NHS.

Within the latter part of the fifty years clients and designers have responded by creating more attractive environments, styling hospital buildings in the manner of contemporary hotels, homes for sale and shopping malls. Patient-focused care does not however provide a theory for designers of health care buildings to employ; what it has done has been to alter conventional briefs for some of the parts of the buildings.

Seeing links between the negative experiences of patients undergoing health care and the clinical outcomes of that care Roger Ulrich, an American environmental psychologist, proposed in 1990 a Theory of Supportive Design[17] (see Chapter 5). Ulrich's theory did not provide the usable elements that would enable

designers to put it into practice. However, his contribution was internationally recognised as important and positive and it has inspired architects to build on his insights in order to develop useful tools for design.

Critique and Conclusion

When it came into being in 1948 only about one third of all the stock of NHS hospital buildings were less than 30 years old i.e. built since the end of World War 1. In its 50 years the NHS has managed a massive programme of addition and renewal and the position now is that most of the stock of hospitals has been built since 1948. As the preceding outline indicates this work was taking place against a background of intense, objective and stimulating discussion, supported by observations, analysis, hypothesising and testing of theories about the design of hospitals and, to a lesser extent, other health care buildings.

Starting with the Nuffield Studies, which can be seen as providing the NHS with its first theoretical model, there has been the DGH, Indeterminate Hospital Design, the low-rise Greenwich model and the Balanced Hospital Community, all under active discussion before 1975. Thereafter the climate of health care design was clouded by stringent economic and political crises and subsequently the only theories about hospital design of significance have been the low energy hospital and the theory of supportive design. What can be said in the year of the NHS jubilee of current theory and practice in health care?

It is arguable that *all* the theories listed are still current, with the possible exceptions of the DGH and the Balanced Hospital Community; however, in the case of the DGH, in pvirsuance of the official NHS policy, nearly every district of the NHS in Britain obtained its DGH so the *practice* is certainly current. On the other hand the Balanced Hospital Community was never attempted in practice and will probably remain a Utopian model incorporating interesting ideas, rather than ever being implemented in the NHS.

The two heavyweight theories of the 1960s - Indeterminate Design and Greenwich - still inform much current hospital design, the former in the universal use of the 'hospital street' and the latter in the almost universal adoption of low-rise forms. As this evidence suggests, the main arguments of these theories were sound but are now seen to be inadequate and neglectful of areas of importance i.e. they were neither explicitly patient-focused nor sufficiently supportive of the users' well-being. It must be said that this criticism applies to public service building of all types in the post-war period.

This became very evident in practice. Both Greenwich and Northwick Park were much disliked as architecture, not only by many experts and professionals, but by their own users - the patients, staff and visitors. However, the wards at Northwick Park were liked very much. Greenwich Hospital was significantly delayed in construction and well over-budget in costs. This was an unforgivable fault in the eyes of government and officialdom which seemed needlessly to condemn and reject all the serious and important thinking invested in the project. Once built and in operation both Greenwich and Northwick Park as major district hospitals should have been evaluated, maintained and improved with especial care and monitoring in order to obtain the best practice from their innovative theories.

