Design as an interesting phenomenon: George Mallen and the Royal College of Art

This chapter traces the story of George Mallen's time at the RCA from 1971 to 1983, asking what Mallen brought to the Department of Design Research there, and how the RCA changed along with him. It connects his innovations to the intellectual concerns of the time including cybernetics and systems thinking, to which Mallen brought his own unique contributions. Unlike most of the chapters in this volume, it prioritises design over other disciplines, reflecting not only the primary job that Mallen was employed to do at the RCA, but also his conviction that design presents special properties as a human – and perhaps machine – activity.

What was the institution that Mallen joined, and what did he bring to it? By the time Mallen arrived in the RCA, the Department of Design Research (DDR) had existed in some form for a decade, starting in 1961 with a project involving Bruce Archer (1922-2005), and known at the time Mallen joined it as the Industrial Design (Engineering) Research Unit: ID(E)RU. Archer was leading the Unit when Mallen arrived; the two men were mutual influences throughout his time there. Archer had been invited to the RCA by Misha Black (1910-1977), while Black himself had been appointed the first Professor of Industrial Design (Engineering) at the RCA in 1959 and was a major public figure in design.[1,2,3] The way that Black and Archer approached design shaped the DDR and created the context for Mallen's contribution. Black was deeply interested in the kinds of knowledge, and interdisciplinarity, required for innovation.[4,5] The work that Black had asked Archer to do was concerned with the design of medical equipment, but Archer's initial research focused on information-seeking methods and the rigorous, stepwise breakdown of every topic.[6] Archer would always remain as interested in method, and in forms of knowledge, as he was in designing *per se*.[7] A significant theoretical contribution by Archer was his series of seven articles for Design magazine in 1963/64 entitled 'Systematic method for designers', reissued by popular demand as an offprint.[8,9] Mallen and his close colleague Pierre Goumain later seem to refer rather unenthusiastically to such 'checklist' approaches,[10,11] and Mallen would say of Archer: 'his business was design methods and that was it… I was interested in it beyond that… I wanted to get the broader implications of what Bruce was doing and develop ideas from that.'[12]

Two individuals were crucial in bringing Mallen to the RCA. Patrick Purcell (1929-2007) had joined the ID(E)RU in 1965.[13] From 1965 to 1968 he was Research Fellow, investigating the uses of steel in industrialised building systems; from 1968 he developed a graphics program and other computer aids for architects; from 1971 to 1975, he was lead investigator on the study of 'Design Activity in a Working Environment.' All this research was externally sponsored, the last being supported by the Science Research Council, predecessor of the current EPSRC, which leads to the other influential figure: John Lansdown (1929-1999) was an architect who had been championing the potential of Operational Research, mathematics, and later on computing, in architecture from 1960.[14] He would become a key figure in computing in art, design, music and choreography, writing regularly on these subjects for the Computer Bulletin of the British Computer Society from 1974 to 1992.[15] In 1988 he became Professor, and later Dean, at Middlesex University (then Polytechnic). In the late 1960s, Lansdown was the chair of the civil engineering subcommittee of the Science Research Council[16] and as such in a position to encourage the kind of work Purcell was

doing. Mallen and Lansdown were involved together in the founding of the Computer Arts Society (CAS) in 1968, in the seminal exhibition *Cybernetic Serendipity*, 2 August to 20 October of the same year, and in CAS's inaugural *Event One* at the RCA, 29-30 March 1969. Lansdown could continue to be a benevolent presence in the SRC during Mallen's time at the RCA, and would briefly end up taking on a role similar to Mallen's at the RCA when Mallen left in 1983. Throughout his time at the RCA, Mallen continued to work with System Simulation Ltd, which he had founded with Mike Elstob in 1970: Lansdown would join the firm in 1977,[17] as did others from the RCA, notably Mike Stapleton, and, for a much shorter time, Brian Wyvill. Lansdown was influential at the SRC in supporting Purcell's research. Later, Purcell would work with Nicholas Negroponte at Massachusetts Institute of Technology's Media Lab, at University of Ulster, and finally Imperial College.[18] Mallen recalls Purcell's assistance with the 1969 *Event One*, in particular his persuading Professor Bill Elliot of Imperial College to loan a DEC PDP7 computer.[19]

Through these multiple connections, Mallen was invited by Purcell to join the RCA as a Research Fellow. But who was Mallen at this time? What did he have that was of value to the ID(E)RU? Having graduated in physics in 1962,[20] Mallen had been introduced to computing in the Mathematical Services department of the Royal Aircraft Establishment, Farnborough, Hampshire, including working on the Ferranti Mercury computer simulating air-traffic control.[21] He recalls that while there, he came across Frank George's book 'The Brain as a Computer':[22] 'I felt there was something very important going on here...which is why I then wrote to Richard Goodman at Brighton and asked, do you know anyone working in this field? He put me in touch with Stafford Beer and Gordon Pask and so on ... it very much felt that there was a revolution happening, and it was going to happen around computing and it was going to be an excitement to be involved...[23]

Richard Goodman, Mallen's tutor, had put Brighton on the computer map with his courses of lectures: Atlas Laboratory staff used to make the difficult journey from Oxfordshire to attend them.[24] In directing Mallen towards Pask, Goodman added new dimensions to Mallen's world that would enhance his contribution at the RCA, and remain important to him. At the end of his time there, Mallen named only Pask in his short introduction to the 1982 RCA conference on Design Policy, describing him as 'a seminal force in cybernetic thinking'.[25] Gordon Pask (1928-1996) had been excited by the multidisciplinarity and novelty of Norbert Wiener's *Cybernetics* while at Cambridge[26] (the book had the same effect on Frank George[27]). Pask's work exemplified interdisciplinarity.[28] Sponsored by governments and industries on both sides of the Atlantic, his research spanned biological computing, artificial intelligence, cognitive science, logic, linguistics, psychology, and artificial life.[29] Mallen's work for Pask, the basis also of his PhD 'A simulation approach to the study of organisational decision processes in the context of crime investigation' at Brighton University (then Brighton College of Technology), involved modelling criminal behaviours within communities,[30] and using simulations of information flow and decision-making in organisations.[31] Mallen recalls eight or nine people working in Pask's System Research Ltd on a range of things, from Mallen's scientific approach through to Pask himself exploring interactive theatre with Joan Littlewood. Mallen started to develop simulation models of Pask's learning theories, which contributed to the development of Pask's Conversation Theory.[32] This important theory was based on circularly-causal, interactive, feedback-based epistemological processes. In its light, the act of designing could be seen as an embodied

conversation between designers, the subject matter and the object to be designed.[33] Ironically, while Mallen was modelling for Pask criminals and policing, Pask was theorising about architecture, the very thing Mallen would investigate first at the RCA. In 1969, two years before Mallen's move to the RCA, Pask, in claiming the 'explanatory power' of cybernetic theory, suggested it could 'mimic certain aspects of architectural design by artificial intelligence computer program.' This would require that 'the program is able to learn about and from architects, including 'experimenting in the language of architects, i.e. by exploring plans, material specifications, condensed versions of clients' comments, etc.'[34] Mallen's work at the RCA would instantiate and extend multiple aspects of Pask's thought: the modelling of architects' (and other designers') behaviours, the inclusion of multiple types of documents and artefacts as significant entities in relation to people and processes, the use of modelling both for simulation and as externalisation to enable understanding, and the emphasis on human-machine interaction as a kind of conversation between mutually active agents. Pask had participated in *Cybernetic Serendipity* in 1968, exhibiting *Colloquy of Mobiles*, whose parts interacted both with the exhibition visitors and each other, modifying their behaviour as they did so. Mallen recalled that, while its electronics were developed by Mark Dowson and Tony Watts, he himself 'had a very, very minor role helping with wiring up and things like that when it was being built.'[35] His role also included getting the system to the ICA and helping with the installation.[36] In another account, this was 'trying to hang it properly so that it could at least pretend to work.'[37] In 1991 Pask gave a talk for the BCS Cybernetics Machine Group despite being 'extremely ill.'[38] He died in March 1996 at only 67.

