Hospital-City

by JONATHAN HUGHES

Perhaps the greatest contribution made by the industrial town was the reaction it produced against its own greatest misdemeanours; and, to begin with, the art of sanitation or public hygiene. The original models for these evils were the pest-ridden prisons and hospitals of the eighteenth century: their improvement made them pilot plants, as it were, in the reform of the industrial town.

Lewis Mumford, 1961[1]

An association between clinical and civic design has long been suspected — and indeed occasionally explicitly invoked — by commentators on architecture and urban design. Certainly, Mumford is not the only historian to have proposed a symbiotic relationship between hospital and town planning over the last two centuries or more. Yet the twentieth century has surely witnessed an intensification of this relationship, an intensification which points to a definite qualitative — if not even quantitative — shift. This article seeks to reconsider this relationship as it manifested itself in Britain after the Second World War, to investigate the similarities and points of contact between what are often considered by their practitioners to be two quite distinct discourses. It aims to do so through a consideration of a single major project, one which clearly exhibited characteristics of debates which manifested themselves in a more diluted form across numerous other schemes. This building, Greenwich District Hospital (1962–74), was one of two 'heroic'[2] hospital projects undertaken in Britain during the 1960s and evidences a plethora of concerns prevalent at the time.[3] Whilst flexibility was a fundamental desideratum, a consideration of the project's zoning of functions and circulatory logic also reveals a profound affinity with the concerns of modernist urbanism. Moreover, it was not simply a case of hospital design plundering town-planning models for its own use; British urban theory may itself have owed a debt to clinical planning, each discourse involved in processes of specialization, separation and sanitization indicative of capitalism's need to order and render controllable the phenomena of everyday life. Furthermore, this equivalence of architectural intervention at the level of both the hospital and the city plan raises important questions about modern society's conception of safety, health and the environment.

HEALTH AND EFFICIENCY

The question of the best size and form a hospital should adopt, in order to give psychic help to the sick and at the same time meet all medical requirements, is somewhat akin to the question of how large a city should be, in order to meet the needs of its inhabitants and fulfil its functional requirements.

Siegfried Giedion, 1951[4]

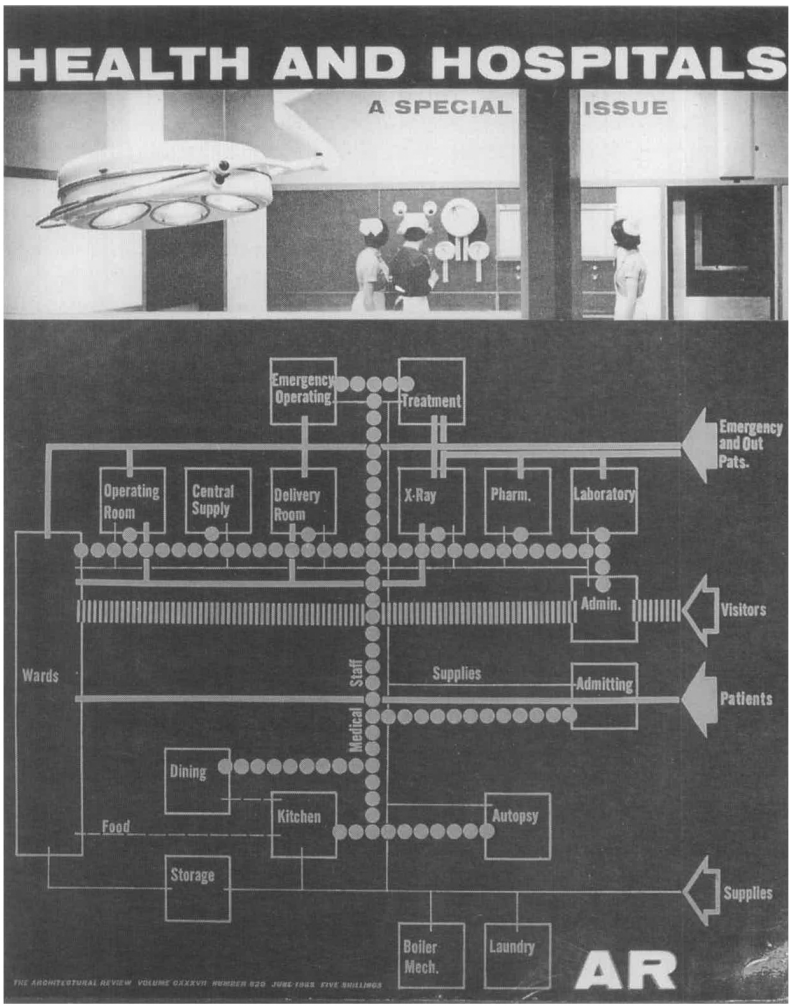

Fig. 1. *Cover of* Architectural Review *(June 1965), showing Gordon Friesen's circulatory logic for the modern hospital*

A parallel between modern hospital design and urbanism was apparent in 1951 to Siegfried Giedion — one of the founding fathers of the *Congrès Internationaux d'Architecture Moderne* (CIAM). Indeed, the programmes of so many inter-War and mid-century modernist urban projects made clear the conjunction of notions of circulation, efficiency and health; most famously, Le Corbusier's 1924 text *Urbanisme* drew an explicit analogy between the act of surgery and urban improvement schemes. By zoning away industry and by separating out traffic flows into specialized, pedestrian-free transportation networks, health and efficiency of circulation could be assured for all. Like Mumford, we can no doubt trace the correlations between urban planning and notions of health back through the centuries; but it is surely only in the twentieth century that these discourses have jointly been pursued with such obsessive vigour and

with such attention to the utter physical separation of functions and traffic flows in the pursuit of health, efficiency and speed — concerns which must surely mirror the development of modern life in a mobile, capitalist society. Such processes of separation, specialization and sanitation appear to have become indissolubly bound-up with notions of efficiency and health. Moreover, sanitation should be understood not only in the limited sense of the adequate provision of drainage and sewerage, but also as modern society's anaesthetizing preoccupation with safety — and by extension health — witnessed most immediately in relation to motor transport, with pedestrians increasingly shepherded behind railings and into subways in order to facilitate the faster movement of vehicles. Both in manifesto and in practice, modernist urbanism has obsessively promoted the efficiency and velocity of circulation through processes of geographical specialization and separation. Sanitation and health may be proffered as worthy mitigating factors but the invisible hand of capital may also be sensed, re-organizing the spatial logic of the city to facilitate the functioning of circulation and thereby, ultimately, production.

In a 1961 *Architectural Design* feature on mechanization and hospital design, the influential American pundit of post-War hospital planning, Gordon Friesen, declared that 'we shape our buildings and then they shape us' — words he ascribed to Sir Winston Churchill.[5] Indeed to extend Churchill's proposition, the hospital may be seen as the exemplary intermediary between the body and the city — standing not only as the site of medical and surgical intervention into the body but also itself linked to the city through its rehearsal of planning techniques akin to those of modernist urbanism. Like modernist town planning, Friesen's hospital planning privileged the building's circulatory systems with the aim of rationalizing and accelerating the delivery of clinical care (Fig. 1); indeed, the increasing proportion of hospital buildings given over to circulatory systems and engineering distribution routes must surely stand as a characteristic of twentieth-century hospital design.

Appropriately enough, the circulation of the blood has provided a corporeal analogy for urban circulation since the time of Harvey (1578–1657), and given that bodily well-being has long been equated with vitality and movement (and illness characterized by torpor, lassitude and confinement[6]) the spatial dimension of our conception of health also becomes apparent. Health and well-being — be it at the level of the body, the building or the town — have routinely been aligned along an axis of circulatory efficiency and facility of movement. And, tellingly, a reassessment of the relationship between patient ambulation and post-operative recovery has constituted a major feature of post-War clinical practice, resulting in an emphasis on the early post-operative ambulation of patients. No longer would confinement in bed be viewed as the surest route to recovery (the legacy of a less clinically efficient and more custodial manner of health-care); the mobility of patients was now actively encouraged, prompting a fundamental reconfiguration of the hospital ward to provide the additional sanitary facilities and day rooms which the ambulant patient was deemed to require.