Unfortunately this did not happen. Without feedback little was

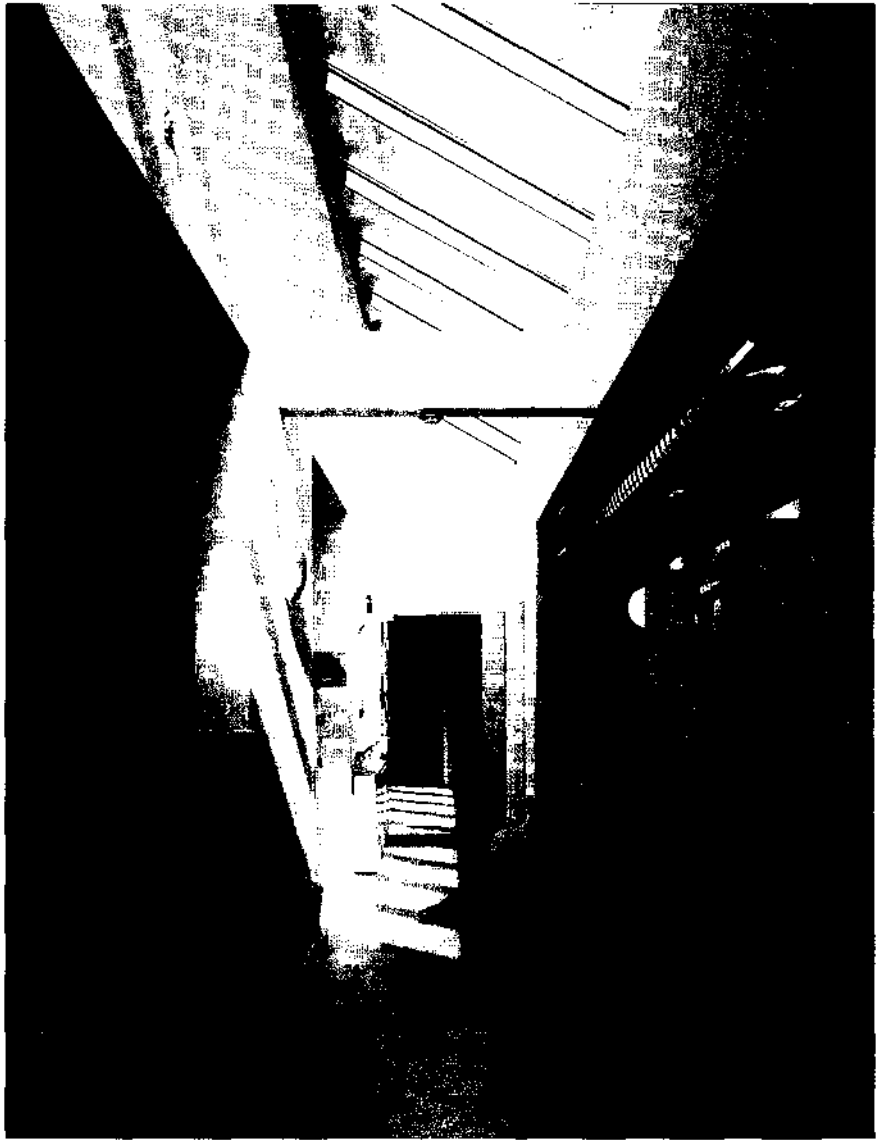

Figure 26 Building for the primary-care-led NHS. Hove Polyclinic

learned and the ideas behind their designs officially 'forgotten'. Although Northwick Park continues to grow and change there are now plans to demolish the thirty year old Greenwich District Hospital. It is suggested that hospitals (like Greenwich and the 1993 Chelsea and Westminster Hospital) that fill their sites are unlikely to survive long the pressures for growth and change. It seems however that this is no longer an issue of general importance and the opportunity to learn from these experiments may never be taken.

The low energy hospital was the major theory of the late seventies. It was fully demonstrated in practice and the energy performance independently monitored. Although undeniably successful the influence of this important work is not clearly evident in design which followed. As with Northwick Park and Greenwich this very strongly suggests that a whole hospital is far too large and complex to use for research and development - many other issues, local, financial, policy and aesthetic, as well as the interaction of separate innovations, complicate an assessment. This may explain the success, absence of controversy and extensive influence achieved by the Nuffield team's much smaller and more easily controlled demonstration projects.

The practice of hospital design has been very profoundly affected by the NHS reform, the devaluation of design guidance and lowering of standards, the acceptance of standard departmental plans and the imposition of new forms of procurement using Business Plans and PFI.We are also beginning to see the design and construction of a variety of hybrid health care facilities especially in non-acute, primary and community health services as a result of policy vacuums and the new freedoms permitted to NHS Trusts and GPs. But no new theories are being put into practice; all ap-

pears to be expedient, pragmatic, opportunist. Although it may be impractical to recreate the successful enterprises of the past a very strong case may surely be made for initiating some new 'Nuffield-style' studies to generate sound theories for the design of health care buildings to be tested in practice in the future NHS.

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CHAPTER 5

Current Ideas

Introduction

Fundamental shifts are taking place in the way we define health and evaluate architecture. The emergence of a more holistic definition of health and 'disease' acknowledges that causes of ill health are not simply physical and that wider environmental issues such as housing, employment and security also play a major part. In architecture, a more sophisticated understanding of the interaction of people and space has given rise to the development of theories which include the importance of the individual and their feelings and emotions.