Mallen recalls another early influence: Jay Forrester's System Dynamics,[39] which Mallen used for Ecogame, CAS's 1970 contribution to *Computer 70* at Olympia [cross ref this volume]. This in turn influenced Stafford Beer, whom Mallen had also found inspirational,[40] in his work for the Allende government of Chile.[41]

RCA computing before Mallen

The ID(E)RU, later Department of Design Research, was no stranger to computing when Mallen arrived. Back in 1965, the unit had begun field trials of the Kings Fund Hospital Bed, its most famous practical design research outcome, at a hospital in north London. The team stressed at every opportunity that the most powerful computer in the country was being used to handle the quantities of information generated by the investigation,[42] no fewer than 'one and three quarter million separate pieces of information.'[43] The computer used was the University of Manchester's Atlas, in use from 1962 until 1971 and considered to be the most powerful computer in the world when launched.[44] Access to Atlas was by shipping punched cards to Manchester. Purcell wrote that 'as a formal research effort in the Department of Design Research, computer aided design began in 1967.'[45] Also in 1967, Robert Aish asked Bruce Archer for ideas for his final year Master's project, and Archer recommended that he look at the 'new field of computer aided design.'[46] Aish went on to be a software developer and design researcher in architecture, later professor of Design Computation at the Bartlett School of Architecture. That same year also, Ken Baynes, a pioneer of design research and design education working with Peter Green at Hornsey College of Art in the late 1960s and with Archer at the RCA, where he headed the Design Education Unit spawned by the DDR in the 1970s, was remarking that 'Computers are now being used on a vast scale as an extension of man's capacity to think and calculate' and

'thought and its development are becoming completely bound up with devices external to man himself.'[47] This was a distinctive concept of the period – the computer as mental prosthesis – that would also influence Mallen. In the ID(E)RU, Purcell had been employed from 1965 to apply computing to research questions. In 1968 Purcell wrote an article for *Design* magazine, echoing the then current *Cybernetic Serendipity* with his own 'Cybernetic Opportunity' in which he set out how 'a great many products – from ships to computers, machine tools to motor cars – can be designed with the help of computer analysis, and for industrial designers, the screens and light pens which enable an overall concept to be examined from every viewpoint, redrawn and examined again is an invaluable tool.'[48]

Mallen joined a Unit engaged in a range of activities within sub-groups. Kenneth Agnew, Tim Coward and Douglas Tomkin focused on the design of products. Richard Langdon specialised in Design Management and would later be pivotal in the creation of the Design Education Unit. John Wood carried out important observational research that fed into the analysis of design processes. A central figure was Gillian Patterson, for a long time the only notable woman in the male-dominated ID(E)RU, who advanced from a secretarial role to Information Research Officer in 1965 and Research Fellow in 1967. Mallen later said that 'the key figures in my world at the RCA were Patrick Purcell and Gillian Patterson'[49], the latter no doubt because of her information finding and handling expertise. In an article in *Design* in 1973 she was referred to as the 'data analyst' on a Science Research Council project in the DDR.[50] She became an expert on user-specifications.[51]

The first big project

Despite the history of computing in the Unit, Mallen later described himself as 'coming in with these crazy ideas about computers and modelling design behaviours.'[52] There is a substantial set of reports on one of the earliest projects he was involved in, which gives a clear idea of the ideas and enthusiasms current at the time: in the first of them, Report 108.1,[53] Stansall reports on the extraction of insights from the Unit's *Computer Aided Architectural Design* research project (COMDAC), sponsored by the National Research Development Corporation, feeding into the *Architectural Design Analysis Project* sponsored by the Science Research Council. Mallen had not been on the team for the former, but he was for the latter. His role was significant, as indicated for example by inclusion in the report's references of three RCA working papers by him, two dated 1971 and the other 1972, concerned with methodology and techniques of measurement. The lead author of Report 108.1 was Paul Stansall who, remarkably, seems to have undertaken this as part of his MA. The Investigator was Patrick Purcell, while other members of the team included John Wood as team leader and Pierre Goumain. Goumain was recruited after Mallen. He would work closely with him throughout their time at the RCA, often co-authoring reports and publications. He had trained as an architect in Paris and London. Later in life he would be president of a Montreal-based research and practice company focusing on workplace environmental design and management, visiting scientist at the Canadian Workplace Automation Research Centre, and describe himself as having extensive experience in practice, research, consulting, and teaching in Europe and North America.[54] Mallen remarked of Goumain that he had 'a strong interest in the ideas, in the intellectual aspect of things.'[55]

COMDAC was the first computer aided architectural design project undertaken by the 'Design Systems Group' in the Department of Design Research at the RCA.[56] The word 'system' becomes a recurrent motif of Mallen's time at the College. For COMDAC, it had been considered essential to 'analyse architectural design activity' to begin with. This was done with the local authority organisations who were the intended users of the computer system to be designed. The aim of COMDAC was to develop computer programs that would enable an architect to design the window-walling of 'system-built schools' using computing that included graphics: that word 'system' again, this time in relation to the application domain. The systems in question were SCOLA and SEAC. These had grown out of CLASP which, starting in 1958, was a collaboration of UK local authority architects' departments aimed at tackling the rapidly increasing demand for new schools using modular 'system' methods.[57] The year 1970-71, when the RCA research was taking place, was actually the peak year for capital spending on such system schools, accounting for 41% of all English schools being built. System-building epitomised the period's belief in rationality, co-operation, industrialised techniques and social good. Such an approach had enjoyed a remarkable accolade when, in 1960, a Nottingham primary school designed and built in the CLASP system won the top prize at the prestigious XI Milan Triennale. By the late 1970s, the various consortium systems – CLASP, SCOLA, SEAC and others – would be regarded more critically. A disastrous fire in a CLASP old people's home in 1974, killing 18, was system-building's equivalent of the Ronan Point 1968 high-rise housing debacle, while increasingly questions were asked about the high ongoing maintenance costs of initially low-cost system buildings.[58] But in 1972, when Mallen worked on computational approaches to system building, these shadows were not yet cast. The window manufacturer involved had already computerised the handling of production control and costing. It was envisaged that information generated by the architect using the COMDAC system could be directly fed into the manufacturer's production control and costing system.