In spite of (or, more likely, because of) this emphasis on movement and circulation, order and rationality have retained positions of fundamental importance in the modern hospital, providing a framework of control within which efficiency might be guaranteed. With patients free to roam the ward, the problem of the clinical

supervision and surveillance of patients demanded new and more elaborate solutions, ranging from additional staff bases to all manner of electrical monitoring devices and communications systems. Increasingly sophisticated techniques of separation and categorization have also been developed to minimize the risk of contamination and maximize control in the battle against illness. Of course, classificatory rubrics have been deployed since the eighteenth century to categorize patients by medical or surgical speciality yet, more recently, the degree of nursing dependency has also been employed to group patients. Equally, isolation wards have long sought to control disease through physical separation and containment, being the equivalent of the tuberculosis or mental colonies of yester-year, whilst latterly the adoption of intensive care units (for immediate post-operative care) has centralized this form of acute care in a single department, as opposed to providing it individually on the general wards. Yet there is a lingering undercurrent of miserable inadequacy to such an obsessive preoccupation with order, efficiency and correctitude, especially within the hospital — an institution essentially devoted to fending off illness, dis-ease and bodily malfunctioning, its task never-ending. Of course, medicine is continually presented with its own impotence in the face of the frailties of the human condition, and one wonders whether modernism's obsessive commitment to medical-architectural functionalism and efficiency could ever have constituted anything more than a flawed attempt at achieving the goal of a truly curative architecture — its ultimate powerlessness effectively repressed beneath its declamatory functionalism.

GREENWICH DISTRICT HOSPITAL

Conceived and largely built during the 1960s, Greenwich District Hospital was explicitly underwritten by notions of throughput and efficiency, as evidenced by Richard Crossman, the then (Labour) Secretary of State for Health, who, upon opening the first phase in 1969, declared, 'The modern hospital is a place which is only fulfilling its function if its patients are acutely ill and if, as soon as they are on the road to recovery, their bed can be vacated for another acute case.'[7] The Ministry of Health had long been aware of the unlimited demands placed on the NHS, and the limited funds available to run it. Official policy therefore sought to raise the throughput of the hospital service via a reduction of in-patient lengths of stay to the minimum clinically necessary, and through increases in day surgery and out-patient treatment. And so at Greenwich not only were advanced traffic and supply systems required to service the hospital's clinical departments, the increasing number of patients to be directed around the building prompted the development of a standardized signing system. Furthermore, the lessons learnt from the project were to be disseminated by the Ministry for incorporation in hospital projects across the country.

On a roughly square $7\frac{1}{2}$ acre site bounded on one side by the noisy Woolwich Road, a major south-east London traffic artery, Greenwich District Hospital was most notable for its remarkable reticence (Figs 2 and 3). Although almost filling its site, with a building footprint of approximately 500 by 400 feet, the squat four-storey block was surprisingly sympathetic to the surrounding Victorian terraced housing. Its compactness belied the accommodation inside, including accident and emergency and

Fig. 2. *Greenwich District Hospital, general view*

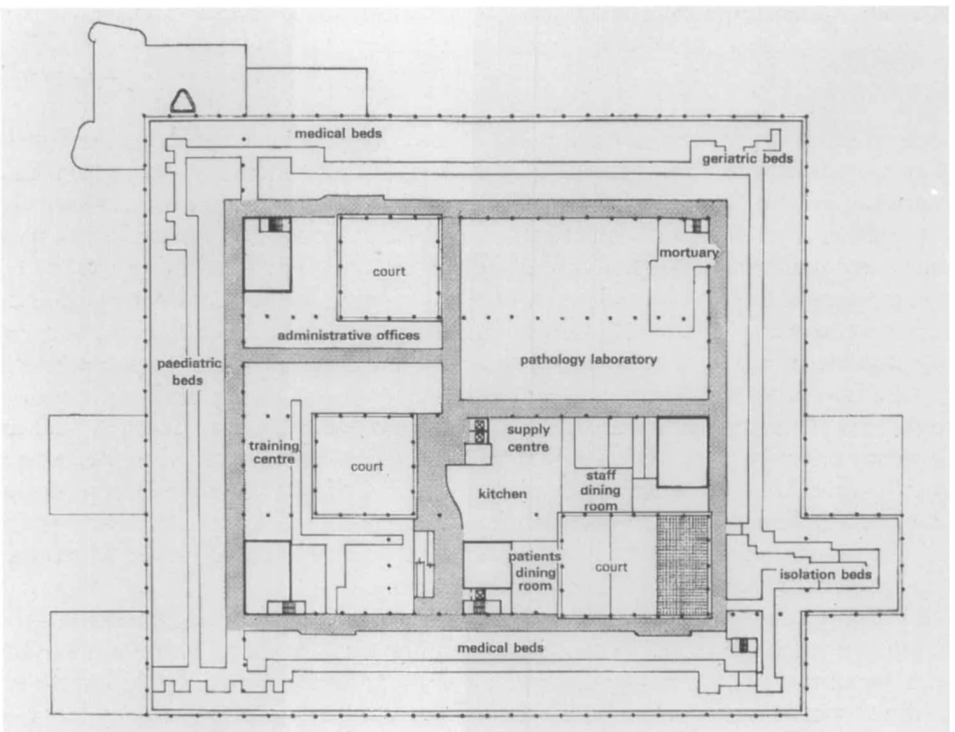

Fig. 3. *Greenwich District Hospital, typical floor plan. From W. A. H. Holroyd,* Hospital Traffic & Supply Problems *(London, 1968), p. 111*

https://doi.org/10.2307/1568678 Published online by Cambridge University Press

out-patient departments, as well as maternity, geriatric, psychiatric and general wards, totalling around 800 beds. The external façades were unified by the repetitive module of the perimeter-beam-and-structural-column construction system, whilst the actual window wall was recessed some three feet behind this façade, providing protection against solar gain. The concrete-aggregate finishes of the building's exposed prefabricated structure were enlivened by the structural display of the stubs on which the internal beams rested, but were hardly brutal; whilst between floors, horizontal bands of Galbestos louvre panels countered the verticality of the structural columns, and hinted at the existence of the intermediate service floors.

Internally, the impression was one of horizontality and spaciousness: with its goldfish pool and bank of escalators the reception had the power to conjure up the image of an 'international hotel' rather than a hospital.[8] However, away from the reception, the main corridors displayed a bland, largely windowless monotony, created out of standardized, modular, storey-height partitions with standardized, modular door assemblies — all unrelieved by the uniform vinyl floors and tiled ceilings. Such drabness was only countered by the three internal courtyards which the corridor system skirted, offering a welcome distraction, a glimpse of natural light and a means of orientation.[9] The in-patient wards themselves were located around the perimeter of the building, conveying a more reassuring, therapeutic environment — their relatively low, nine-feet-high, suspended ceilings diminishing their institutional feel.

The DHSS's promotional literature was upbeat in its description of its new hospital. Nor was it alone: local residents dubbed the building the 'Greenwich Hilton',[10] whilst the *Architects' Journal* praised the hospital's 'considerable spaciousness, lightness and quietness'[11] and the *Architectural Review* noted its 'low-key and at times downright friendly atmosphere'.[12] This was not wholly surprising given that it had replaced the old Greenwich and Deptford Union Workhouse, built in 1840 and progressively extended until, by the end of the nineteenth century, it housed over 1,000 inmates, the more seriously ill in a series of infirmary blocks. Extended during the 1930s and bomb-damaged during the War, it was this ramshackle and partially unsound 670-bed hospital (by then known as St Alfege's) which the Ministry of Health inherited in 1948 under the terms of the 1946 NHS Act. It was evident to St Alfege's NHS guardians, the South East Metropolitan Regional Hospital Board, that major repairs were required, but funding was initially unavailable.[13] However, in 1960, the Ministry of Health was searching for an urban hospital site on which to undertake an experimental redevelopment project and St Alfege's presented the ideal test-bed. With Ministry and Board co-operation formalized by 1962, plans for the £6m hospital were ready by May 1964 and received positive press coverage.[14]

The project was to fulfil several goals, most notably providing the Ministry's fledgling Architects Department with its first attempt at whole hospital design. The aim was to close the outlying Miller General Hospital and rationalize services on one site, creating an 800-bed facility approximating to the multi-disciplinary District General Hospital (DGH) envisaged in Enoch Powell's 1962 *Hospital Plan for England & Wales*[15] which had proposed the modernization of the nation's hospital infrastructure. The project offered the opportunity to investigate and evaluate Ministry design recommendations from first principles, ranging across nursing methods and staff

organization, through dimensionally co-ordinated modular systems of furniture and fittings, to the development of a structural system known as the 'Universal Hospital Space'. The latter sought to accommodate virtually any hospital function, from wards to laboratories to high-specification operating theatres alike, whilst also being capable of flexible internal sub-division and servicing, offering the ability to reconfigure accommodation efficiently, in line with changing clinical need. To fulfil these requirements a long-span beam with an integral intermediate services sub-floor was developed, thereby largely obviating the need for vertical service risers which might constrain the open planning of the clinical floors. Given the air-conditioning such deep-planning necessitated it was a costly structural system and running costs were expected to be two per cent higher than in a conventional hospital.[16] None the less, it was stoically hoped that 'the total cost of the Greenwich project will itself be less significant than the value of information which will be fed back into the Health Service for use in planning future hospitals.'[17]