With the establishment of the NHS, the role of the 'modern hospital' gained central importance, but after fifty years that particular role now needs to be reviewed. Having developed from charitable hostels, through the philanthropic era of voluntary and municipal institutions serving manifest and urgent public health needs, the modern hospital became a more clinical and scientific establishment. The functions became increasingly specialised and complicated and an interpretation of functionalism, 'form follows function', using a limited definition of function, produced predominantly utilitarian health buildings. Reduced to a collection of elements or components connected by circulation systems based on supposed organisational and work-flow efficiency, the hospital tried to attain a perfect medical interpretation of an industrial flow system.

Architecture has been slow, relative to other disciplines, to acknowledge developments in cultural theory that have criticised functionalism.This may help to explain the preponderance of dull hospitals in the NHS which adroitly fulfil a complex brief but hardly offer an enjoyable, positive or reassuring experience to staff or patients and bring little, if any, delight to passers-by. There are a few notable exceptions in the larger hospitals but the more exciting and inventive designs have emerged in recent years for community and primary health care. Whilst accommodating a wide variety of health care services, these latter share a remarkably similar approach to the design of the built environment. This approach deals with people as individual sentient beings. It is concerned with the human experience and emotional needs of individuals, each with their own background and expectations. It is one that therefore recognises the special nature of each place and the quality and character of particular spaces. In the best of contemporary architecture these design issues are treated as real functions of the building alongside those directly to do with the basic health care purpose of the facility.

Many excellent health care buildings are designed by architects who do not specialise only in such projects, though any suggestion that all the designs draw on, or are attributable to, a particular architectural theory would be merely speculative. However, there are clearly some aspects of the designs that accord with these ideas, for example, designing for the specific nature of the site, concern for lighting quality, views, attention to the tactile and sensual nature of materials and finishes, and a humane sensitivity to the environmental needs that respect the emotional needs of often vulnerable and fragile people.

It would be unfair to suggest that health care has been without any champions for humane design. In the era immediately prior to the establishment of the NHS, for example, some notable buildings of recognised architectural quality were built such as Finsbury and Peckham Health Centres. Later, in the early decades of the health service, hospitals such as Powell and Moya's Wexham Park and Wycombe General are exemplary modern

Figure 21 Model of proposed Ambulatory Care and Diagnostic Centre, Central Middlesex Hospital

designs which clearly encapsulate a sense of pride in designing for the public sector.

Contemporary understanding of architecture, informed by critical theory, exposes the limitations of a heritage based in a largely prosaic and limited interpretation of Functionalism, and offers insights into a more complete and sensitive design approach. There is no question that elementary functional requirements should be met, it is simply that they are not sufficient as determinants of form.

Patients First

Health policy has addressed the needs of patients through documents such as *The Patients Charter* (1991)[1] in which respecting privacy and dignity are keywords with assumed implications for design. A series of publications by the King's Fund entitled *Obtaining the Views* (1993)[2] offers guidelines on how to find out the opinions of service users of specific care services. Most of the surveys concentrate on organisational and management issues and few refer to the environment or building design. However, two ideas that have recently emerged which do address the physical environment are known as 'patient-focused' and 'patient-centred' care.

'Patient-focused' care is a management driven approach, which aims to improve the patient experience by rationalising logistical processes by claiming to be more efficient and to put the patient to the least disruption. This approach emphasises teamwork and the decentralisation of diagnostic, treatment and support services to increase local control. Kingston Hospital is one often experimental pilot sites in the UK where the reorganisation of the ward floor into smaller multi-skilled teams of nurses and technicians, with local provision of diagnostic and treatment services such as x-ray, endoscopy and simple pathology testing, is being put into practice. A similar approach also drives the organisation of the day surgery and maternity units. An idea that first developed in the USA was the designation of single rooms for maternity services. This arrangement enables each woman in childbirth to remain in her own room from admission to discharge rather than being moved from one specialised room to another at each stage. This has proved very popular and clearly provides more dignity and privacy. The rooms are referred to as LDRP rooms (labour, delivery, recovery and postpartum), a graphic reminder of the flow system approach of functionalism.