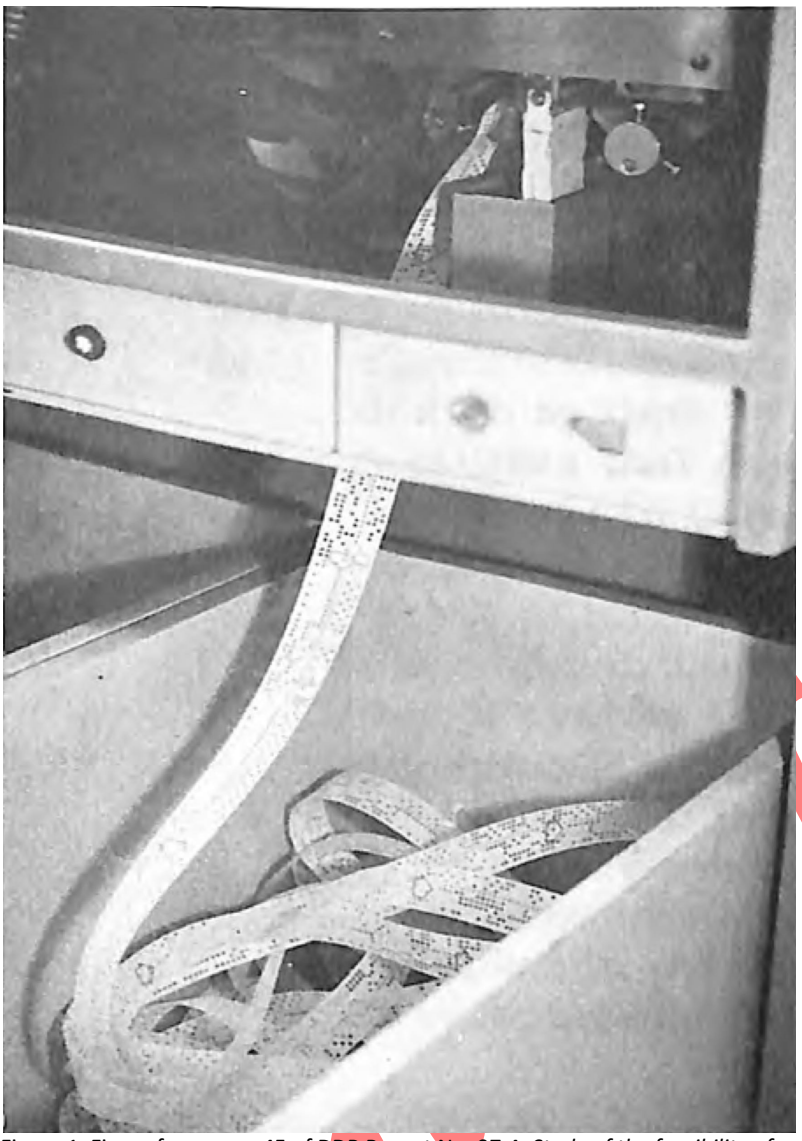
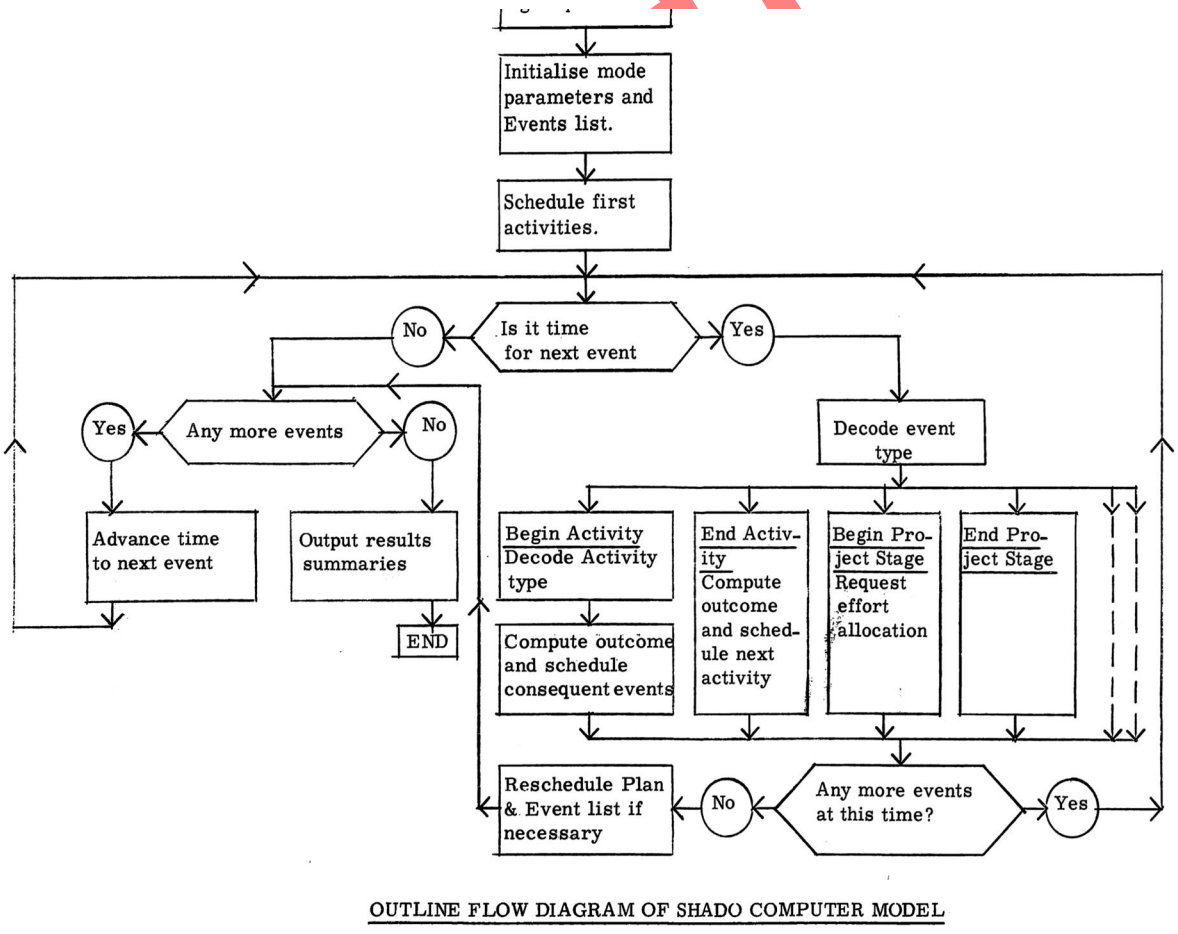


Figure 1. Figure from page 45 of DDR Report No. 97.4. *Study of the feasibility of a computer-aided architectural design system for a consortium of local authorities,* December 1970 (reissued October 1973). The original caption is *'3.f. a tape description of the building.'*

Using computing to configure modular window-walling for system-built architecture was obviously going to be easier than trying to create a general-purpose architectural design package, but the system was nevertheless ambitious: it would assist the architect by giving access to catalogued information; it would test the performance of any design by the use of an evaluation routine; and it would obviate the need for manual coding procedures by outputting descriptions on computer tape that could be directly used by the window manufacturer to drive the factory's machines (Figure *1*).[59] The idea of bringing computing to bear on the architect's active task in hand, giving live access to necessary data and to means of evaluating designs, would persist, long after this project, in the thinking of both Mallen and Lansdown.[60,61] Mallen sees the 1970 Ecogame [cross ref this volume] as essentially an *information environment*, and his contribution to the Conference on Design Policy at the RCA in July 1982, his last major involvement with the RCA, is entitled *Design for the Information Environment*.[62] Interestingly, Werner sees Pask as the originator of the information environment concept: Paskian environments were ones that could 'adapt,

change, understand and grow, and in which designer and user were linked in complex relationships.'[63]

While the COMDAC project had required 'building models of design activity,' the *Computer Analysis* project that Mallen came into needed to go further. This project would distinguish clearly between 'descriptive models,' capturing what actually happens during the architectural design process, and 'normative models,' specifying what a decision-maker 'should' do and therefore what decision 'should' be taken at each point. The report suggested that normative models 'can be arrived at by rational deduction and are essentially conceptual models', while 'descriptive models can only be formulated through empirical observation.'[64] It seems possible that this vivid distinction between theoretical and real-world models reflects a historic shift in Archer's thinking from the prescriptive checklists and flow charts of the 1965 *Systematic Method* to the complex realities of live projects like the hospital bed.[65] Mallen would always retain a strong sense of the messily real activities of designers and other users, and an intellectual curiosity to discover what these were. As will become apparent later, this commitment to understanding real users in real contexts would be a major point of difference from prescriptive theorists uninterested in what Pask had called 'the cussedness of organisms.'[66]



OUTLINE FLOW DIAGRAM OF SHADO COMPUTER MODEL

Figure 2. *Outline Flow Diagram of SHADO Computer Model* from Mallen and Goumain 1973: 2.14.