THE MINISTRY, DESIGN GUIDANCE AND THE *HOSPITAL PLAN*

The Ministry's Greenwich project was the third to be undertaken following the establishment of its Architects Department in 1959 — this over a decade after the commencement of the NHS, and lagging behind similar appointments at, for example, Education (filled by Johnson-Marshall in 1948). During the 1950s Ministry involvement in design had been limited to rubber-stamping Regional Hospital Board (RHB) plans and overseeing the so-called 'make do and mend' programme (which none the less brought back into service some 35,000 beds). Although some RHBs employed their own architects, substantial commissions were generally contracted-out to private practices. However, with the slight expansion of hospital building during the decade came the Ministry's appointment in 1956 of two architects to provide technical support to the RHBs and to undertake research.[18] Indeed, it was not until the end of the decade that the Ministry formally established its architectural department to increase the available fund of hospital design guidance — until then limited to the ground-breaking ward studies undertaken by the Nuffield Provincial Hospitals Trust programme run by Richard Llewelyn-Davies.[19]

Upon his appointment as Chief Architect in 1959 William Tatton Brown (1910–97) created three development teams. The first focused on development and building design, undertaking a series of hospital projects of which Greenwich was the largest. A second group dealt with research and education, investigating technical and environmental aspects of hospital design such as traffic and supply services, lighting and lifts. The third team dealt with casework and guidance, analyzing proposed and completed projects, comparing design criteria and developing the Ministry's standard guidelines via *Hospital Building Notes* (HBNs) and specialized *Hospital Technical Memoranda* (HTMs) — akin to the Ministry of Education's renowned design guidance. Like the Nuffield studies before them, the HBN methodology was rooted in the observation, research and analysis of hospital functions, with the later department-focused HBNs offering design criteria ranging from preferred planning relationships of rooms to minimum environmental standards. The later HBNs segregated departments into

specialized entities, classifying the functions proper to each and separating off functions which could profitably be centralized. By contrast, the first three volumes published in 1961 took a wider view of, respectively, the preparation of a hospital's building programme, cost-planning,[20] and a description of the services offered by the 600–800 bed DGH, which was to be the basic hospital unit for a population of 100,000–150,000. Clearly indebted to Friesen's schematization of the hospital this third HBN included flow diagrams linking the individual hospital departments with lines indicative of various traffic flows including patients, staff, visitors, food and supplies (Fig. 4).[21] No overall form was suggested for the hospital, but the emphasis on communication and circulation for the efficient functioning of the hospital was clear.

During the 1950s there had been neither the funding nor the political inclination to build new hospitals — housing and schools having been considered far more pressing concerns. Yet by the time of the 1959 general election, mounting public alarm over the state of the nation's hospital infrastructure prompted manifesto pledges of increased hospital building from all the main parties. By now, it was clear that Britain's hospitals were old, decaying and over-stretched by the new NHS and that a major investment programme would be required to make amends. Following the re-election of the Conservative administration Enoch Powell was appointed Minister of Health in July 1960 and, whilst an ardent free-marketeer, firmly placed health (and defence) within the State's remit.[22] Supported by his Permanent Secretary Sir Bruce Fraser's commitment to honour the government's election pledge, Powell proposed a £750m ten-year programme of hospital construction (£500m up to 1970, and a further £250m to 1975, at 1962 prices[23]). Following discussions with the RHBs, the *Hospital Plan for England and Wales* was unveiled on 25 January 1962, outlining 90 new and 134 substantially remodelled hospitals to be started during the ten-year period to 1971, with 1,250 hospitals to be made redundant in the move towards rationalized single-site 600–800 bed DGHs.[24] The DGH was to centralize clinical specialities on one site, reversing the existing dispersal of geriatric, psychiatric and obstetric facilities across the community — Ministry and medical opinion favouring the benefits of inter-disciplinary contact and economies of scale which such large hospitals were considered to provide. However, although a prime example of the oft-quoted post-War advocacy of long-term planning, Powell's *Hospital Plan for England & Wales* remained one of only two long-term plans for Britain, the other being the roads programme — both committed in different ways to notions of efficient circulation.

WILLIAM TATTON BROWN: FROM TOWN TO HOSPITAL DESIGN

The Ministry's new Chief Architect, William Tatton Brown, was well placed to effect Powell's *Hospital Plan*, having organized reconstruction groups in Burma after the War, and heading Hertfordshire's pioneering schools-building programme. And whilst it would be unfair to place undue emphasis on the biographical detail of one individual (both in view of the obviously collective nature of Ministry architecture, and valid theoretical objections to such an approach) it is useful to note the contributions which Tatton Brown's career might have made to the work of the Ministry.

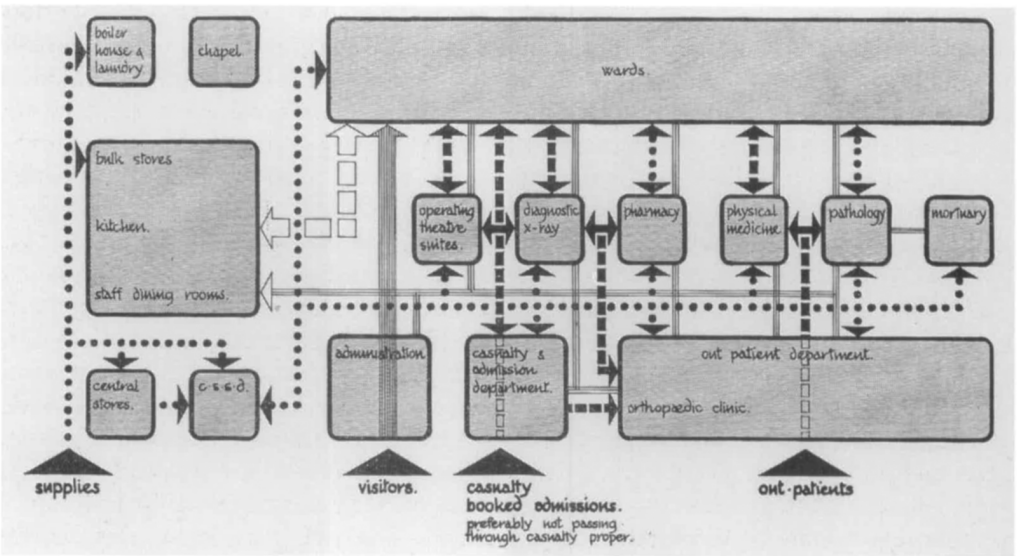

Fig. 4. *Flow diagram of the District General Hospital, from Ministry of Health,* Hospital Building Note 3 *(London, 1961), p. 12*