The second idea is known as the 'patient-centred' approach which assumes a change in organisational culture in which the design process plays a part in facilitating the adoption of a new

care 'philosophy'. The intentions of this 'philosophy' are to change the nature and image of health care environments by following a holistic approach founded on continuity, accountability and education. Departures from conventional care approaches include changes to nursing care and clinicians' attitudes, an emphasis on patients' access to information, nutrition and family support. There is a belief in the self empowerment of patients to enable them to share responsibility for decisions about health care interventions. Planetree is an American organisation which promotes this philosophy and there is currently a hospital in the UK at Poole in Dorset affiliated to Planetree which has been recently reorganised in part on these principles.

Figure 28 Maternity room Kingston Hospital

Both the patient-focused and patient-centred approaches have questioned existing organisational and planning principles of hospital design by giving greater importance not only to patients but to the carers and staff, and more particularly to an understanding of their experience and feelings. But it is the Planetree model that has become part of a wider and more fundamental interpretation involving the reconsideration of management, care and design. In both cases the physical design aims to provide greater comfort and convenience to the patient. But in practice it results in a rather superficial massaging of the interior decor so that it resembles hotels instead of 'stark unfriendly utilitarian modernism'.

The Therapeutic Environment

The idea of the therapeutic environment, one that positively contributes to the healing process, has recently appeared. It not only gives greater importance to design but also provides a framework for convincing key decision-makers that design is important: for clinical staff in improving patient outcome; for managers in terms of a better service; for patients, visitors and staff in appreciating the value to health of good environmental quality.

Current theories about what constitutes a therapeutic environment may be broadly classified into three groups according to the discipline of their authors: scientists, psychologists and designers.

The aim of the scientific studies is to test whether design can directly affect clinical outcomes. The well-known study by Ulrich[3], investigated the influence of the view from the hospital window on recovery of two comparable groups of surgical patients. Indicators included reduction in the dosages of analgesics, fewer complaints, lower blood pressure, fewer adverse observations by staff

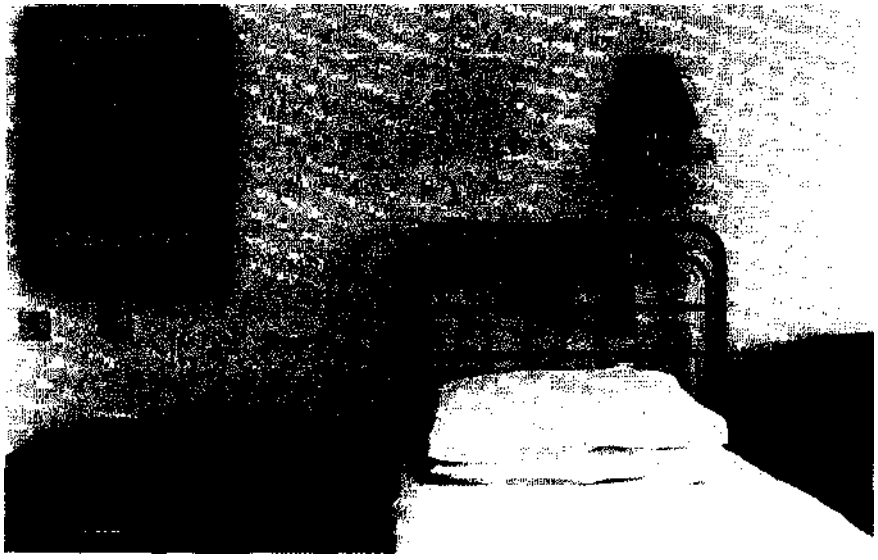

Figure 29 Single bedroom in conversion, Poole Hospital Dorset

and earlier discharge. They were compared retrospectively in two patient rooms, one with a view of the landscaped grounds and one with only a brick wall in view.

Other studies in this category include Brainard's study[4] on the implications of light on hormones, brain and behaviour. He contended that light has a profound effect on human biology independent of the visual system. It is well known that light treatment is a significant factor in the treatment of people with SAD, seasonal affective disorder.