Elsewhere in the report, we learn how the architectural task can be broken down into sub-tasks, each of these being resolved in the service of the whole.[67] This reads as pure Bruce

Archer, whose default approach to any question or problem was its piecewise decomposition into sub-topics, as Lawrence had noted. Pask, by contrast, had no faith in such approaches: 'Nor is there any unique measure of growth, for it is the growth of an organism, and that upsets the assumption that an optimum condition can be achieved by some manipulation of sub-optima such as 'maximize turnover', 'maximize productivity' and others.'[68] Although when she later worked at the DDR Janet Daley would often disagree with Mallen, she too invoked the concept of 'system' in opposing the idea that something 'worked' simply because each of its parts was functional.[69] Piecewise decomposition however was obviously well-suited to implementation in computing, with its sub-routines each delivering whatever was necessary for the completion of the overall program.

The inquiry being reported in 108.1 is positioned as 'a scientific research project' with a 'need to state explicitly certain hypotheses about design activity.'[70] These hypotheses require exposure to 'empirical observation within the practice of design.' The nature of a possible science of design, a phrase often associated with Herbert Simon's *Sciences of the Artificial,*[71] was a key part of Archer's inquiry,[72] though what this concept meant to him, to Mallen and others is often not entirely clear, and changes over time.[73] Perhaps echoing Pask's integrative worldview, Report 108.1 rejects simplistic approaches: 'One cannot validate the usefulness or otherwise of a project by the exclusive use of a single criterion e.g., cost-benefit ratios, since what might be a resounding success to the accountant could prove disastrous to the environmentalist.'[74]

The Design Analysis project generated multiple reports. Although Goumain is the named author of Report 108.2 *The Analysis of data from field studies in architectural offices: a methodology*[75] it is essentially about Mallen's work. The Analysis project now draws not only on COMDAC, but also on METHOD, funded by a consortium of local authorities, and CEDAR, funded by the Department of the Environment and Property Services Agency, two UK government departments. This enabled a broadening beyond systems building to other architectural types and beyond local authorities to private architectural practices. The investigation now included experimental studies and analysis of drawings, described as 'the most essential means of communication on design problems between members of the briefing/design/construction team' (p.3). Drawings were considered 'as the overt manifestation of the designer's covert information processing activity' (p.4). For Mallen this question of the designer's inner models, and of what kinds of evidence might reveal them, would be of abiding interest.

Based on this approach, two basic (computer) models were proposed: SIMDAC (Simulation of Design Activity) and SHADO (Simulation of an Hypothetical Architectural Design Organisation). SIMDAC adopts a stepwise breakdown: 'The decomposition of an initial problem into subproblems is hierarchical.'[76] The problem-solving mechanism is firmly attributed to Mallen, and must be based on the decision-making he had modelled for Pask. While SIMDAC models the activity of the individual designer, SHADO (Figure *2*) models the behaviour of design organisations. Mallen's work for Pask on police simulation for the Home Office could again feed straight into this. Changes to the structure, the functioning, or both, of the organisational model could be carried out, allowing evaluations of efficacy and cost. The report moves on to broader implications for methodology and a by-now very familiar concept appears: 'Our approach can in one word be described as a "systems" approach.'[77]

The case is made that this allows a reiterative model, that ultimately connects the organisational context to design activity on the drawing board, and thence to the designed output itself. Effectively recursive, this clearly differs from a hierarchical tree, but does not go as far as Pask's suggestion that aberrations from organisational hierarchies are often the very thing needed for success.[78] A key feature of Mallen's approach is that at all times any 'Plan of Action' in the design process is subject to evaluation and modification. There is no question here of gathering requirements, weighting them, and then simply proceeding to the design stage (as the early versions of Archer's *Systematic Method* seemed to imply): objectives are revisited in light of ongoing evaluation and, as new information is received, plans for future action are revised. The report cites Piaget, making it clear that the models proposed by Mallen are not conceived as simply effective, but also as resembling how the mind may work.[79] There is a powerful acknowledgement of external circumstances on design solutions: the 'external environment' includes 'the public at large and its democratically elected representatives…' Section 5 of the Report, 'The Evolving Methodology and the Data from Case Studies' makes clear that both SIMDAC and SHADO are derived from field studies in architectural practices: they are rooted in real-world designing, and the report sets out the methods including iterative prototyping of diagrams with designers, supplemented by interviews. The work of the DDR's John Wood using photographic logging to study design activities is also referenced. Finally, one case study, a system-built primary school budgeted at £95,000 in April 1973, is described in more detail.[80]

RCA computing grows

Although CEDAR, which the DDR were tasked with analysing, was a project of the Property Services Agency, its team was actually based in the RCA, again as a result of Purcell's connections.[81] And, as a result of the Lansdown connection, the Computer Aided Design Centre (CADC) at Cambridge was also present. The CADC had been set up in 1969. In 1973, *Design* magazine reported that 'Computer aided design is only a local telephone call away for London subscribers with the opening of a new Department of Trade and Industry financed centre based at the Royal College of Art. Tucked away in a tiny mews house at the back of the college, the centre is an outpost of the Computer Aided Design Centre linked directly to CADC's Atlas II computer in Cambridge.'[82] In PAGE, the newsletter of the Computer Arts Society, Purcell reported use of this link, as did Jerrard for Textiles Research at the College, and Christopher Cornford for his RCA work on Aesthetics of Proportion.[83] Meanwhile in the same issue of PAGE, Colin Emmett (discussed below) reported his use of the Atlas at Chilton, Oxfordshire.

CADC took space in the former Yugoslav Embassy at 25 Kensington Gore, near the main RCA building facing Hyde Park, while the DDR moved next door, to No.24 (Figure *3*). Though No.25 has recently been restored, Nos. 23 and 24, home of the DDR, were demolished in 1995.

Figure 3. Immediately beyond the two black cabs, No.24 Kensington Gore was home to the DDR during much of Mallen's time at the RCA. It and its neighbour closest to the College, No.23, were demolished in 1995. The grand house to the right, No. 25, which survives, was formerly the Yugoslav Embassy. The 1960s building to the left is part of the main Kensington campus of the RCA and is now called the Darwin Building.