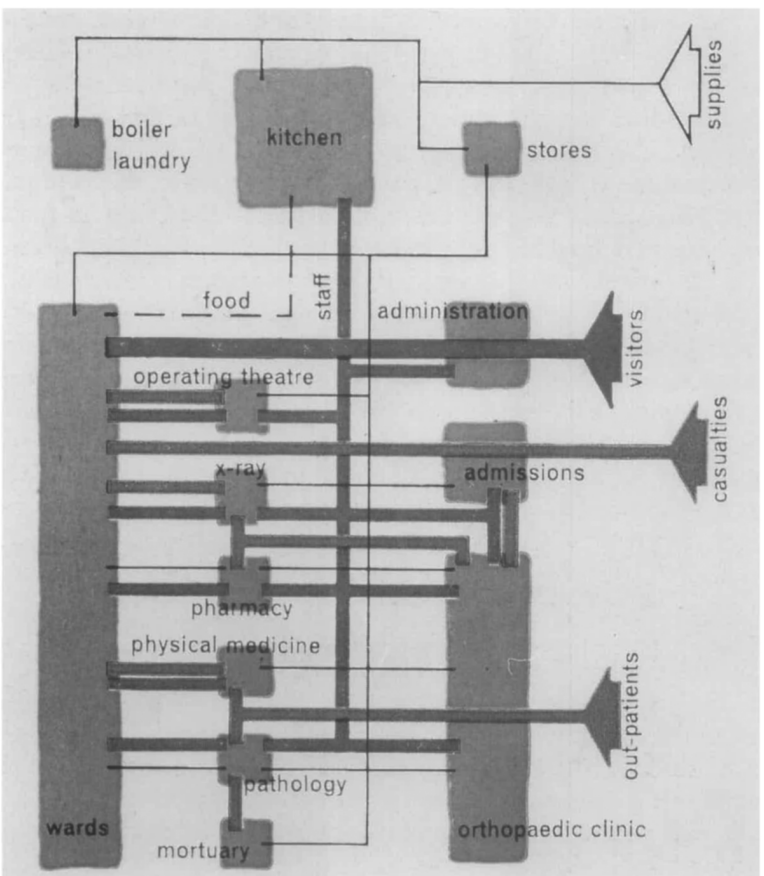

Fig. 5. *The 'basic principle' from* Traffic in Towns *(London, 1963), p. 41*

https://doi.org/10.2307/1568678 Published online by Cambridge University Press

Educated at the Architectural Association, and a member of Britain's Modern Architectural Research Group (MARS), Tatton Brown belonged to that celebrated côterie of architects so inspired by the 1927 publication in translation of Le Corbusier's *Vers Une Architecture*. Upon completion of his studies, Tatton Brown worked briefly in Paris for André Lurçat — a founding member of CIAM. Espousing the cubic forms of Le Corbusier's and Loos' work, Lurçat was known for his commitment to the idea of architecture as an agent of social change — a stance shared with his friend Berthold Lubetkin, with whom Tatton Brown also worked as Chief Design Assistant from 1934 to 1938. After a brief partnership with the ex-Tecton member, Lionel Brett (1938–40), Tatton Brown subsequently spent a year with Finsbury Borough Council, for whom Tecton had designed housing schemes and the iconic Finsbury Health Centre before the War.

Finsbury was the undeclared location of Aileen and William Tatton Brown's two studies of urban redevelopment published in the *Architectural Review* in September 1941 and January 1942.[25] The scheme proposed the linear reconstruction of an inner-city area, with a string of housing and office towers over a pedestrian deck of shopping and leisure facilities — themselves architecturally integrated with the expressways beneath. As such, it presented a development of the thinking behind Tatton Brown's plan for London along linear arteries exhibited at the MARS group's 1938 show, and aired previously at the CIAM 1937 conference.[26] Compared to the Corbusian *tabula rasa* approach, the project sought to respect the existing urban fabric by dovetailing the new with the old, creating at their junction an urbanism somewhat characteristic of the collaging aesthetic of the *Review*'s contemporary promotion of the Picturesque.

The project's significance lay in the stress it placed on issues later of profound importance not just to urban planners, but also hospital designers. Most notable was the attention given to the demands of all forms of traffic and the circulatory systems needed to service them. The emphasis on the separation of pedestrians from vehicles was explicit, creating specialized — and more efficient because speedier — routes for cars alone. Also significant was the separation of through traffic from local traffic, creating a hierarchy of major roads serving distributor roads in the interstitial areas, as was the convincingly rigorous elaboration of a multi-level architecture integrating the vertically segregated transportation systems. Yet, while the separation of the pedestrian from the car could be justified in terms of amenity and efficiency, it entailed a potential loss of freedom. Such issues could not have been unfamiliar to Aileen Tatton Brown, a contributor to Clough Williams-Ellis's 1937 pro-conservation and pro-planning book, *Britain and the Beast*,[27] where the editor noted that 'part of the price for a saner and more ordered England must be paid for in liberty — not omitting that most cherished private right to do public wrong.'[28] Clearly planning, founded on scientific rationality, classification and ordering, could improve the lot of society, but only with limitations on individual liberty.

Tatton Brown spent the latter part of the War as a Royal Engineer during the recapture of Burma, and subsequently with Percy Marshall establishing reconstruction planning organizations — such experience being later of use implementing the *Hospital Plan*. As was suggested in 1961, '[Tatton Brown] regards the hospital building programme as rather like the invasion of a country . . . In the next ten years the plan is

to build and replace — a re-conquest of British hospitals to be done on an ordered and active plan.'[29] The Ministry of Town and Country Planning provided Tatton Brown with his first post-War work as an Assistant Regional Planning Officer (1946–48) under William Holford, forming contacts with Hugh Casson and Colin Buchanan. This was to be cut short by the vacancy in 1948 of the post of Deputy County Architect at Hertfordshire under C. H. Aslin (following Stirrat Johnson-Marshall's move to the Ministry of Education) with Tatton Brown beating Richard Llewelyn-Davies to the job. The Hertfordshire schools had been early and widely acknowledged beneficiaries of the research-based building technologies of prefabrication and standardization with a 'kit of building parts' being developed for the dry, on-site assembly of schools in response to the extensively researched needs of the building's users.[30] Yet, as the early pioneering work was completed, the original Hertfordshire team gradually dispersed (with Cleeve Barr going to the Ministry of Housing and Local Government, John Redpath to Defence and Dan Lacey to Education). With a vacancy at Health in 1959, Tatton Brown likewise returned to Whitehall to initiate the hospital building programme there.

MINISTRY DEVELOPMENT PROJECTS, THE UNIVERSAL HOSPITAL SPACE AND THE VIERENDEEL

To furnish architects with design guidance for the hospital building programme prompted a series of Ministry of Health development projects through which to formulate and test HBN recommendations. Whilst Greenwich marked the first attempt at *whole* hospital design, the Ministry had already undertaken two smaller schemes to assess structural solutions and design guidance — at an out-patient and accident and emergency department at Liverpool's Walton Hospital (1959–67)[31] and at a kitchen and dining room at Kingston Hospital, Surrey (1961–67).[32] Each project employed a long-span structural system to create wide-open internal spaces amenable to flexible sub-division as required. In both cases, the horizontal structural system was deep enough to deliver utilities and engineering services from above or below as required, rather than via a network of vertical ducts. As such, the projects formed valuable precursors of the 'Universal Hospital Space' which was to be developed at Greenwich.

Greenwich was the Ministry's third and most ambitious project, prompting the most concerted exercise of research, analysis and re-appraisal of whole hospital design undertaken in this country. With a design team headed by the Ministry of Health architect Howard Goodman (1928-?), a process of atomization, separation, evaluation and definition was applied to every hospital function in the pursuit of the most economic use of labour, time and space in the running of the hospital. Horizontal movement was emphasized (to minimize capital-intensive vertical circulation systems), although extended horizontal travel was also considered uneconomic, and so a compact, low-rise design was ultimately proposed as the most efficient and reassuring to the visitor. The designers' goal of efficiency was to be met through the flexibility of the 'Universal Hospital Space' structural system, and was to be achieved with 64-foot prefabricated vierendeel beams incorporating an integral 6-foot-deep intermediate

services sub-floor.[33] Given this generous interstitial space, the clinical floor could be cleared of engineering ducts, and services delivered to any area from above or below as desired.[34] The major engineering service risers were rationalized into four vertical service ducts, whilst communications facilities were centralized in a further single 'supply core' (housing the automated goods distribution system, lifts and escalators). Yet in spite of the heightened potential for flexibility and change offered by the Universal Hospital Space, the structure was rarely to be put to the test. Indeed, the stability of the building's plan (and, most notably, its corridor system) has served to emphasize an altogether different set of concerns relating to the circulatory efficiency of the design.

GREENWICH: RATIONALIZATION, CIRCULATION AND THE CLINIC

Greenwich's design evidenced a profound interest in rationalized servicing and circulation systems, especially when compared to the ramshackle routes of the old hospital.[35] Gordon Friesen's place in this debate has already been acknowledged: his advocacy of automated conveyors, centralized service departments, trolley distribution of goods and other such methods promised the managerial and financial benefits of control, productivity and economies of scale, and were to underwrite Greenwich.[36] Accordingly, the hospital's instrument-sterilizing services were centralized off-site in a facility serving several hospitals, and laundry was dealt with similarly. Likewise, a reduction in the provision of departmental storage space was attempted through the automation of the delivery of supplies from the central stores. Goods entered the hospital at the basement, to be transferred to the bulk stores via a programmable conveyor system. An automated paternoster then distributed goods to individual 'supply centres' on each floor, using photo-electric sensors to 'read' destination cards placed on the containers. The dimensions of the standard container were methodically investigated, its size having to accommodate the majority of hospital supplies *and* be of 'a convenient woman-sized lifting load'[37] (found to be 25lb, suggesting a container of two cubic feet). The design of the hospital's supply system assumed that only part-time female labour would be available for such loading work. Thus, the architecture of the hospital was dictated by and reinforced assumptions about the types of work women would, or could, undertake. The system ceased to function many years ago.