In Stanley Graven's[3] research study examining the effect of light and noise on the REM sleep of infants in intensive care, he demonstrated the physiological reactions of infants who are overexposed to light and noise which can adversely affect their physiological development.

Ulrich has further developed his studies into a 'theory of supportive design'[6] which promotes improved outcomes by fostering three principles: a sense of control with respect to physical surroundings, access to social support and access to positive distractions. The aim of this approach is to reduce and relieve stress from the environment. He gives examples of design approaches to achieve this: for increasing control he suggests greater privacy, personalised controls for lighting and music, and better signage; for social support he suggests providing kitchens for visitors, social spaces and overnight sleeping arrangements for carers; positive distractions include entertainment, gardens and views.

A report commissioned by The Center for Health Design, *An investigation to determine whether the built environment affects patient medical outcomes*[1] (Rubin and Owens 1996) looked at over 38,000 studies published in the last 30 years from which only 48 were selected for containing relevant data. Of these, 42 demonstrated that some health care environmental feature was related to at least one patient outcome parameter. The features which were found by at least one of the studies to influence health outcomes were: light, heat shielding, humidity, temperature, music, sound, noise levels and window views.

Whilst this investigation may not appear to offer significant data (because the number of relevant studies is so small and indeed the outcomes are not conclusive) it does demonstrate a commitment to a serious investigation through scientific methods. An inherent difficulty with this area is of reducing the complexities of an individual's medical condition and of environmental factors to enable one variable at a time to be investigated.

Figure 30 Lambeth Community Care Centre

The second group of theories includes studies carried out mainly by psychologists and shows that building features have observable psychological effects on users. They are concerned mostly with issues such as privacy and territoriality. In the late 1970s Canter and Canter published a collection of articles on the effect of environments on perceptions of space[8]. These showed, for example, that the type and arrangement of furniture in a sitting room can have a marked effect on the pattern of social interactions. The collection focused mostly on care groups with mental health problems. Several of the issues explored related to children with special emotional needs, e.g the article by Rivlin and Wolfe looked at room sizes, sharing of spaces and the extent to which socialisation was determined by a physical setting. They identified 'the strong influence of the therapeutic environment as an institutional socialisation agent'.

In an article entitled *The psychological environment: patients perception,*[9] Julie le Ferre explored aspects such as personal space, territoriality and privacy. The article explains these as complex issues where territoriality not only relates to boundaries but also to rank and status; and privacy involves isolation but is also a measure of the amount of access we allow others to have towards ourselves.

This group of studies by the psychologists raises another set of issues: they share a qualitative approach to research and are prepared to explore a complex set of factors in relation to the given topic.This approach would help in the systematic exploration of ideas about 'non - institutionalised' settings or, as it is the current fashion to describe them, spaces with 'domestic' or 'homely' characteristics.

The third group of theories is generated by designers and architects, a group which scientists and psychologists might

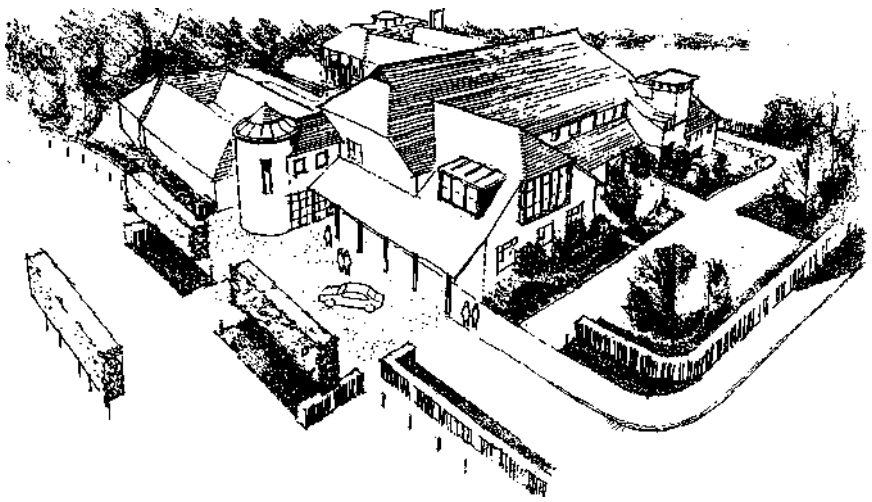

Figure 31 Hospice in the Weald

characterise as the 'faith healers'. It is an understated but obvious fact that these professionals believe their designs can improve healing - it is an imperative of any creative process for the creator to believe that the proposal will be of positive benefit. Implicit in this material are notions about quality of design that have the effect of blurring the boundaries between therapeutic issues and aesthetics.

