1 March 2004

Professor Bruce Archer CBE
15 Church Vale
London
N2 9PB

Dear Bruce

Thank you so much a) for your kind letter and b) for taking the trouble to write your account of the early days of research in the College. Both were exceptionally good of you, given the current state of your health. You have been marvellously loyal to the College – through thick and thin – and I cannot tell you how much that means to me.

I do hope we meet soon.

With very best wishes

[Signature]

Professor Sir Christopher Frayling
Rector
Autobiography of research at the Royal College of Art 1961-1986

This is an account of the development of research at the Royal College of Art during the 1960's and 70's. It is a personal account, rather than a scholarly historical study. It is also a condensed account, since only a few projects are described in detail.

The story begins in 1961. So far as I can tell, there had been little or no serious research at the Royal College of Art before 1961, other than in art history. The College's Department of General Studies housed postgraduate studies in the history of art, but design history and cultural history had yet to be invented. If industrial design and graphic design history and criticism were handled at all, they were conducted on the same terms as art history and criticism.

In 1961, Professor Misha (later Sir Misha) Black had recently been appointed head of the School of Industrial Design. He promptly renamed it The Department of Industrial Design (Engineering). At the same time, I was teaching design methods at the Hochschule für Gestaltung at Ulm, West Germany. To my surprise, I was invited by Misha Black to join the College to lead a research project he had created under the title Studies in the function and design of non-surgical hospital equipment, to be funded by the Nuffield Foundation. I don't know how he had heard of me. Perhaps it was because of the series of articles I had written for Design magazine, critically appraising various design products. I had also published papers on systematic methods for designers. I readily accepted his invitation, handed in my resignation at HfG and returned to England in the summer of 1962.

I quickly found out that Studies in the function and design of non-surgical hospital equipment was a successor to a big exercise recently conducted by the architects Llewellyn-Davies and Weeks for the same sponsor under the title Studies in the function and design of hospitals. The Llewellyn-Davies and Weeks team had conducted an extensive literature search and a limited number of live case studies, and on these bases had set out principles for the design of large hospitals. These principles were later to have a profound effect on the hospital building programme of the 1960's and 1970's. I had also learned from Llewellyn-Davies and Weeks that in order to be able to generalise from such a mixed bag of evidence, the literature search and case studies had to be conducted within some orderly framework.

In view of these precedents, I agreed with Misha Black that the object of Studies in the function and design of non-surgical hospital equipment was The development of an organised body of knowledge that will assist manufacturers to design and hospital planners to select fixed and moveable equipment.

The first step was to design a system for developing an organised body of knowledge. The second was to begin the literature search. I asked for a temporary office, temporary furniture and temporary assistance, so as not to prejudice the installation of the system for research once it had been designed. In those days, the School of Industrial Design was housed in rather makeshift accommodation in the Western Galleries of the Science Museum. I was allocated a spare room adjacent to the aeronautical collection of the museum, a rather remote part of Western Galleries. It was a weird place. It had a modest floor area, but was immensely high. It must have been thirty
feet or more from floor to ceiling. In one corner of the room there was a Victorian iron spiral staircase, corkscrewing upwards several turns to disappear through a trapdoor in the ceiling. Climbing the staircase, one found oneself in a tiny domed room from which there was no other exit. One could imagine the Sleeping Beauty up there, spinning. I suspect the room below had once housed one of those very long pendulums that demonstrate precession due to the earth's rotation. The room was completely bare: unfurnished and without cupboards or shelves. I ordered a few plain tables and chairs, and lots of boxfiles with which to "design a system for developing an organised body of knowledge". And I borrowed a typewriter (this was before the days of wordprocessors). I brought over from Ulm one of my star students, Reinhart Butter, to act as a temporary Research Assistant. I hired a secretary, Gillian Patterson, who ultimately became a Senior Research Fellow and served as Information Research Officer for virtually all the projects subsequently conducted in what later became the Department of Design Research. The three of us set about designing data systems and modelling prospective research and design programmes. Reinhart Butter and I spent a lot of time in the libraries of the Ministry of Health and King Edward's Hospital Fund for London, trying to find out what were the problems of specifying, designing and selecting hospital equipment. In so doing, we met a highly respected senior nurse, Doreen Norton, who had moved over to research through her interest in geriatric nursing, and I took her on, on a consultancy basis, as nursing adviser.