The CADC were responsible, around 1974, for one of the less auspicious moments in RCA computing when, as Mallen has enjoyed retelling, they decided to display a simple rotating vector model of a vase to demonstrate the great future of computer-aided design. David, Lord Queensberry, Professor of Ceramics at the RCA 1959-83, responded "Humph, is that all it can do?" and stomped off. Though Mallen jokes that this 'set back computing at the RCA by a few years' he also acknowledges that Queensberry later became a significant supporter of computing in the College.[84]

Not only were CADC and CEDAR important loci of computing in the RCA, there was also the Experimental Cartography Unit (ECU), established in 1967 and funded by the then new Natural Environment Research Council; in addition, there was research into computer-aided textile design within the Textiles Research Centre. Mike Stapleton forms a link between these two, moving from the textiles project to the ECU, and eventually to System Simulation Ltd.

Capturing the subjective

Report 108.2 explains Mallen's concept of design modelling: 'An information processing "systems" approach to the study of design activity will look at the way *design activities* process *design information* at both the level of the *individual designer* and the level of the *design organisation.*'[85] It is important that Mallen is not looking, as so many did, at the interactions of the lone architect/designer with external knowledge representations: throughout, the social workings of the design team and wider organisation are vital to the study.

If Goumain was nominally the author of Report 108.2, Mallen is the first-named co-author for 108.3, which is again based on his distinctive methods. The report argues that 'While considerable research and development effort has been expended on the development of CAAD systems, little analytic work has been done on the nature of the activity these systems have been created to aid': CAAD systems were being developed in terms of their imagined value rather than their utility in the real world of designing. Mallen and Goumain's work would fill the gap left by other authors 'conceptualisations of the design activity which are not always firmly based on empirical study.'[86] They had only managed to identify one similar attempt to apply computer simulation to the modelling of design activity, that of Frischmuth & Allen.[87] Incidentally, that paper is in itself interesting in concluding that, whereas engineers often modify existing solutions to meet new requirements, they could often more productively seek to alter the requirements: a classic case of the brief being part of, not external to, the design.

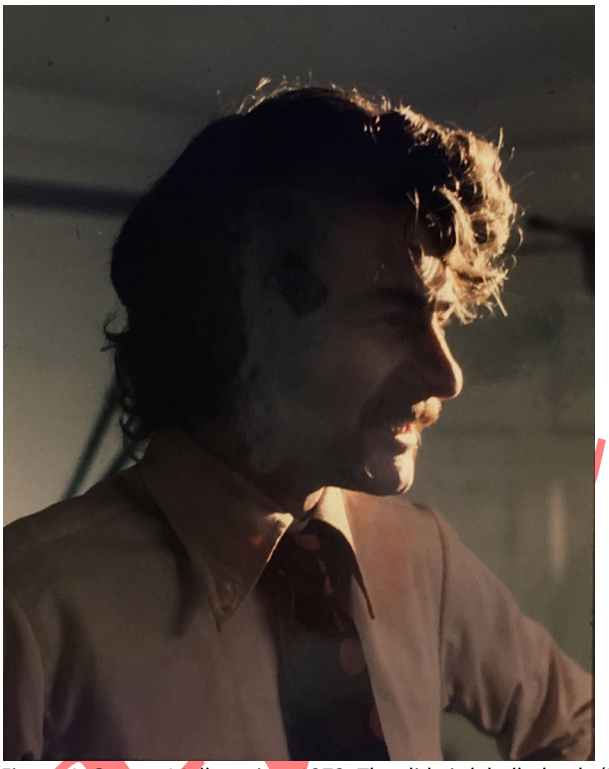


Figure 4. George Mallen, circa 1973. The slide is labelled only 'DDR' and '26'. From the Archive of the Department of Design Research held by the Victoria & Albert Museum.

The Mallen innovation at the heart of Report 108.3 works with a version of Kelly's Repertory Grid[88] to elicit subjective breakdowns of a design problem. This was undertaken with seventeen architectural students at two different levels of experience. The resulting data was analysed using three techniques a) a multi-dimensional scaling algorithm, b) principal-components analysis and c) a cluster analysis program. These together allowed the researchers to capture subjective characteristics of a particular design problem (the now familiar one of designing a school). The problem that the three techniques were designed to solve was this: they had asked the architects to express their views on the relative merits of designs and in so doing had elicited a large number of user-volunteered criteria. As a result, each design was effectively positioned in an n-dimensional space where each criterion was a dimension. Such locations being impractical to visualise or make sense of, the three techniques were needed to reduce the dimensionality, rendering the data perceptible and

useful, analogously to how a two-dimensional drawing is able to represent a three-dimensional scene – but only if the viewpoint and projection are well-chosen. Mallen's use of these techniques ensured that minimal information would be lost. Mallen always regarded his own work as distinct in thus dealing with the subjective. When asked in 2013 whether Bruce Archer thought that design was or should be a science, Mallen replied: 'I think he felt it could be treated rigorously. I didn't, I never believed that, and he and I used to have arguments about this. Because I was more interested in creativity and how that actually worked as a cognitive process and hence, my probing into the subjective aspects of design.'[89]

The work Mallen and Goumain were doing was grounded in observed realities and theories of decision-making and mental models. But they were also standing back and thinking more generally about the implications of their work. Purcell joined them in reporting on this, in *A Strategy for Design Research*. This book chapter, based on a conference paper, is also useful to historians in sketching out the nature of the DDR's work at that time, which was 'rare in the University environment in that it comprises a group of experienced designers, ranging in interest and expertise across industrial design, furniture design, health equipment design and architectural design, as well as research and teaching staff whose interests range from the scientific analysis of design behaviour through the design of aids for designers to design education.' The three authors argued that 'immediate cross fertilisation between practice and research is particularly important for the design disciplines in view of the urgency with which improvements in design processes at all levels in society are required.'[90] In its academic research role, the DDR 'seeks to contribute to the advancement of scholarship in design philosophy and in design methods, management and education' (p.77). The application of computing to design is presented here as having appeared in the mid 1960s as a somewhat separate discipline 'owing more to computer science than to the discipline of design methods.' The authors position the DDR's work in this area as having begun in 1968. Now, they particularly want to improve the relations between computer systems and users: 'A major goal of these descriptions of design activity was to achieve *greater sensitivity in the specification and design of integrated computer systems*, especially in respect of the user's requirements and methods of working' (p.78, emphasis added). Again the qualitative, the subjective and the social are brought to the fore: 'Whilst many of the engineering design processes are of a fairly quantitative and predictable nature that can readily be translated into computer algorithms, architectural design processes are far more deeply rooted in the social psyche of our time' (p.78). The authors make clear that what happens beyond the walls of the architect's office is as important as what happens within: 'The sum total of all such organisations involved in a particular design process constitute the design coalition – finally the whole *design coalition* operates within the general *social context*' (p.79, original emphasis). Mallen is continuing a theme he had already set out before joining the RCA, critiquing decision techniques that are of 'little use for characterising complex decisions in real situations.' He makes clear his debt to Paskian cybernetics with a demand to 'distinguish concepts of control as applied to mechanical systems from concepts of control applied to organisations involving complex decisions. The former has been described as the domain of conventional control theory and the latter as the domain of applied cybernetics.'[91]

It is notable that several years later in 1978, when Goumain and Mallen contribute to a conference on computers in engineering and building design, theirs is the only paper, out of more than seventy, to focus on interface and interaction design.[92] Again their research is built on fieldwork. Although a Special Interest Group on Social and Behavioral Computing was started in the USA in 1969, it did not become the Special Interest Group on Computer-Human Interaction until 1982; the British HCI group was not established until 1984. Mallen's engagement with human-computer interaction as a dynamic relationship between users and machines was ahead of its time. The next paper at that same conference was by John Lansdown. It took a more general stance, but ended: 'Above all, we must seek to establish a theory of CAAD where the emphasis is on the architecture rather than the computing.'[93]