Human circulation about the building was facilitated by three bed lifts, two goods lifts, and a bank of six escalators — the latter contributing to the 'department store feel' of the hospital.[38] The main public floors (above basement level) were planned as a double cubic figure-of-eight (dubbed the 'hot cross bun' principle) converging on the central communications hub where the lifts, escalators, disposal rooms and paternoster 'supply centres' were located (Fig. 3).[39] The Ministry claimed the design would enable 75%-more-efficient distribution rounds since the building's figure-of-eight plan avoided return journeys.[40] The main corridor route (Fig. 3, highlighted in grey) passed by rather than through clinical departments, and as such formed the counterpart of the Tatton Browns' network of routes for through traffic in their *Architectural Review* articles. To complete the analogy, a secondary of system of corridors ran within the departments, notably around the perimeter of the building through the wards. Supply

and disposal traffic was not to use this 'local' corridor — supplies being distributed to ward utility rooms whose doors opened onto both sets of corridors. Similarly, waste disposal was effected through hatches for collection by dedicated portering staff outside the department. Whilst beneficially separating clean and dirty traffic, and seeking to sanitize clinical areas even further, the plan also acted to segregate grades of staff, thereby specializing and limiting the scope of their employment in true Taylorist fashion.

The hospital's ward plans deployed an amended American 'racetrack' plan, that is, zoning ancillary accommodation towards the centre of the building (in artificially lit and mechanically ventilated rooms) with patient areas occupying the perimeter of the building, enjoying natural light. Moreover, the linear strip of wards permitted the flexible allocation of beds between clinical specialties, given that each ward was simply defined as a segment of variable length along the perimeter. Such flexibility was clearly dependent on the linear plan of the wards and is surely reminiscent of recurrent modern architectural interest in the linear city as a means of uniting the multifarious demands of urban design with efficiency of circulation, a lineage which might be traced back to the Spaniard Arturo Soria y Mata's 1882 Ciudade Lineal, Edgar S. Chambless' 1910 Road Town, Le Corbusier's Algiers Project or the Tatton Browns' War-time *Architectural Review* schemes.[41] Moreover, this preoccupation with linearity was to underwrite numerous British town plans of the 1960s, including Cumbernauld, Hook and Runcorn.

CIRCULATION AND POST-WAR TRANSPORTATION

The care taken at Greenwich to specialize, separate and render circulation more efficient was paralleled by changes in Britain's urban infrastructure. The Ministry's own Chief Architect, William Tatton Brown, had already published urban reconstruction plans underwritten by similar assumptions about the desirability of separating people from traffic, increasing the efficiency of circulation, and the ameliorating, sanitizing potential of modern architecture on the environment. Yet it was only with post-War reconstruction that such ambitious modernist schemes found a more attentive British audience, marrying well with the simultaneous re-appraisal of the nation's transportation systems. A brief consideration of the post-War development of Britain's rail and road networks will therefore serve to highlight the similarities between hospital, urban and transportation design.

Rarely as privileged as the road in Modernist conceptions of the city, railway travel lacked the impulsive spontaneity and facility of the car. Following the end of petrol rationing in 1955, what meagre profits the newly nationalized British Railways had been making rapidly disappeared as motor traffic grew, prompting Harold Macmillan to call for the rationalization of the railway network to make it profitable. Richard Beeching's subsequent 1963 report, *The Reshaping of British Railways*, offered a simple choice: either to preside over the system's demise, or to concentrate on its financially viable activities and discard the rest. Notable was the emphasis on consolidation and

specialization to increase productivity and profitability, just as at Greenwich departments and circulatory systems were specialized in order to increase their efficiency, whilst the *Hospital Plan* rationalized care into a network of DGHs.

Motor transport raised different problems for the State. Post-War governments realized that rising car ownership would necessitate investment in the road network, and in 1946 the Minister of Transport, Albert Barnes, proposed a ten-year, £800m programme of motorway building.[42] Effective vehicular circulation appeared fundamental both to economic health and the redistributive goals of the Labour government, as well as potentially unifying the regions. The plans were all but abandoned with the worsening of the economy during the late 1940s, although the 1949 Special Roads Act empowered the creation of roads for the exclusive use of traffic. Banning pedestrians, these new traffic-only motorways were, of course, justified through appeal to arguments of safety, efficiency and the need for segregation.

Britain's motorway programme was not resumed until the late 1950s. The Preston by-pass (later part of the M6) was the first motorway-standard road to be opened (in December 1958) whilst the first 72 miles of the M1 were opened in November 1959. Indeed, the 1960s witnessed the increasing specialization of Britain's roads. In 1960, the establishment of London's Road Traffic Management Unit heralded the introduction of major one-way systems, box junctions and urban clearways to further regulate the users of London's roads, whilst the 1963 report of the Worboys Committee on all-purpose roads (as distinct from motorways) added to the momentum, urging a network of primary routes across Britain.[43] Yet it was another official publication which was to have the greatest influence on architects: published in 1963, *Traffic in Towns* had an immediate and enduring impact, the volume selling a remarkable 17,000 copies in four months and being reissued as an abridged Penguin paperback.[44] More importantly here, the publication made explicit a connection between modern hospital and city planning.

TRAFFIC IN TOWNS: HOSPITAL-CITY

Known as the Buchanan Report after the chair of the Working Group, Colin Buchanan, *Traffic in Towns* was the final report of the committee appointed in 1961 by the Minister of Transport, Ernest Marples, to consider the problems of increasing car ownership.[45] Coming fresh on the heels of the abortive LCC Hook New Town project,[46] the report was flush with the optimism of 1960s town planning, offering daring solutions elaborated in a series of case studies whilst warning that complete accommodation of the car would be physically and financially impossible. The report aimed to separate traffic (especially through traffic) from 'environmental areas' (such as shopping centres, residential and industrial estates), creating a network of roads equating with the public's 'desire lines' (its unconstrained, preferred routes) — rather than arbitrarily imposing ring and radial road schemes (a typical post-War approach, applied at Coventry). Notably, Buchanan's 'traffic architecture' and his emphasis on the separation of through traffic were redolent of the Tatton Browns' *Architectural Review* articles, and whilst it would be incorrect to view *Traffic in Towns* as a reworking

of the Tatton Browns' texts (many of the ideas were clearly in wide circulation anyway) it is possible that Buchanan knew of them through the *Review*, or contact with Tatton Brown at the Ministry of Town and Country Planning.

Most importantly, the analogy Buchanan used to elaborate his strategy was that of the hospital. Illustrated with a flow diagram of a District General Hospital from the 1961 *Hospital Building Note 3* (although not acknowledged as such) Buchanan elaborated his 'basic principle'[47] of through routes and environmental areas in terms of the corridors serving hospital departments (Fig. 5, cf. Fig. 4 rotated and inverted). As he put it, food trolleys would not pass through operating theatres on their way to the wards, just as through traffic should not pass through environmental areas. The comparison was a significant one, as the hospital designer John Weeks noted in 1964:

> Analogies with city planning which can be drawn from hospital design are close. The separation of main communication routes from the [clinical] departments they serve is similar in principle to the avoidance of 'environmental areas' by main roads — one of the principles proposed in the Buchanan Report.[48]

Buchanan's notion of 'traffic architecture' was accompanied by Kenneth Browne's sketches of schemes for pedestrian decks of shopping and leisure facilities spanning redesigned road systems (Fig. 6), at once integrating whilst also segregating all the circulatory components to increase their efficiency and offer a safer, more amenable environment to the pedestrian.

Buchanan's ideas found their realization towards the end of the 1960s in the new town at Runcorn (designated 1964). Runcorn's master-plan, by ex-MARS member Arthur Ling, exemplified the logic of separated circulatory systems and functional zoning espoused by Buchanan and CIAM before him (Fig. 7).[49] At heart, its model was once more that of the linear city, with a strip of housing and industrial facilities strung along a communications system, now knotted into a closed figure-of-eight. An urban motorway known as the 'Expressway' carried general traffic whilst a separate 'Busway' (a buses-only road network) offered a more local, public, mode of transport. Runcorn's housing was grouped into separate estates (Buchanan's environmental areas) along the Busway and bounded by the Expressway, the latter separating off the rigidly zoned industrial estates. At the centre of this network was Shopping City[50] (Fig. 8), the supply centre of the town, a multi-level communications interchange, shopping and leisure centre, with superstores, a market, pubs and a cinema.