Llewellyn-Davies and Weeks, in their research into principles to guide hospital building design, had selected a number of proposed hospital building projects for the development of "concept designs" to underpin their findings and to test their practicability. We decided to do the same. We identified four candidate problems:

The first of these "concept design" problems was the design of a soiled dressings receiver for use in operating theatres. This would almost certainly turn out to be a simple sculptural product design, a typical "art school" design, and although it might not qualify as 'non-surgical', we thought it would serve as a pilot exercise.

Second, we selected the problem of the mal-distribution of medicines in hospital wards. It had been reported, to the scandalised reaction of the newspapers, that the ordinary patient in a hospital ward, typically receiving medicines three times a day, would get the wrong medicine at least once every other day. This was self-evidently a systems problem, to which I hoped we would be able to devise an equipment solution.

Third, the Ministry of Health brought to our attention the problem of hospital beds. The Public Account Committee of Parliament had complained that there were over three hundred bed types in use in the hospitals of England and Wales, all made in petty numbers by a rag-tag-and-bobtail supply industry. There should be, according to the Public Accounts Committee, a standard design or designs "suitable for use in the ordinary wards of General Hospitals" manufactured in more economic numbers. It happened that the Royal College of Nursing had, at more or less the same time, published a report on the high incidence of permanent back injury among nurses, due to the poor design of the hospital beds then in use, and they, too, through Doreen Norton, brought this to our urgent attention.
Fourth, the Ministry of Health and the Ministry of Public Building and Works drew our attention to the widespread abuse of fire and smoke control doors in public buildings. Hospitals were particularly guilty, smoke control doors being regularly tied or propped open. Could we find an equipment solution to this abuse?

The identification of these, together with our outline for the development of a body of knowledge, formed the basis of our first year's report to Nuffield.

The committee at the Nuffield Foundation hated it. They thought it totally inappropriate. They had expected a series of beautifully presented designs for funny-looking cutlery for patients use lying in bed, and possibly ingenious devices to hold up patients' reading books, and other such stuff. That was 'what art schools did'. They refused to fund our second year. They told us to go away and never darken their doors again.

I was absolutely stunned. So was Misha Black. There was nothing in the Nuffield briefing that had suggested that that was what they had expected. But they were adamant, and the RCA team was fired. I later suspected that the eminent physicians and surgeons who sat on the Nuffield committee were perhaps incensed by our having apparently thrown in our lot with the centralising tendency of the Ministry of Health. There was a lot of resistance on the part of the hospital management committees of the day to the creation of a truly national National Health Service. For my part, I was not prepared to give up. I took a job at the Eldorado ice cream factory in Southwark, humping ice cream from their cold store into refrigerated vans every night, so that I could continue to work for nothing at the RCA during the day. Reinhart Butter got a grant from Germany and stayed on as a student in Misha Black's department. Doreen Norton was freelancing, anyway, and committed to the improvement of hospital practices, and wanted to carry on. Gillian Patterson had independent means. So we were able to continue working, unpaid. In the meanwhile, Misha Black had found a small project for one of his star graduates, Kenneth Agnew, and now assigned him officially to our unofficial team. The new exercise was sponsored by a surgeon at The Great Ormond Street Hospital for Sick Children. Its purpose was to explore the possibility of suspending beds and equipment from the ceiling in the children's intensive care ward, or cantilevering the beds from the walls, so that a completely unobstructed floor surface could be machine-washed daily. It was an impracticable proposition, as Kenneth Agnew soon found out, but surprisingly this exercise kept him at least partially employed for four years, on and off. In the meanwhile, Kenneth Agnew started work on our first concept design. Soiled dressings receivers were simply stainless steel basins into which soiled dressings could be thrown in operating theatres and treatment rooms. Their redesign was a straight-forward form-giving job that even Nuffield would have been happy with. To fund this project, a hospital equipment supply company, Allen and Hanbury Ltd, agreed to pay for some prototypes for their catalogue. I cannot say that the conduct of this exercise contributed much to our proposed "body of knowledge calculated to assist manufacturers to design and hospital planners to select fixed and moveable equipment", but it did mean that we had a full team to pursue "studies in the function and design of non-surgical hospital equipment". But we had to change our name. We were re-christened Industrial Design (Engineering) Research Unit.