From research into teaching

That same year, Pierre Goumain assembled a set of notes for students. In parallel with their research, Goumain and Mallen were engaged in teaching for the DDR and supervision of research students at Master and PhD levels. They assembled a joint course: *Design Systems – a Scientific Framework for Understanding Design*. The 110 pages of notes comprise eight sections starting with 'What is Design Research? Scientific Knowledge and Design Research' and including 'Beyond Reductionism – The Origins of System Theory and the Work of Leading System Theorists'; 'Knowledge, Theories, Representations and Models'; 'The Analogy Between Artificial (Designed) and Natural Phenomena'; 'Knowledge, Representations and Models in Design Research as seen from Various Scientific Viewpoints'; 'Knowledge, Representations and Models in Design'; 'Background in Design Method' and finally 'A Review of Design Research.'[94] Most of the notes were reused from their own earlier handouts dated 1976. A phrase from Mallen's notes for the first course provides the title for the present chapter.

The emphasis on the word 'science' in the course again requires comment. Bruce Archer had used the phrase 'science of design', but it is notable that by this same period, when Goumain is compiling the course notes, Archer was reflecting that he had 'wasted a lot of time trying to bend the methods of operational research and management techniques to design purposes.'[95] He now offered a dramatically different approach: humanities, science and design as equal points of a triad of disciplines. Archer announced that 'there exists an under-recognised but definable *third area* of human knowing, additional to numeracy and literacy' (foreword, emphasis added). He was no longer assimilating design to science, but saw design as a form of knowledge in its own right. It was 'Time for a Revolution in Art and Design Education.'[96] Though Mallen and Goumain do not go that far, theirs is certainly not reductionist science. The short list of reference for the opening chapter includes Kuhn's *The Structure of Scientific Revolutions* and most significantly three books by Popper. Goumain and Mallen return to Popper repeatedly in the course notes. Their key argument is that Popper's hypothetico-deductive model of scientific inquiry is analogous to the way designers work. The key aspect for Mallen of Popper's thinking is that science is not, as classically imagined, based on receiving data from the world and on that basis forming a theory, but on a continuous cycle of hypothesis-making and evidence-seeking. For Mallen this clearly parallels the design cycle where, rather than collecting all the requirements and then proceeding to design, a reiterative, tentative process of making and evaluating leads towards a designed artefact.[97] This resemblance is not coincidental because both are rooted in the way the human organism operates in relation to the external world. This leads in

Chapter 5 of the course notes to a further model – or pair of models, one specific and one general – where designing is now, recursively, the object of observation and interaction (Figure 3). This is essentially a second-order cybernetics approach. Cybernetics unsurprisingly features strongly in the notes, with Ashby,[98] Beer,[99] Bertalanffy,[100] Wiener,[101] Pask,[102] and von Foerster, the originator of second-order cybernetics in 1974,[103] all referenced repeatedly.

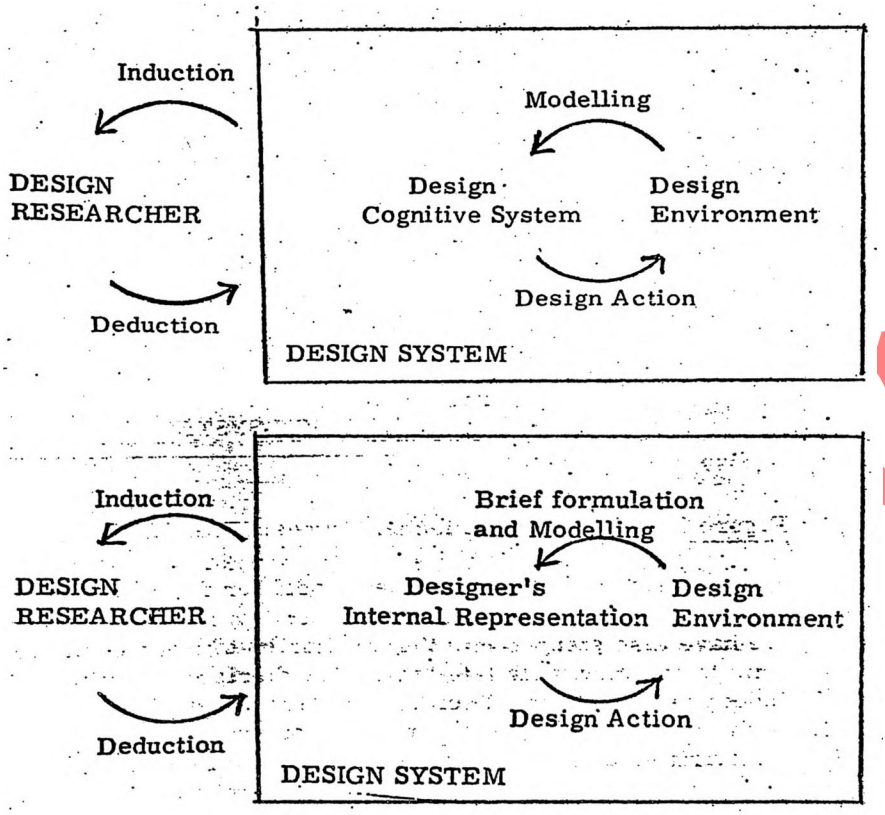


Figure 5. Figures 1 and 2, 'a model for design research' and 'a generalised model for design research' from Goumain and Mallen (1978) Chapter 5. *Knowledge, Representations and Models in Design Research as seen from Various Scientific Viewpoints*.

It is notable that Archer had not cited Popper in his doctoral thesis,[104] but retrospectively he found Popper's message a great comfort. It legitimised the idea of conceptualising solutions, and even starting to make them, in advance of fully understanding the requirements. Perhaps only half-humorously, Archer wrote of his relief that the Popperian rationale meant that 'Design activity was scientifically respectable!'[105] It seems certain that Archer had been 'rescued' by Mallen introducing him to Popper's thought.

Finally in relation to the science of design, one further reference in Mallen's opening chapter of the notes is worth highlighting: this was Peter Medawar's *Induction and Intuition in Scientific Thought* of 1969.[106] Medawar acknowledges his debt to Popper, but goes beyond him. Not only is scientific reasoning, according to Medawar, really 'an exploratory dialogue' (p.46), it originates in 'creativity and "creative imagination"' (p.55). When, years later, six former members of the DDR, including George Mallen, met at the RCA in 2016 to discuss the origins of design research, Medawar's book was still recalled as a vital influence on their thought at the time.[107]

Computing for all

Mallen's RCA life was not confined to research and teaching inside the DDR. He also led development in 1977 of the Computing Activities Unit, enabling others in the College to benefit from access to computer facilities and expertise. It 'raised a few eyebrows in the Senior Common Room of a college of art, but it took root. And before long it was teaching and introducing visual art students to computing.' … 'if you remember, computing was very much in the province of high science and big business, and not really in the art world at all. So artists would have reflected that zeitgeist of technophobia, if you like. I saw it as one of the challenges for us to try to break that down, by doing stuff in the Royal College of Art and elsewhere.'[108] There is an obvious parallel with the activities of the Computer Arts Society, of which of course Mallen was a founder and co-leader [cross ref this volume]. The Computing Activities Unit offered courses that were attended by staff and students of other universities and polytechnics.[109] Mallen was head of the unit, in addition to his other responsibilities, while Brian Reffin Smith was appointed to teach.