What is striking about Runcorn is not just the whole-hearted adoption of Buchanan's boldest ideas, but the conceptual similarity with Greenwich District Hospital itself: both were planned around figure-of-eight circulation systems, converging at a distribution hub providing shopping at Runcorn, and hospital supplies at Greenwich. Both relied on binary systems of hierarchical transportation routes, with two types of road at Runcorn serving through and local traffic and two corridor systems at Greenwich enforcing a similar split. Indeed, just as the wards at Greenwich were positioned around the perimeter of the building in a circuit along the 'local traffic' corridor, so too were the housing estates at Runcorn sited along the 'Busway'; and just as such banding at Greenwich utilized the 'through traffic' service corridor architecturally to divorce ward areas from support departments, so too were the

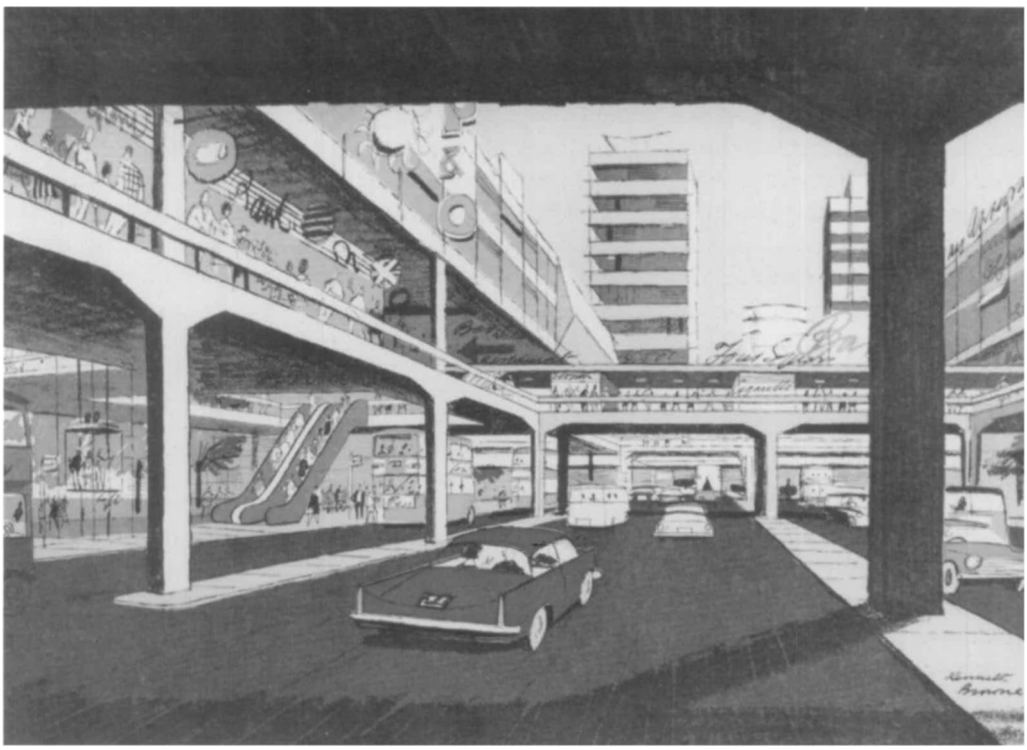

Fig. 6. *Comprehensive redevelopment scheme illustrated by Kenneth Browne, from* Traffic in Towns *(London, 1963), p. 143*

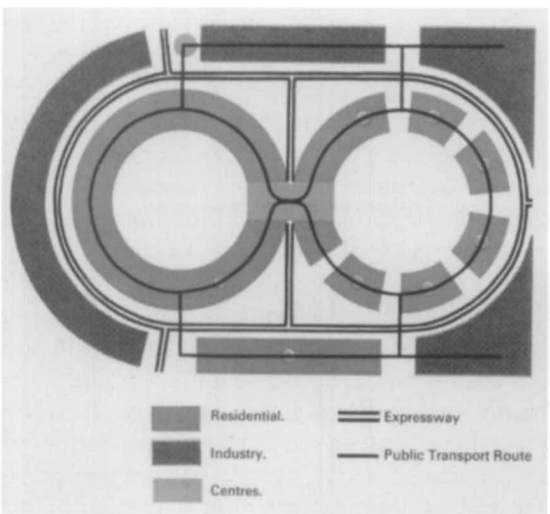

Fig. 7. *Runcorn New Town, Arthur Ling's concept for the master plan, from Runcorn Development Corporation,* Runcorn New Town Master Plan *(Runcorn, 1967), p. 20*

Fig. 8. *Shopping City, Runcorn New Town, Runcorn Development Corporation, opened 1972. Vehicular traffic enters at ground level, pedestrians have their own walkways and buses have a third, elevated, access system*

housing estates at Runcorn physically separated from the zoned industrial areas by the 'Expressway'.[51] In both schemes specialized circulatory systems served to link segregated functional entities, whilst at the same time acting to separate them. Runcorn's Shopping City embodied the multi-level traffic architecture foreseen by Buchanan, with cars, delivery traffic, buses and pedestrians all arriving on different levels into this megastructural centre, united by lifts and banks of escalators with the main pedestrian shopping floor; in a similar manner Greenwich enforced the separation of patient/visitor and goods traffic using different mechanical systems to transport them through the building. Both hospital and town had now been modelled according to the same principles of sanitized zoning, circulation and efficiency, even making recourse to an identical physical format, and implying a common relationship with the body.

HOSPITAL-CITY: THE SIGNIFICANCE OF SIGNING

Just as post-War town planners sought to accommodate rising car ownership, hospital designers were equally aware of the increases in hospital traffic: for both parties alike clear, modern signing systems promised to foster more rapid and efficient circulation. Indeed, the late 1950s witnessed an outburst of interest in signing, from the aesthetic possibilities presented by signs, to the new signing systems regulating and speeding movement through the environment. Legibility was a central concern: machines learnt to read such new typefaces as E13B (used on cheques to speed up the circulation of money), whilst the illegibility of Britain's road signs threatened to slow the circulation of traffic and became a regular cause for concern in design journals. The designer, and *Typographica* editor, Herbert Spencer, characteristically bemoaned the 'jumbled jungle of words' in a 1961 photo-essay of London's road signing, demanding graphical discipline, restraint and a cleansing of this visual disorder to sanitize the urban environment.[52]

The necessary clarity was soon to be imposed and, remarkably, it was the work of just one practice which during the 1960s redesigned the signing of virtually every national transport system: Kinneir Calvert Associates, originally formed as Kinneir Associates in 1956 by Jock Kinneir (1917–94) and later joined by Margaret Calvert (1936-?). Notably, an early commission was for the signing of Britain's first road, rail and air interchange at YRM's Gatwick Airport (1958), soon to be followed by numerous airport commissions including the 'rational' house-style for British European Airways[53] and later for the British Airports Authority.[54] Similar signing work was also undertaken for British Railways (including Sealink ferries), with the practice characteristically modifying a Helvetica typeface.

Kinneir's most prominent work was for the national road networks. Britain's signing system dated from 1933 and by the 1950s its overhaul was considered imperative by apparently all but the government. Indeed, an experimental scheme initiated without official approval by Oxfordshire County Council in 1957 on the A40 was quickly banned by the Ministry of Transport until Council and media protest forced the Ministry to sanction it as an official experiment.[55] Oxford's experiment, with light-coloured letters on a dark ground, and mixed upper- and lower-case

lettering, may have prompted the Ministry's decision in 1957 to appoint the Anderson Committee to recommend signing for the first motorway-standard road, the 1958 Preston by-pass.[56] The committee appointed Kinneir as its consultant and his signs subsequently formed the basis for all of Britain's motorway signage. The Committee's requirement for legibility at both speed and distance were again met by utilizing Kinneir's mix of upper- and lower-case sans-serif Helvetica-based lettering, a strategy later adopted by Kinneir for his signing work for Britain's all-purpose roads, undertaken for the 1961 Worboys Committee.[57] And so, within a decade, Kinneir and Calvert's signs were directing traffic around virtually every transportation system in the country — not to mention numerous other organizations.

Against this background Tatton Brown also launched a Ministry project to prepare a standardized signing system for the NHS. The piecemeal redevelopment of existing hospital complexes had at worst generated labyrinthine routes through buildings, and it was considered that clear signing would help reduce apprehension in large, unfamiliar buildings, not to mention reducing the need for visitors to distract staff by asking for directions. Unsurprisingly, Tatton Brown appointed Kinneir and Calvert as his designers. First tried out in 1965 at the new Out-Patient Building at St Stephen's Hospital in London,[58] and subsequently employed at Greenwich, Kinneir and Calvert's signs sought to combine, as Margaret Calvert has recalled, '*value for money*, clarity, simplicity of application, as well as æsthetic considerations'.[59] The resulting signing system consisted of a series of sign 'planks' capable of flexible combination with a standardized taxonomy of authorized departmental names, symbols and directional arrows — the planks' coloured backgrounds varying with function: brown for general signs, red for accident and emergency, and blue for safety. Clarity of definition and standardization were central to the system; as Kinneir and Calvert's signing manual for the BAA characteristically stated, 'Communications depend on standardization. Deviations from the norm give rise to misunderstanding . . . no deviation is necessary or permissible.'[60] In this context, Williams-Ellis's comments on the potential curtailment of individual liberty in the formation of a saner, more ordered environment appears remarkably prescient, whilst hinting at the rhetoric of control which underwrites such projects.