Our second concept design was a different matter. Whilst Kenneth Agnew got on with the design of the soiled dressings receiver and the problem of suspended beds, Doreen Norton, Gillian
Patterson and I took a close look at the problem of errors in the distribution of medicines in hospital wards. We applied conventional industrial work study methods of observation and recording. On Doreen Norton's advice, and with the assistance of King Edward's Hospital Fund for London, we selected appropriate hospital wards and observed the distribution of medicines in them over a period of time. It quickly became apparent why medication errors occurred. Standard practice at the time was for all scheduled medicines to be kept in locked cupboards in ward sisters' offices. In preparation for a ward medicine round, three or four times a day, two nurses would unlock the cupboard and load stock-bottles of potions and pills on to a plain glass topped trolley. The trolley would then be wheeled round from bed to bed, the treatment card at each bed would be inspected in turn, and medicines dispensed as appropriate. If the patient was absent from the bedspace at the time, then one of two things would happen. Either the medicines would be left on the patient's locker, or the nurse would walk on by, ignoring the treatment card. Quite frequently, therefore, a patient would miss a treatment. Sometimes, if the ward round was interrupted by the nurse having to break away to do something else, when the medicines round was resumed it would not continue from the same point, and a patient might be dosed twice or not at all. Sometimes a patient would steal somebody else's medicine whilst the nurse wasn't looking. The repeated taking out and putting back of stock bottles led to occasional mishaps and sometimes to total losses. King Edward's Hospital Fund for London had already become involved with us, and in 1963 provided a two-year research grant to pursue a solution to the medication problem. I said goodbye to Eldorado, caught up on my sleep, and commenced a proper systems analysis of our observations of ward medicine rounds. It was not difficult to pinpoint the occasions for error. Our systems solution was, in effect, to put the whole medicine cupboard on wheels, and to padlock it to the wall of the ward sister's office when not in use. We built a few prototype designs. We advised that all the patients' treatment cards should be collected before a medicine round began, and stored in a pocket we had provided at one side of the cupboard. As the ward round proceeded and each treatment was dispensed, the card would be moved to another pocket on the other side of the cupboard, so that it would be clear who had, and who had not, had their medicines. If a patient was absent from his or her bedspace, the medicines, we argued, should NOT be left on the patient's locker. The presence of an "undispensed" card in the "to do" pocket when the ward round was complete, and when the mobile cupboard had been returned to the office, would be enough to remind the nurse in charge that there were missed doses to be dealt with later. We ruled that, if, in the course of a medicine round, the nurses had to abandon the trolley for a few moments, then the cupboard should be slammed shut, locked, and kept locked until they returned to it. More or less concurrently, hospital pharmacies had started adopting the practice of dispensing medicines in little bottles bearing the patients' names, rather than in big stock bottles. It was not at all difficult to persuade senior nurses of the merits of such a system, and in our prototype designs we fitted the cupboard, tilted backwards, with narrow shelves to house a large number of small bottles. Designing was a doddle. The greater difficulty was in persuading the powers-that-be that a cupboard on wheels, whilst it was padlocked to the wall in a ward sister's office was a fixed cupboard within the meaning of the Dangerous Drugs Act. It took a lot of lobbying, much sitting to attention in Permanent Secretaries' offices and periodic lunching of officials and Junior Ministers in the Senior Common Room. We also had to persuade senior administrators that irresponsible persons were unlikely to run off with an entire trolley if it were left unattended in a ward. We made sure that our concept design was ergonomically efficient, difficult to break into, and had a distinctive profile that could not be mistaken for anything else if it was seen being pushed along a hospital corridor. This all worked out well, and our prototypes were field tested in collaborating
hospitals. Our concept design was a success. Nevertheless, it was impossible to claim, after such limited trials, that the incidence of medication error was actually reduced. It was possible, however, to demonstrate that the opportunity for medication error was significantly reduced. Detailed designs for commercial versions were commissioned by Cox of Watford and by F Llewellyn and Co Ltd, and within eight years the wheeled medicine cupboard had become standard equipment throughout the National Health Service, and remains so to this day. At the level of establishing principles contributing to the "development of an organised body of knowledge which will assist manufacturers to design and hospital planners to select fixed and moveable equipment", we had at least established that work study, systems analysis and ergonomics were proper tools for the industrial designer's trade. We had also discovered that politicking was an essential element in applied research.