Patrick Purcell had originally persuaded Smith to do a Master's degree in the DDR, when had applied to, and been rejected by, another department.[110] He was appointed Research Fellow in 1979 and in 1980 lecturer in computer-based art and design. He left the RCA in 1984, the year that his influential book *Soft Computing: Art and Design*[111] was published. He continues as an academic and practising artist to this day. The Unit started with an Altair self-build kit that Mallen bought for the Department.[112] It was replaced by the Research Machines 380Z. Smith says that initially he brought in his own, on the bus. In 1979, he wrote 'Jackson', an early digital painting program, for the 380Z, which was widely distributed by the Ministry of Education.[113] He was involved on-screen and as a programme adviser for BBC TV's *The Computer Programme*. Innovative use of computing by artists was as important for the Computing Activities Unit as use by designers. This reflected not only the artistic commitments of Smith, but also the breadth of Mallen's own thinking. He called his 2017 retrospective article for *Interdisciplinary Science Reviews* 'A journey – crossing boundaries.'[114] For Mallen, science, design, art and other disciplines are all important, interconnected forms of inquiry into the human mind and society.

As students and staff of other departments became more engaged with computing, a growing strand of work developed in computer graphics,[115] of which graphics for TV were an important outcome.[116] Before the use of in-house microcomputers, a second-hand Elliott 903 was installed in the basement at Kensington Gore where Mallen recalls that it functioned for two or three years, mainly running demonstrations rather than doing anything useful.[117] Online access to mainframe computers elsewhere was essential. Most of Mallen's research 'was done at Rutherford and Farnborough.....because it had numerical facilities.'[118] The link to Cambridge through the CADC has already been mentioned. The link with the Rutherford high energy physics laboratory again came about through the SRC connection. 'Again, John [Lansdown] had a finger in this, with the emergence of computer animation with people like Colin Emmett. Colin was a graphic design student and keen to do this, and we managed to get him access to the resources at Rutherford. So he used to go down and began the development of what came to be known as ANTICS. ANTICS was used in '73 for the Finite Elements film, a joint production between the Royal College of Art and the Science Research Council and the Lab.'[119] Lansdown himself noted in an article at the time: 'Two young computer film-makers are Alan Kitching and Colin Emmett who have

devised a system called ANTICS to aid in the production of animated films. They used the system to produce the title sequence for the *Burke Special* TV programme.'[120] Smith[121] gives his own perspective on the artistic work of the ACU, while Mason[122] sets these developments in the national context of the time beyond the scope of the present chapter.

Mallen seems proud of his contribution to the development of computer graphics, but ideas were more important to him than images. In 1984 he reflected: 'Much computer graphics is an attempt to do quickly or in some new way what could have been done by hand.'[123] Nevertheless, computer graphics and animation would produce a succession of projects for System Simulation Ltd. This was partly because requests from outside the College for computer graphic work, like all external projects, had to be approved by Senate. This process was so slow, it made more sense to guide these inquiries to the company.[124] A landmark project in 1978 was the animated sequence for Ridley Scott's *Alien* (cross-reference in this volume). Among those listed as contributors who were also at the RCA with George Mallen were Colin Emmett, Chris Logothetis, Mike Stapleton and Brian Wyvill.[125]

One further link between RCA interests and those of System Simulation Ltd lies in the area of databases. Mike Stapleton developed database techniques within the Experimental Cartography Unit.[126] The DDR also discussed at least two potential database projects: one was an 'integrated design/design research computer database of bibliographical references.'[127] In their document, Purcell and Mallen described the potential for a videodisc-based graphic database for designers, to be developed collaboratively with MIT. This is work that Purcell would carry forward, but not, as it turned out, at the RCA, but rather at MIT where he moved next. Back in London, visual databases would become a mainstay of System Simulation's output.

Mallen helped the Research Unit, as it had originally been, to grow sufficiently in size and profile to become a Department of Design Research its own right. But at times, the DDR was not a harmonious place. At one point, in the mid 1970s, there was a vote of no confidence in Bruce Archer as its head. 'As a result of that, the department was kind of restructured, into a teaching bit under Richard Langdon, a research bit under me, which wasn't entirely right, because we had these senior guys like Patrick and Kenneth and so on. So it was not a happy time.'[128] Mallen remained 'Deputy Head of Department (Research and Practice)' until he left in 1983. The post was not without its own challenges: at one point two colleagues made formal moves to have him removed from his post. They were unsuccessful. The Design Research Board felt that Mallen was being targeted for problems that were none of his making, problems experienced right across the College.[129]

Trouble with theory

Mallen and Goumain's reports had argued that 'the possibility of an "intelligent" design model leads directly to the concept of "intelligent" design aids.'[130] This emphasises how the development of models of the design process had multiple objectives: one was to advance theoretical knowledge for its own sake, another was to design systems that passively but effectively support the designer and design organisation – but a third was to go beyond that and develop interventionist computing systems: intelligent design aids. Although the distinction between developing theoretical understanding and practical applications is perhaps a necessary one, Mallen's emphasis on the value of theory recalls a favourite

quotation of Lansdown's that 'there is nothing as practical as a good theory' (author reminiscence). The phrase originates with Kurt Lewin (1894-1947), author of the term Action Research, who championed the necessity for practice and theory to interact.[131] All the evidence points to Mallen's own belief that one can never have too much knowledge, and that knowledge can, and should, be structured by theory. While such a view may seem uncontroversial, Frayling identifies what he calls a 'deep trauma in British art education about theorising design.' Many in the RCA were strongly opposed to theory in any form, including John Hedgecoe (1932-2010), who became Acting Rector at the end of Mallen's RCA career, and whom Frayling describes as 'the Caliban of art education' and 'fanatically anti-theory.'[132] Perhaps the strongest contrast with Mallen's hunger for knowledge and his belief in the value of theory was the next Rector, who subsequently closed down the Department of Design Research altogether, along with its offshoot the Design Education Unit. Jocelyn Stevens (1932-2014), favoured for the Rectorship of the RCA by Margaret Thatcher, revelled in his reputation for brusqueness and bullying. 'Thought and reflection are not his thing,' said a colleague at the RCA. 'He believes you get the best out of people by shouting at them.'[133] In Frayling's words 'Anything Jocelyn could not understand he was against.'[134] Mallen's own comment was 'One of the actions of course of Stevens was to almost annihilate any intellectual activity in the College.'[135]