Employing another variant on Helvetica (itself produced by Max Miedinger in 1957 as a variation on the Grotesque face), Kinneir's 'Health Alphabet' typeface (Fig. 9) was a clear, sans-serif face with all the simplicity and anonymity of international Modernism, by now thoroughly shorn of any earlier *avant-garde* connotations. Likewise the sans-serif arrow, stripped down to its essentials and possibly derived from Klee's *Pedagogic Sketchbook*, could be seen by typographer Edward Wright as 'a vital symbol of the technological age'.[61] Yet for some, such simplicity verged on banality; as Cedric Price noted in connexion with Calvert's design for a typically spartan corporate publicity brochure, 'Unfortunately the imagination falters and is replaced by the totally unreliable belief that if you do a really important job simply enough the best results will be obtained.'[62] Indeed, this purity and directness (surely archetypal high-modernist concerns) possibly concealed an even less distinguished pedigree — sans-serif faces having once connoted a primitive vulgarity. An engraving of a garden setting in Humphrey Repton's *Designs for the Pavilion at Brighton* (1808, Fig. 10)

Fig. 9. *Health Alphabet, Jock Kinneir, c. 1965, reproduced in DHSS,* Health Technical Memorandum, *65 (London, 1984), p. 35*

Fig. 10. *Engraved frontispiece from Humphrey Repton,* Designs for the Pavilion at Brighton *(1808)*

reserved serif letter forms for the denotation of those things proper to the realm of art, intellect and beauty, whilst sans-serif lettering was assigned to the province of the crude, 'natural' world.[63] In serif letter forms the frontispiece noted that 'Gardens are works of art rather than of nature', whilst in sans-serif lettering it continued, 'Designs that are vast only by their dimensions, are always the sign of a common and low imagination.' Surely it is wholly appropriate that the sanitized, clean-cut, efficiency of modernist sans-serif lettering might be little more than the flipside of a vulgar, 'natural' baseness, especially in a setting such as a hospital where all the calm, ordered efficiency of functionalist architectural rhetoric is ever compromised by the presence of unpredictable, degenerate, dysfunctional disease.

This negotiation of discourses of control and disorder is highlighted by the signing system's operation as a 'corporate identity' for the NHS, providing a nationwide house style for hospitals, attempting to weld together the disparate constituents of what had formerly been discrete (and often private) hospitals with distinct identities. Such a view is plausible, since the idea of standardized signing had been suggested to Tatton Brown by Sir Ewart Smith (then the vice-chairman of ICI) who had undertaken a similar programme there. Likewise, British Railways' contemporary programme of unification was partly implemented through design (including Kinneir's signing), with the aim of erasing the plural histories of its constituents. Kinneir's lettering was as much a part of this programme as the Design Research Unit's classic double-arrow logo, and similar motives may be perceived behind the NHS signing system. Indeed, this conflict between diversity and singularity, between freedom and control,

summoned-up by the very programme of a national signing system, is surely equally indicative of the issues at stake in the programme which underwrote the design of Greenwich Hospital itself, where the ordered clarity of the figure-of-eight corridor system co-existed with the potential indeterminacy of the plan facilitated by the Universal Hospital Space.

'SOMETHING MORE THAN EFFICIENCY'?[64]

For a brief period between the austerity of the early post-War and the economic and social retrenchment of post-oil-crisis Britain a conjunction of relative prosperity and a belief in a scientifically-developed modern architecture found its realization in buildings such as Greenwich District Hospital. A logic of separation and specialization underwrote the project, aiming to achieve efficiency of clinical care through the technics of architectural flexibility, underwritten by dimensional co-ordination, standardization and prefabrication grounded in planning and research. A flexible and efficient building, it was hoped, would change with developments in medical care, to assist in the battle against disease. This desire to control and cure illness with ever greater efficiency reinforced the need to separate and specialize, to categorize and compartmentalize clinical functions. Such processes may be viewed as sanitizing, minimizing the risks of contagion and disruption; rendering neat, comprehensible, controllable. Attempts to offer ultimate efficiency and architectural flexibility might now be viewed as over-ambitious, but the techniques employed in the process may be seen to underwrite much broader urban debates, ones which drew equally on discourses of efficiency, circulation and sanitization in their attempts to render our cities more efficient and pleasant. This is not the place to chastise such optimistic endeavours, rather it is to point to the operation of regulation and segregation implicit in such manoeuvres, seeking to create an architecture of separation, sanitation and control which, however, can never ultimately hope fully to contain all the processes of everyday life and death. Even if medical knowledge and modernist architecture can constantly evolve, so also do viruses and disease. Illness remains as prevalent as ever, ever testing both the medical profession's curative skills and the modern hospital's ability to adapt in response. Modern architecture has sought to cope with such problems, to offer understanding and solutions whilst constantly threatened with change. But the apparent futility of such a constant heroic struggle suggests an alternative view, proposing modernist hospital architecture as one of denial, obsessively seeking to defeat the challenges thrown at it through the valiant declamation of its own efficiency and ability to cope, all vouchsafed by its supposedly scientific validity.

ACKNOWLEDGEMENTS

I should like in particular to acknowledge the assistance of the late William Tatton Brown and staff at Greenwich District Hospital, Kingston Hospital and Walton Hospital in the production of this article. Thanks are also due to Professor Christopher Green at the Courtauld Institute of Art under whose supervision the research for the article was undertaken.

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NOTES

1 Lewis Mumford, *The City in History: Its Origins, Its Transformations, And Its Prospects* (London, 1961), p. 474.
2 Peter Stone, 'Hospitals: The Heroic Years', *Architects' Journal* (15 December 1976), pp. 1121–48.
3 The other project being Northwick Park Hospital (1960–74) in north London, by John Weeks (of Llewelyn-Davies Weeks). Northwick Park addressed the same questions of flexibility and change as Greenwich but did so in a radically different manner, proposing 'indeterminate' buildings which paralleled (in a less fantastic manner) the work of Archigram.
4 Siegfried Giedion, *A Decade of New Architecture* (Zurich, 1951), p. 183.
5 Gordon Friesen, 'Mechanization and Hospital Design', *Architectural Design* (January 1961), pp. 7–9.
6 Fits and spasms being the obvious exceptions.
7 Richard Crossman, Secretary of State for Social Services, inaugurating Greenwich District Hospital, 24 October 1969. Quoted in M. Sharman, 'Greenwich District Hospital: £6,000,000-Worth of Just What the Doctor Ordered?', *Building Design* (December 1969), pp. 13–23.
8 Sharman, 'Greenwich'.
9 Four courtyards were originally envisaged but only three built.
10 Anthony Noakes, 'Greenwich District Hospital: A Personal Assessment', *Health Service Estate*, 41 (March 1979), pp. 11–20.
11 'District Hospital', *Architects' Journal* (26 November 1969), pp. 1369–80.
12 'Manplan 6: Health & Welfare', *Architectural Review* (May 1970), pp. 337–40.
13 Julian Watson, 'A Brief History of the Hospitals', in Greenwich and District Hospital Management Committee, *1973 Annual Report* (London, 1973), pp. 14–25.
14 See for example: 'Hospital Experiment', *Economist* (23 May 1964), p. 843; 'Experiment at Greenwich', *Architects' Journal* (27 May 1964), p. 1170. The *Architects' Journal* boldly noted elsewhere: '[Greenwich] may turn out to be both aesthetically and technically the most important architectural contribution yet made by any Ministry research and development group'; see 'Greenwich District General Hospital', *Architects' Journal* (3 June 1964), pp. 1263–68.
15 Ministry of Health: National Health Service, *A Hospital Plan for England & Wales* (London, 1962). See also the subsequent revisions in 1963, 1964 and, most importantly, 1966.
16 It was thought that reduced cross-infection of patients (due to the air-conditioning) would offset this. See Alan Diprose, 'Greenwich DGH: Conference and Progress Report', *Architects' Journal* (11 January 1967), pp. 61–62. Dr J. S. Fairley (Senior Admin. Medical Officer, SEMRHB) confidently stated that 'the great fund of knowledge gained from the project has already made any extra running costs worthwhile.'
17 Sharman, 'Greenwich'.
18 'The Work of the Research & Development Groups, IV: The Ministry of Health', *Official Architecture & Planning* (February 1963), pp. 145–46.
19 Nuffield Provincial Hospitals Trust, *Studies in the Function & Design of Hospitals* (London, 1955). The Trust sponsored pioneering research into hospital design after the War in the absence of State-funded research. Its departmental studies were widely influential, but drew short of analyzing the whole hospital.
20 The approach sought to assign building costs to departments via their dimensioning in 'functional units', i.e. measuring the capital cost of a central kitchen in terms of the number of meals produced, or a ward in terms of its bed complement.
21 Ministry of Health, *The District General Hospital (Hospital Building Note 3)* (London, 1961).
22 For Powell's career see Patrick Cosgrave, *The Lives of Enoch Powell* (London, 1989). See especially pp. 170–75 on his period as Minister of Health.
23 The expenditure on *new* buildings in 1961–63 was greater than that of the previous thirteen years. See Herbert J. Cruickshank, *Planning, Design & Construction of Hospital Buildings for the National Health Service*

(London, 1973), p. 9. The *Hospital Plan* was itself subsequently revealed to be funded by increasing prescription charges to recoup £65m per annum.