These lessons were crucial to our conduct of our third concept design, a standard National Health Service hospital bed. It turned out to be a very big exercise. A detailed account of the project has been prepared as a doctoral thesis by Ghislaine Lawrence of the Science Museum, and one of the original Mark I beds is stored at the museum. The following abbreviated account picks out some of the issues of particular interest.

Our main sponsor and collaborator for the bed project was the King Edward's Hospital Fund for London. This charity was founded by King Edward VII when he was Prince of Wales, in the days when hospitals were locally funded. It provided grants, financed research, organised training programmes and arranged conferences. Hospitals outside London were financed by other local and national foundations, including the Nuffield Provincial Hospitals Trust. With the coming of the centrally funded National Health Service, King Edward's Hospital Fund for London wanted to reposition itself. The qualification "for London" was dropped and the charity rechristened "The Kings Fund". The Trustees of The Kings Fund also wanted to conduct a major exercise that would promote their new name and role. They chose to tackle head-on the problem of the standardisation of the design of hospital beds. They formed a high-powered Working Party, comprising senior representatives of the Ministry of Health, the Kings Fund and all the relevant professions, plus a representative of the hospital equipment manufacturers' federation. The Working Party started to meet at regular intervals. In due course, having become aware of our success with the medication error problem, the Working Party invited me to come on board to represent the Royal College of Art.

At the first meeting I attended, it became clear that the Working Party had already come to some provisional conclusions. They had agreed that no hospital bed then on the market was appropriate for selection as a national standard. They had agreed that the proposed standard bed would need to be height adjustable. This was because existing fixed height beds were compromises. It transpired that all existing fixed height beds were too low for nurses. A study had revealed that virtually all nurses with two or more years' service were suffering from permanently injured backs, brought on by daily bedmaking and lifting of patients. At the same time, existing fixed height beds were too high for patients. All but the fittest or tallest patients had to be helped to climb on or off the bed, wasting nurse time and delaying the patients' return to mobility. So variable height was a necessity. The Working Party had agreed that a new standard bed should have the facility for foot-high tilt to ease resuscitation and postural drainage. They also agreed that the standard bed should have large lockable castors. One of the elements in the Llewellyn-Davies and Weeks
report had been the advocacy of bed mobility, in which the patient's bed would be wheeled to treatment areas with the patient still on the bed, rather than having to transfer patients to wheelchairs or trolleys and back again. In order to be able to cross lift thresholds, the wheels had to be bigger, and in order not to create static sparks whilst the bed was in vulnerable places, the whole bed had to be electrically continuous and trickle earthed. Under pressure from the Ministry of Health and the manufacturers' representative, the Working Party had agreed that the outcome of their study should be a performance specification rather than a design. Manufacturers could tender competitively with their own designs, rather than obliging them to contract to supply against a given single design, in deference to the fact that the early 1960's fell within a long period of successive Conservative governments, which were committed to the merits of free market competition. Beyond these five generalisations, however, the Working Party had become bogged down in detail in attempting to define other aspects of performance. In the face of this, they agreed to recommend that a contract be offered to the Royal College of Art to finish the job, reporting progress to the Working Party.

