Examining two distinct scientific approaches to architectural research developed at the schools of architecture at Cambridge and the Bartlett, UCL in the 1960s.

Architectural research in university schools of architecture: Cambridge and the Bartlett, 1960–9

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In November 2004, the University of Cambridge announced its intention to close the Architecture Department,[1] following a drop from a 5 to a 4 in the 2001 Research Assessment Exercise (RAE), which aimed to measure the quality of research activity across the Higher Education sector in the UK.[2] Other departments in the University of Cambridge achieved a 5 or a 5* rating in the same exercise. In 2004 the University's General Board, which oversees academic standards within the University, came to the conclusion that the Department of Architecture was making 'insufficient progress towards meeting Cambridge standards in terms of research quality' and advised that it should be shut down.[3] While this remained a recommendation, with no official action having yet been made, the threat of closure sparked an outrage both within and outside Cambridge. After a campaign in the national press, the architecture department was saved [1, 2].

The 2004 near-closure of Cambridge was by no means the first time that architectural research and the place of architecture within the Universities had been challenged or indeed that the Cambridge Department of Architecture had faced the threat of closure. Debates whether architecture belonged in universities had been going on for a long time. The roots of the debates about research lay in the postwar professional crisis when architects became

1 A campaign against the possible closure of Architecture Department at the Senate House, Cambridge, 29 November 2004.

increasingly challenged and anxiety within the profession intensified. Research was introduced as a means to strengthen the profession's standing by instituting architecture as a scholarly discipline comparable to law and medicine, vocational subjects that had been taught in universities since the Middle Ages. Although the first architecture schools had been set up in universities there remained a strong prejudice among academics that the course was more suited to vocational training.[4] It is in this light that debates over the role of research in architecture need to be seen, debates that still have resonance today.

There are two key figures who played a significant role in shaping the place of research in architecture. In Cambridge the response was led by Sir Leslie Martin, who chaired the 1958 RIBA Conference on Architectural Education in Oxford and remained an important figure in the development of architectural education throughout the 1960s. Martin had been appointed as Head of Department in 1956 to save a department that was threatened with closure. In UCL, following the Conference, Richard Llewelyn-Davies was chosen in 1960 to reform the Bartlett.[5]

By examining Cambridge and the Bartlett, the institutions that were led by key instigators of the Oxford Conference, this article seeks to add to and correct the historical narrative on architectural research, previously addressed by Hay, Shasore and Samuel in the 2017 **arq** article 'Research at the RIBA: An Institutional History 1958–71'.[6] In particular, it

seeks to examine the degree to which architectural research in the 1960s was, as they stated, 'allied … so closely to a scientific ideal'.[7] As we shall see, the positions of the Bartlett and Cambridge were subtly different in this respect.

This article starts in 1960 as this marked the year when Llewelyn-Davies replaced Hector Corfiato, the previous Head of School who was leading the Bartlett in a 'full-blooded Beaux-Arts' fashion.[8] The article then ends in 1969, before there was another major shift in architectural education resulting from the changes in the political attitudes of society, students, and governments, which affected research activities in universities.[9] Furthermore, following Martin's retirement in 1972, Cambridge witnessed a shift in research interest. Under William G. Howell, Martin's successor, the early 1970s saw an environmental research boom and the introduction of research on the acoustics of auditoria. Llewelyn-Davies's headship also came to an end in 1969, when he became instead Professor of Urban Planning and Head of the School of Environmental Studies.

The article is divided into six main sections. The first looks at the roles of Martin and Llewelyn-Davies at the Oxford Conference and the second discusses

architectural research activities that had taken place before that Conference. The third and fourth parts focus on the Schools of Architecture at Cambridge and at the Bartlett, respectively. The fifth part summarises similarities and differences between the two Schools, too easily confused, before the conclusion draws together what we can learn from this review that might inform the debate today.

Leslie Martin and Richard Llewelyn-Davies at the Oxford Conference

Architecture remained a relatively weak profession throughout the 1950s despite the presence of the RIBA examinations and the 1931 and 1938 Architects' Registration Acts. Although these provided control over how one could practice as an architect, there was nonetheless, as today, nothing 'stopping anyone from practising as a designer of buildings, nor was there anything to stop builders and developers from erecting buildings'.[10] Moreover, when, in 1960, the Pilkington Report, which scrutinised earnings of various occupations from 1957 to 1960 was published, architects were more alarmed than anyone else having realised they were earning less than other professionals, in particular doctors, dentists, lawyers, and engineers.[11]

This led to widespread debates about the aims and methods of architectural training. Thus, it was in this attempt to give the profession the professional credibility it deserved, that the idea for the reform was conceived. This took the form of a residential conference at Magdalen College in Oxford: the RIBA Conference on Architectural Education in 1958. Widely known simply as the Oxford Conference, this arguably marked the first time since the RIBA International Congress on Education in 1924, that the subject was formally discussed.

The Oxford Conference took place over the weekend of 11–13 April 1958, during which time many issues were discussed. These ranged from the general concerns regarding the professional standing to the means of education and entry requirements to the profession. Among many things, it was concluded that the primary form of architectural training should take place in a university and that research should be carried out alongside training.