24 Ministry of Health: National Health Service, *A Hospital Plan for England & Wales* (London, 1962). See also the subsequent revisions in 1963, 1964 and, most importantly, 1966.

25 William and Aileen Tatton Brown, 'Three-Dimensional Town Planning', *Architectural Review* (September 1941), pp. 81–88, and (January 1942), pp. 17–20. Also correspondence with the author, January 1995.

26 Tatton Brown has attributed the thinking behind the plan to H. de C. Hastings — editor of the *Architectural Review* (correspondence with the author, March 1995). The plan was part of Hastings' and the Tatton Browns' 'theory of contacts' (pre-dating the Smithsons' insistence on 'association', outlined at the 1937 CIAM conference (see: 'Communication du Groupe Anglais', in Congrès Internationaux d'Architecture Moderne, *Logis et Loisirs: 5e Congrès CIAM Paris 1937* (Boulogne-sur-Seine, 1938), pp. 79–80). The plan is illustrated in: Modern Architectural Research Group, *New Architecture* (London, 1938), p. 12. The plan was reworked into its spine-and-branch form by Arthur Korn *et al.*, 1938–42.

27 Aileen Tatton Brown, 'Fifty Years Hence' in *Britain and the Beast*, ed. Clough Williams Ellis (London, 1937), pp. 298–308.

28 Clough Williams-Ellis, *Britain and the Beast* (London, 1937), p. xviii.

29 'Chief Architect With A Purpose', *Hospital & Health Management* (February 1961), pp. 51–56. This may be compared with Churchill's 1944 description of post-War housing construction: 'I hope we may make up to half a million of these [prefabs]. The whole business is to be treated as a military evolution . . . As much thought has been and will be put into this plan as was put into the invasion of Africa' (quoted in Anthony Jackson, *The Politics of Architecture: A History of Modern Architecture in Britain* (London, 1970), p. 164).

30 For an early exposition see Guy Oddie, 'The New English Humanism: Prefabrication in Its Social Context', *Architectural Review* (September 1963), pp. 180–82. See also Andrew Saint, *Towards a Social Architecture: The Role of School-Building in Post-War England* (London, 1987).

31 Ministry of Health job architect: Michael Bench, in association with Liverpool RHB architect T. Noel Mitchell.

32 Ministry of Health job architect John Ward, in association with South West Metropolitan RHB architect Richard Mellor.

33 For the history of the vierendeel see David Wickersheimer, 'The Vierendeel', *Architectural History (U.S.A.)* (March 1976), pp. 54–60.

34 On a 1961 research trip to the US, the Ministry architect John Green had noticed that structurally sound buildings were being demolished since they could no longer accommodate changing servicing requirements. The American solution was to use long-span reinforced concrete slab floors and columns (like Le Corbusier's *Dom-Ino*) with few permanent internal load-bearing walls (See J. F. Eden and John Green, 'The Integration of Building & Engineering Design in Hospital Building: A Review of American Practice', *RIBA Journal* (July 1963), pp. 273–76).

35 Illustrated in Ministry of Health, *A Traffic and Organization Survey for Hospital Redevelopment: Description of a Pilot Survey* (London, 1964). See also W. A. H. Holroyd, *Hospital Traffic & Supply Problems* (London, 1968).

36 Its goals being 'economy, flexibility, reliability, security and stability'. See Howard Goodman, 'Greenwich District Hospital: An Exercise in Logistics', *Hospital Management, Planning & Equipment* (October 1966), pp. 574–77.

37 'Problems and Solutions — Greenwich — II', *British Hospital Journal & Social Science Review* (30 May 1969), p. 1029.

38 Sharman, 'Greenwich'.

39 A similar plan had been used at Bellevue Hospital, New York, again with an emphasis on large unimpeded floor areas.

40 'Ministry Experiment With an Original Design at the New Greenwich District Hospital', *British Hospital & Social Service Journal* (19 June 1964), pp. 856–58.

41 On linear cities see, for example, George R. Collins, 'The Linear City', *Architects' Year Book*, 11 (1965), pp. 204–17.

42 For a discussion see, David Starkie, *The Motorway Age: Road and Traffic Policies in Post-War Britain* (London, 1982).

43 Ministry of Transport: Traffic Signs Committee, *Report of the Traffic Signs Committee* (London, 1963), para. 13.

44 Ministry of Transport, *Traffic in Towns: A Study of the Long-Term Problems of Traffic in Urban Areas* (London, 1963).
45 For a discussion of Buchanan's career, see Michael Bruton, 'Colin Buchanan, 1907- ', in *Pioneers of British Planning*, ed. G. E. Cherry (London, 1981), pp. 203–23. Buchanan's interest in the car and the modern city had already surfaced in his 1958 work *Mixed Blessing* (London, 1958).
46 London County Council, *The Planning of a New Town* (London, 1961). The Smithsons' Haupstadt Plan (*c.* 1958) had already proposed a multi-level circulation system.
47 Ministry of Transport, *Traffic in Towns*, p. 41.
48 John Weeks, 'Indeterminate Hospital Design on Urban Sites', *Hospital Management Planning & Equipment* (December 1964), pp. 507–16.
49 Arthur Ling, *Runcorn New Town: Master Plan* (Runcorn, 1967).
50 Designed by Runcorn Development Corporation (Roger Harrison) *c.* 1967–72. See 'Runcorn Main Shopping Centre', *Architects' Journal* (21 June 1972), pp. 1377–92.
51 Ling's theory did not rule out the possibility of interspersing discrete residential and industrial areas along the local traffic spine; nonetheless at Runcorn these areas were rigidly segregated on either side of the 'expressway'.
52 Herbert Spencer, 'Mile-a-minute Typography?', *Typographica*, 4 (December 1961), pp. 3–16.
53 David Wainwright, 'Boss of Britain's Airports', *Design* (January 1967), pp. 32–33.
54 Gillian Naylor, 'Signs of the Times', *Design* (December 1966), pp. 48–51.
55 'Lettering on Traffic Signs', *Design* (July 1957), p. 54; and, 'Experimental Road Signs Reprieved', *Design* (September 1957), p. 51.
56 See Ministry of Transport: Advisory Committee on Traffic Signs for Motorways, *Motorway Signs: Final Report of the Advisor Committee* (London, 1962).
57 See Ministry of Transport: Traffic Signs Committee, *Report of the Traffic Signs Committee* (London, 1963), para. 25. For an overview see Anthony Froshaug, 'Roadside Traffic Signs', *Design* (October 1963), pp. 37–50; also, 'Designing a System for Britain's Road Signs', *Design* (May 1967), pp. 69–71. See also J. M. Richards, 'Traffic Signs', *Architectural Review* (August 1963), pp. 82–85.
58 Architects: Richard Mellor, Architect to the South West Metropolitan RHB in association with R. A. H. Ruth and A. Gear.
59 Correspondence from Margaret Calvert, February 1994. Jock Kinneir was unwilling to discuss the signing project.
60 'Introduction', in British Airports Authority, *British Airports Authority Sign Manual* (London, 1972), n.p. (The *Manual* was devised by Kinneir Calvert Tuhill.) The approach was typical of the post-War Modernist 'Swiss typography'; as one typographer put it, 'exacting artistic postulates or creations are no longer involved; the endeavour is simply to find a formally and functionally satisfactory answer to daily requirements.' See Emil Ruder, 'The Typography of Order', *Graphis*, 15 (September/October 1959), pp. 404–13.
61 'Townscape: The Perfect Symbol', *Architectural Review* (August 1952), pp. 127–29. See also, Edward Wright, 'The Arrow in the Road', *Typographica* (old series), 13 (1957), pp. 18–21.
62 Cedric Price, 'Graphics: Where Next?', *Design* (August 1964), pp. 28–31.
63 James Mosley, 'The Nymph and the Grot: The Revival of the Sanserif Letter', *Typographica*, 12 (December 1965), pp. 2–19.
64 Hilary Saunders, *The Middlesex Hospital: 1745–1948* (London, 1949), title to chapter 6.