My initial advice was that it was absolutely essential to prepare a design to meet the performance specification, once agreed. First, in order to pre-empt manufacturers' possible objections, it was vital to demonstrate that it was indeed practicable to meet all the requirements of the specification. Second, in order to counter the inevitable scepticism of existing hospital establishments, it was essential to validate the findings through field trials in real working hospitals. Moreover, unless we could demonstrate convincingly that every statement in the performance specification was valid and necessary, we would be shot down in flames by antipathetic consultants, hospital administrators, the Press, the parliamentary Opposition and every sort of sceptic. Also, unvoiced, was my suspicion that there would be some elements of performance requirement that could only be determined by experiments with mockups and prototypes. The Working Party agreed that a double-headed programme - specification and design - should be funded.

Given this go-ahead, I set up two independent but intercommunicating teams: one under Gillian Patterson, to generate a specification of performance requirements, and one under Kenneth Agnew to develop a design meeting those requirements. The two teams then went ahead, bootstrapping propositions and mutually challenging each other's logic and findings. We included in the teams an ergonomist who was also a qualified medical doctor, a structural engineer who was also a materials scientist, a systems analyst who was also alive to the emerging world of computing, an industrial designer, a workshop technician and a secretary. Our sources of information included extensive literature searches, experiments conducted inhouse, and studies commissioned elsewhere. At about this time, Misha Black and the School of Industrial Design (Engineering) moved to the newly built Darwin Building. The Industrial Design (Engineering) Research Unit was allocated half a floor at the western end of the fourth floor, and we exploited this space, and our access to the workshops of both the School of Industrial Design (Engineering) and the Department of Furniture, to build mockups and experimental test devices. We had to find answers to questions such as:

How narrow can the mattress platform be, whilst still providing a comfortable sleeping space for a patient? How short a lying space will still be acceptable for the tall patient? What is the highest low height of the bed that will still allow a small patient to reach the floor with his or her feet? How low can the highest height be that will still allow a tall nurse to work at it without stooping? How big must the castors be in order to permit the bed to be wheeled safely across lift thresholds? How much force can a typical nurse apply to footpedal, lever or handwheel in raising and lowering
the bed (electrical operation was out of the question at that date)? What is the longest duration of time in adjusting the bed from the lowest height to the highest height that is acceptable to a working nurse? What materials of construction would stand up to hospital cleaning and sterilising procedures? And so on. We ended up with eighty-six statements, every one of which had to be justified on reliable evidence. With some mock-ups, it was possible to get relays of nurses to come in to mimic typical nursing procedures in order to determine their needs. The Wolfson School of Nursing devised new bedmaking and patient lifting procedures. Eventually, we were able to build on the fourth floor a complete mock-up bedspace, complete with the newly designed bed and typical curtains, locker and chair for the members of the Working Party to see and for The Kings Fund publicity people to photograph.