Ironically, the worst thing to happen to DDR and its computing activities before that final demise came from a less obvious source. The RCA that Mallen joined in 1971 had been transformed from 1948 onwards by Robin Darwin (1910-1974), who had brought in leading practising artists and designers as tutors, including Dick Guyatt, (1914-2007), who had been in the Camouflage Unit with him during World War II, of whom more below. A friend and Eton schoolmate of Darwin, Lionel Brett, Lord Esher, was the next Rector, in post at the time Mallen arrived. His autobiography gives a strong impression of someone out of sympathy with his time: 'the increasingly illiterate output of the provincial art schools', 'no less dispiriting were those lank-haired girls in their colourless, waistless clothing, and the alienation from RCA values', 'the sour seventies', 'Illiteracy, solemnity and suspicion were now in command.'[136] Esher would resign when overwhelmed by discontent among both students and staff in 1977.[137] Like Darwin, Esher had no great interest in work like the DDR's but does not seem to have stood in its way. Dick Guyatt moved from Graphics to take over as Rector, and, despite his commitment to commercial practice, was not an enemy of research. He had encouraged the development of the Graphic Information Research Unit, which had been established by Herbert Spencer at the RCA in 1966 as the 'Readability of Print Research Unit';[138] this unit would sometimes seek computing assistance from Mallen and his colleagues. Mallen found Guyatt 'very affable, a kind man, and very sympathetic to what we were trying to do.'[139] He and Herbert Spencer, of the Readability of Print Research Unit, endorsed the move to create the Computing Activities Unit. Guyatt was 'very supportive as Rector in a way that Lionel Brett had not been.'[140] But Guyatt did not stay long before retiring. In the search for his successor, Archer was one of those who actively favoured the appointment of Lionel March, an architect with a strong interest in computing. March took over as Rector at the start of academic year 1981/82. On the face of it, this should have created a benign environment for computing to flourish at the RCA. On 1 October 1981, Archer records in his journal 'At 12.15 went to see the Rector to "report for duty" and assure him of my unequivocal support.'[141] March brought with him as Dean of Studies George Stiny, 'who did algorithmic aesthetics.'[142] In Frayling's view, Stiny was 'a

nerd, a real geek.' Someone asked him about the Francis Bacon painting on the wall of the Senior Common Room and asked what algorithmic aesthetics would make of that. Stiny replied: 'I could generate hundreds of them.' In Frayling's view 'Stiny really took against Design Research. Like a lot of fundamentalists, the enemy wasn't everybody else: it was the department closest to him.' 'Stiny really went for Design Research like a pit bull terrier.'[143] As far as Mallen could see, the new Rector thought that the RCA was 'just in the backwoods as far as computing was concerned.' 'He was actually pro-computing, but thought that the Royal College was doing it wrong.' March and Stiny's aggressive promotion of their own kind of computing was counterproductive, alienating many in the College.[144]

March and Stiny were co-authors of numerous articles before, during and after their brief time at the RCA, often in *Environment and Planning B: Urban Analytics and City Science*, a journal they cofounded. The differences between their publications and Mallen's could hardly be more marked. Of course, there are superficial resemblances between their thought-worlds: in Stiny and March we find 'The best models of thought we have today are information processing ones. These models are given by algorithms that can be run on a computer; they treat thought as a computational process in which symbols are used to describe things in the outside world and things in our heads.'[145] But throughout the gamut of their publications, the central concern is combinatorial design generation using patterns of one sort or another: 'rule-based shape grammars' to use March's preferred term.[146] At no point do March or Stiny author acknowledge the social and cultural variation in what constitutes a 'good' solution; they never discuss actual architectural practice, nor show any interest in architects as people or in the organisations within which they work; they never consider the end-users of buildings. This is worlds away from Mallen's understanding, where designing feeds on input from (at least): the designer's memory and experience, solution evaluations, drawings, lists, and other documents, the design office with its own rich variety of sources of information, the design coalition that includes all agents who make a contribution to the design process, and the external environment where the end product of the design activity will eventually take shape.[147] In summary, March and Stiny have no interest in how designers or designs actually work. Theirs are prescriptive, idealised schemata. As a young man, Lionel March had been at Cambridge with Christopher Alexander (1936-2022).[148] Alexander for a while was enthusiastic for the kind of Systematic Methods so appealing to Bruce Archer, but then turned his back on them. When Alexander said 'people who are messing around with computers have obviously become interested in some kind of toy. They have very definitely lost the motivation for making better buildings'[149] it is tempting to think that it is exactly March whom he had in mind. Any apparent similarities between March's and Mallen's thinking belie fundamentally different interests and beliefs. The humanity of Mallen's concerns jumps out in contrast with the world of March and Stiny.

Looking back

Through his time at the RCA, Mallen had brought new ways of thinking to Design Research, including the emphasis on modelling; mathematical techniques for making sense of multidimensional data; modelling subjective data, representing the cultural and social complexity of design; the Popperian model of designing as analogous to science; the discipline of systems analysis and the insights of cybernetics. He had made computing an increasingly mainstream RCA activity and had benefited the institution through multiple

projects with significant external funding. He had also helped guide and lead the DDR. In terms of the wider world, he had fulfilled the 'cybernetic opportunity' highlighted by Purcell in 1968, and contributed to the early days of computer graphics for broadcast and film. He had pioneered the use and usability of computer systems rather than crude functionality. He had advanced the notion of computing as prosthesis, and symbiosis, for the mind – not just a tool like any other, and not just about making images.

Later, interviewed by Brian Reffin Smith, Mallen reflected on his experience of the RCA: 'I see the Royal College of Art as a microcosm of English society. … All the forces that we see in society are there in one form or another, and I must say I've been very interested to try to innovate in that environment, and to learn lessons about politics and management. … I think the institution has been appallingly slow in adapting to this technology. It's thrown away opportunities … its ruling mechanisms didn't know how to react to new ideas.'[150]

Archer's personal journal for June to July 1983 gives glimpses of what happened next in the battle with March and Stiny. On 1 June 1983, he notes how many people have discussed their concerns over Stiny with him. There is a move afoot in the College to get Stiny dismissed at the end of his probationary year. On 6 June, John Hedgecoe discusses with Archer the 'shortcomings' of March and Stiny including 'heavy-handedness, self-aggrandisement, misuse of resources and failure to produce College development plans.'[151] At Senate on 22 June, Rector March 'announced that the Rectorship would be vacant from 1 September 1984.' He then 'vacated the chair and left the room.'[152] While these departures might have meant that the RCA would once again be a place where Mallen wanted to work, Archer's entry for 13 June had already included the words: 'RL [Richard Langdon] and BA [Bruce Archer] to cover for GM [George Mallen], who is leaving.' Mallen's last appearance in Archer's journal is that same day, when Mallen and Archer have lunch with Richard Langdon and Natasha Spender (the former concert pianist, and wife of the poet Stephen Spender, who for many years taught visual perception for the DDR).[153]

On 14 February 1985, in an RCA now under the aggressive and unsympathetic Rectorship of Jocelyn Stevens, Archer notes simply: 'DDR to close!'[154] It duly closed the following year. It had lasted for 25 years, for almost half of which Mallen had been a key researcher and a contributor both to its intellectual culture and leadership.

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The chapter is based on five interviews with Mallen himself, two by the present author in 2013 and 2015, and others by Jo Stockham and Bronac Ferran in 2011, by David Upton in 2018 and by Lisa Rotzinger the same year, supplemented by interviews with other individuals. Due regard has been given to standard problems of oral history, with Mallen himself sometimes expressing limited confidence in his exact dating of events. Other sources include Mallen's publications, and extensive documents in three archives: that of Bruce Archer (Mallen's boss at the RCA) held by RCA Special Collections, and that of Archer's department, the Department of Design Research, held by the V&A, and that of Mallen's long-time collaborator and friend, John Lansdown, at Middlesex University. The RCA Special Collections also hold unpublished internal reports of research projects in which Mallen was involved, some of them donated by Mallen himself a decade ago. The Archer archive at the RCA also includes personal journals kept by Bruce Archer, which give useful insights into some of the more startling events of those years.

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