Publications from Arts for Health have not only highlighted the importance of the cultural potential for arts in health care settings but have explored a definition of a patient-focused architecture. Scher's contribution addresses users directly, aiming to explain in simple language some key ideas about design.[10] He suggests that environments can be assessed as having positive and negative attributes linked to well-being. Positive ones would be those which promote healing in patients, enhance the performance of staff and promote caring behaviour in carers. Examples include art work to distract or to stimulate patients and windows in intensive care units and operating theatres where staff stress levels may be high.

Guidance such as *Better by Design"* (1994), *Design that Cares*[12] (1993) and *Environments for Quality Care*[u] (1994) encourage health sector clients to consider themselves as patrons of good architecture. They aim, for instance, 'to show how good design can help to achieve contentment and satisfaction, rather than irritation and discomfort, in local health buildings' (1194 pv).[14] They also offer a methodology or a checklist approach to briefing in a non-prescriptive way. For example, *Better by Design* lists the following factors as design considerations:

> 'that buildings comprise "domestic scale, element of surprise, the patient environment, defining public and private space, designing the built environment, low energy, low maintenance, lighting, art"'[15] (1994).

Such are a welcome antidote to the majority of government publications in this field in that they have given status to product as opposed to process.

Malkin[16] in *Hospital Interior Architecture* (1992) discusses the relationship of research and design and develops many of the themes found in the work of scientists and psychologists as parameters for design. These are analysed in relation to the needs of specific care groups or services. The characteristics identified as indicators of good and therapeutic design tend to be more concerned with interiors such as colour, light, finishes, texture, and noise, than with building form or location.

Christopher Day, in a more holistic approach, professes that the spatial qualities are experienced as an integral part of the development of the individual, where the harmony of curved shapes for example, conveys humanity in scale and construction. He writes;

> 'To be healing, a place must be harmonious, bringing change as an organic development so that new buildings seem not to be imposed aliens but inevitably belong where they are. They must respond to the surroundings and be responsible, seeking to minimise pollution caused by their materials. But places - and buildings - must be more than that; they must be nourishing to the human being'[17] (1993, pl9).

Figure 32 St Mary's Hospital, Isle of Wight

This work illustrates a subjective and intuitive response to architecture, which in its own way offers valuable insights into, and understanding of, design.

These three approaches of the scientists, psychologists and designers share a common emphasis of placing importance on the feelings and experience of the individual. But they are unable to deal with the variables outside each discipline and to describe satisfactorily the complexity of the issue of what constitutes a healing environment. So we may appreciate that a room with a view is more therapeutic than one without but how will we assess whether the room's aesthetic qualities also contribute to its therapeutic efficacy? Or, the arrangement of seats may offer a place for social interaction but so might the shape of the room.

Sustainability

Issues of what is now called sustainability were explicitly addressed in two government research and design projects for hospitals namely, St. Mary's on the Isle of Wight and Wansbeck Hospital. Both sought to reduce revenue costs by improved environmental design and as demonstration projects were scrutinised in evaluative studies to compare performance with targets.

Recent developments in this arena have broadened the approach to design and specification by seeking to distinguish between embodied energy and energy expenditure in use. A number of other issues are also being explored under the sustainability umbrella including the judicial use of natural resources, awareness of the toxic effects of materials, concern for environmental degradation and diligence in application of health and safety measures in production and construction.

In the UK this has generated legislation and guidelines for a

'green approach' e.g. for selecting materials which are not harmful to producers, users or the earth. As well as new technical innovations such as photovoltaic cells and providing insulation below ground floor level, there are some developments which are more concerned with issues of a broader planning nature. Experimental schemes for providing naturally lit and ventilated spaces in large scale buildings such as offices and banks offer models for complex and compact health buildings.