There was only one really disastrous element to the exercise. We had found no way of determining whether, in the framework of a mobile bed system, explosive anaesthetic gases would ever be used on patients in bed. This had important implications for bed materials and construction. Expert opinion amongst those we had consulted seemed hopelessly divided. We arranged for a questionnaire to be sent to virtually every hospital in England and Wales, to be answered by mixed teams of doctors, anaesthetists, nurses and technicians who would watch a television presentation giving the salient facts, and make their judgements. The BBC agreed to broadcast this, but chose to do so through the medium of the Panorama programme. In the event, on the very night of the proposed broadcast, a news story broke which seemed to show a rift opening up between the leaders of the Soviet Union. Panorama did not wish to be pipped at the post by the other channel, and savagely cut our piece so as to fit their news story in. Hardly any of our visual material was broadcast. The presentation was a mockery of what we had intended. The following morning we received sackfuls of mail from the hospitals concerned, and from members of the public who had seen the broadcast. The letters were insulting in the extreme. Who did we pip-squeaks think we were, wasting professional people's valuable time with such banal and amateurish rubbish? Some of the language was vile. We had guessed this was going to happen. Overnight the Kings Fund conscripted all the temps they could get their hands on, for us to write personalised letters to all the people in our intended audience, explaining what had happened. We begged our witnesses to send in their questionnaires, answered as best they could. Their and our bags of mail crossed in the post. To do the people in the hospitals credit, the great majority did, in the end, send us answers to our questions. The consensus was that explosive anaesthetic gases were going out of use, and would certainly never be used on patients in hospital beds. This greatly eased our materials and construction problems.

Of the field trials, I shall say very little, except that they were extensive and prolonged, as much for political as for scientific reasons. In the end, our specification was adopted by the Kings Fund and later became a British Standard. As an interesting aside, one of the largest hospital bed manufacturers, J Nesbit-Evans and Sons Ltd, commissioned the Royal College of Art to produce the Nesbit-Evans design answer to the Kings Fund specification. Kenneth Agnew and a team executed this design and it proved to be the biggest seller in succeeding years. Almost every bed in almost every ward in the hospitals of England and Wakes is now to our specification and/or design.

Of our fourth "concept design" problem, the abuse of smoke control doors in public buildings, there is little to say beyond the fact that we concluded that smoke control doors should be provided with
electro-magnetic holdbacks, wired into the fire alarm system, so that when a fired alarm was sounded, all smoke control doors would automatically swing shut. The approval of this also required a lot of political manoeuvring, but all hospitals, and many other public buildings are now equipped with such smoke control doors.

Thus the solutions to all four of our model problems offered to the Nuffield Foundation turned out to be technically and commercially successful, adopted on a national scale. The Kings Fund reaped most of the benefits. In the meanwhile, the Industrial Design (Engineering) Research Unit had begun to take on all sorts of other projects, including, for example, a long series for the Police Scientific Development Branch of the Home Office. We designed Command and Control Rooms for several of the largest police forces in the United Kingdom. These were comprehensive projects, comprising systems design, computer graphics, console design and interior design, but very little was said about them, because work for the police was considered to be sensitive in the College, and most of the work was done off-site. It was quite profitable, nevertheless.

At some point, in the middle of all this, Sir Robin Darwin called me into his office, and gruffly told me that I was to become a professor in my own right, independent from Sir Misha Black. The Department was to be called the Department of Design Research. I never got to the bottom of this sudden change of heart, although some of my staff believed that Misha had been caught creaming off the more profitable projects for his own company, which was called, incidentally, Design Research Unit, leaving the less profitable contracts for the College. Much later, I was told that the Department of Design Research was to become a teaching department like any other, and have its own capitation. By the time Jocelyn Stevens took over the Rectorship of the College, the Department of Design Research was running three types of course: individual Masters and PhD research programmes; short courses recognised by the Department of Education and Science for teachers and inspectors; and a rudimentary computing course. Jocelyn peremptorily shut all of this down on one week's notice, but the trauma of what happened next is another story altogether.

Suffice to say that The Department of Design Research conducted over two hundred externally funded projects in its twenty five years' history, every one of them contributing to College and Departmental overheads. A good beginning, and a contribution, I hope, to the growth of the College's present star-rated research performance.

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