With radical changes in government transport policy and the abolition of crown immunity for health care buildings, there are likely to be significant constraints and requirements for location of, and access to, health buildings which will be monitored through local planning mechanisms. The planning guidance which aims to encourage local access and limit unnecessary travel, especially car journeys, specifically refers to hospitals.[18] This signifies a general trend to develop a less technocratic and more holistic approach to the issue of sustainability.

The Application of Information Technology

Advances in computer technology have significant ramifications for health care. Data handling which has already made an impact on patient record systems and administration will continue to develop and change. Just as other sectors such as banking and air travel have developed sophisticated and intelligent uses of record management systems, so there is reason to believe this intelligence will eventually be available in the health service. The revolutionary transformation in diagnostic techniques from film to digital images for example, is also likely to have a profound impact: not only will this mean changes in the processing of information, but it may also change how and where health care is delivered. The notion that the patient and doctor can be in different rooms, towns, even countries is already being put to the test. Modem links between the home and hospital, a surgery and hospital, and between hospitals are already in use. Another significant implication for design is the shift in spatial conception from adjacencies to networks calling for a radical rethinking of conventional departmental relationships and priorities. Patients waiting for appointments may not be required in future to sit in a waiting room but could be paged from within a reasonable distance to arrive for their appointment just in time. It is likely that these new developments will make possible changes as well as economies in space planning.

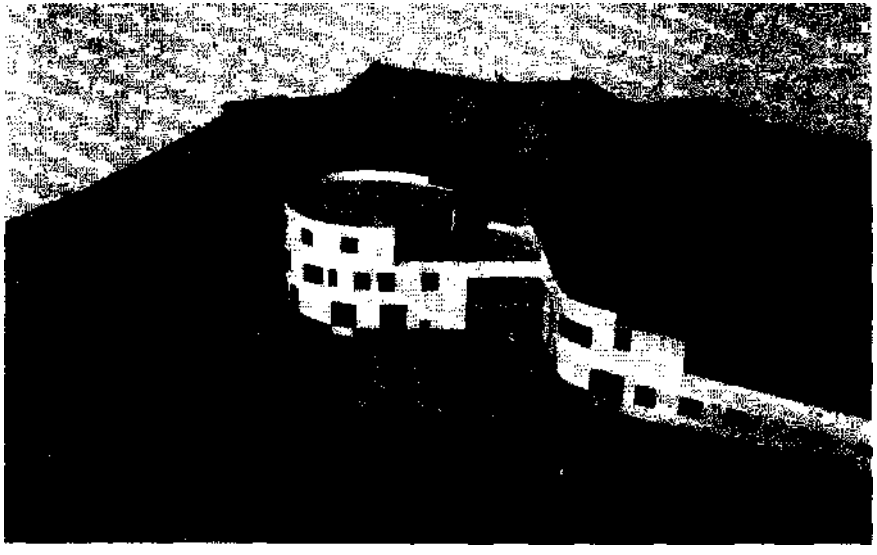

Figure 33 Model of Neptune Healthy Living Centre

The Impact of Development in Medical Technologies

Scientific developments and technological advances are having a profound effect e.g. the development of sophisticated equipment for minimally invasive procedures and advances in anaesthetic techniques. These developments are changing the nature of the work that takes place in hospital. For example, with a target of 80 per cent of planned surgery expected to be undertaken as day procedures within the NHS, there will be a significant shift in the building required towards day appointments and away from overnight stays. Other technological advances that have further affects on hospital planning are: remote diagnostic outposts linked to specialist centres, robotic laboratory and surgical suites operated through satellites, and minimally invasive techniques in real time with diagnostic procedures.

The extent of the impact of biogenetics, bioinformatics and such highly controversial developments as genetic engineering is extremely difficult to assess, fast though these are now developing. Ethical and moral debates will be important determinants of practice, it is still more difficult to predict their impact on the design of the health care environment.

In Conclusion

The creation of the NHS in the UK was the result of an idealistic and positive commitment to social ideals. Visionary zeal and modernist outlook are encapsulated in the design of several notable health buildings of the early years of the NHS. Once the service was well-established however the majority of the new buildings needed for the nation's health care do not express this.

Few recent hospital designs have made a positive contribution to mainstream architecture, and as places for care may arguably inhibit rather than contribute to the healing process. Contemporary architectural criticism outside a few specialist publications seems to ignore the field, and few design and professional awards are made for health care buildings. Health care building design is not perceived as a fashionable design arena for either practice or for schools of architecture.

Within current theory and practice there is potential to put architecture back into health: to offer dignity, privacy and respect for the individual and to create a responsive and sensual environment. This is already happening in some community and primary health projects for nursing homes, community hospitals, hospices and healthy living centres. The challenge is to reassert in contemporary terms, the importance of the social, public and civic role of health buildings.

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CHAPTER 6

Conclusion

As new ideas appear, older ideas and their links to practice may be obscured. This text has selected some of the important ideas of the last fifty years in health building design and appraised them from our current viewpoint. The aim has been to consider their relevance today and to see if any lessons may be learned. Currendy there is some concern for innovation but this overview may indicate whether any of today's innovative ideas are truly new or simply old ones re-invented.

The pioneering research in hospital function and design initiated by the Nuffield Provincial Hospitals Trust set an approach and a way of thinking about health building design that shaped activity over the opening half of the fifty years of the NHS hospital building. The seminal achievement was to set in train the long term design guidance programme which put the UK well in the lead internationally. Sweden, Australia and Canada were amongst only a handful of other countries that developed similar programmes in this period.

This UK work made some key contributions which should be remembered today. It explored a number of methods for collecting and analysing data using systematic methods that took account of working practices in healthcare and used the data to generate authoritative information for planning and design. It provided the opportunity to develop and articulate a shared vision through wide discussion and publication. It embarked upon a development programme which tested new ideas in practice through demonstration projects. It adhered to the principle that planning and design information should be applicable to specific projects on specific sites, resulting in individual schemes of high standard but not standardised.

The development of a shared vision for health care buildings was created by encouraging the exchange of ideas between theory and practice through a free culture of co-operation and an intelligence network amongst professionals. The impetus for developing standards was driven by a goal to achieve equity and quality. The HBN programme when supported by underpinning research studies, was the envy of the world. The role of systems and standards to support the implementation of a large building programme always required a respect for the fine dividing line between ensuring quality and stifling innovation. When the balance was tipped too far towards standardisation and in a form that did not allow a site-specific approach nor recognise the needs of local users, difficulties and division were created.

Another lesson is the need for independent evaluation of the outcomes of innovation. It is essential that the claims made by innovators are scrupulously verified. A number of new ideas in the last fifty years were misjudged or overlooked for want of proper, or indeed, any feedback.

The shift to a more holistic understanding of health and ill health is apparent in the range of building types now accommodating health care including hospitals, nursing homes, hospices and healthy living centres. Innovative ideas about architecture which acknowledge the emotional needs of individuals are appearing in exemplary community and primary care buildings. The potential for health care buildings to reassert their role in the social, public and civic realm is becoming more evident. Future building ideas must respond to the patient as an individual with a choice and must provide environments conducive to healing. And like all new development now they should contribute positively to sustainabilty in their use of finite resources.

A new research programme of freely available information shared in the public as well as the professional arena is now needed to recreate a culture of informed co-operation amongst experts. The programme should examine changes in society and in the individual's needs and expectations. It should also examine national health policy and its outcomes, for example in a primary care-led NHS, and the effects of dispersing services and facilities away from the comprehensive role of the DGH. Technological advances in medical procedures and data handling are attractive areas of research in building form but should not be pursued outside the human, social and political context.

A **'20/20 Vision'** for future health care facilities has yet to come into focus. But some of the issues that it will need to address may already be articulated: e.g. the relative qualities of planning for major hospitals with minor support facilities; comprehensive services in one place or specialist centres with a single service; the balance of emergency and planned services; a service led by primary health care that embraces health education and social care.

If the UK is to regain its position at the leading edge of ideas about health care building new initiatives would take into account the fact that we will be operating in a borderless Europe and can draw upon and test ideas for this vision in this wider arena. The fifty years just reviewed confirm that we have an unrivalled foundation of knowledge and experience upon which to start building and developing anew.