The full proceedings of the Conference were never circulated or published as Sir Leslie Martin, the Conference Chairman, had assured members of the Conference that the discussions would be confidential so that they could speak frankly.[12] Accordingly, Martin summarised the discussions in the form of a report, which was published in the RIBA Journal.[13] According to Martin, the recommendation that highlighted the importance of research was the most important of all. Research, he argued, was central to the redefinition of architecture in articulating that architecture comprised 'widely different types of knowledge' and hence was worth serious study.[14] Nevertheless, quite what research meant was not clarified. Insofar as general principles were adhered to, each individual school could organise

their own teaching of architecture in any direction they saw appropriate.

At the time of the Conference, Martin had just been appointed in 1956, as Head of the School and the first Professor of Architecture at the University of Cambridge. Martin's emphasis on architecture taking place at a university and the role of research undoubtedly seems to have stemmed from the new position he found himself in, saving a school threatened with closure. The Conference Organising Committee originally proposed that the Conference should be chaired by 'a layman, perhaps a senior Civil Servant' and suggested that Sir Edward Bridges, the former Secretary of the Cabinet or A. A. Part Secretary for Further Education of the Ministry of Education should take the chair.[15] This was later given to Martin.[16]

After the Conference, Martin's name would appear in the minutes repeatedly, not least because he authored the report, which would become one of the most important documents in the history of British architectural education to date. He therefore played a substantial role in reshaping architectural education and particularly its relationship to research.

The Oxford Conference owed much to Llewelyn-Davies, an important member of the Conference Organising Committee, who had been involved in the planning of the Conference since its inception[17] Among many things, he initiated the idea for a small conference,[18] and this resulted in the idea for an exclusive, invitation-only conference.[19]

Because both Martin and Llewelyn-Davies had played a key role at the Oxford Conference and the way its recommendations were to be implemented, it was thus natural that their respective architecture schools were at the forefront of the postwar re-evaluation of architectural training.

Architectural research before the 1960s

Prior to the 1960s, there had been many developments in architectural scholarship and research but these occurred outside universities. Within the British context, there had been an array of research work in the public sector, a majority of which emerged as a response to the demands during the interwar years. In 1921, the Building Research Station (BRS) was founded by the Department of Scientific and Industrial Research (DSIR) as a government-funded laboratory to assess performance of materials and construction methods in the search for the most suitable ones to be used in the new housing following the First World War.[20] Their research drew upon geotechnical, structural engineering, material sciences, and building physics.[21]

A different initiative appeared in 1932 when Berthold Lubetkin brought together a group of former students who had studied the Bauhaus and so-called the New Objectivity at the Architectural Association between 1926 to 1930 to form the Tecton Group. Together, these 'building designers' instituted architectural research as a 'self-conscious activity'.[22] Modern Architectural Research Group (MARS) was

formed in the following year, drawing together architects, critics, and academics. Although its naming suggests an emphasis on research, the MARS Group in reality hardly conducted research. As the historian John R. Gold noted, research was a 'rather clever wording in order to make a serious-sounding title' for the general discussion of architecture.[23]

Before the Second World War, architectural research in academia predominantly resembled research in art history. For example, at the University of Manchester in 1936, a doctoral dissertation undertaken by Leslie Martin, one of the first architects in Britain to hold a PhD in Architecture, was on 'The Position of Jose de Churriguera in the Development of Spanish Baroque Architecture'.[24] The calls of the modern movement to address topics of modern materials may have been discussed by architects but did not seem to have been the subject of research in architectural schools.

The war would change this radically. Firstly, there was the need for huge numbers of buildings to be rapidly deployed and, as the war progressed, there was a growing need to address the problems in rebuilding critical infrastructure. In 1942, a committee was assembled by Sir George Burt, bringing together people in the building industry, architecture, government service, and the Building Research Stations.[25] Officials were drawn from various ministries – Works, Labour, Health, and the Board of Trade – to form an interdepartmental committee on housing construction.[26] Together, they made recommendations in a series of reports published by the HMSO for postwar practice on materials and construction with regards to efficiency, economy, and speed of erection, but also covering factors such as daylighting and acoustics.[27]

Nevertheless, this technical research, which was continued in engineering departments, seems to have taken its time to work its way into architectural departments in universities where research that did take place was chiefly historical. In Cambridge, the first example of technical research in the architecture department was Martin's doctoral student David Croghan, who, in 1962, completed a thesis on daylight in buildings.[28] The situation was much the same at the Bartlett: at the time Richard Llewelyn-Davies became Chair of Architecture in 1960, there was just one PhD student and his thesis was on 'the design of national libraries'.[29] By 1970, Bartlett students were undertaking research on various topics from building economics to planning principles and environmental policies.[30]

The aftermath of the Oxford Conference witnessed not only a rapid growth of academic research activities, but also marked the point when architectural research started to transcend its longest established form as a branch of art history, to a more rational and science-oriented one. Evidently, there had been an explosion of interest and a growing support from various parties.[31] For example, funding from an array of federal agencies from the National Science Foundation to the National Endowment for the Arts became more widely available; universities began to provide greater internal support for architecture faculties to pursue research; doctoral programmes in architecture began to emerge; a number of major architectural firms developed research-oriented divisions; and many well-established architectural journals began to address scholarly studies of architecture.[32]

In this, Britain lagged behind other countries. In Germany, Walter Gropius and Hannes Meyer at the Bauhaus would promote the idea that design needed to be allied to production, Meyer stating that 'building is a technical, not an aesthetic process'.[33] Ernst Neufert's work during the war and afterwards at the Technische Universität Darmstadt and Tomas Maldonado at the Hochschule für Gestaltung (HfG) also recognised the principles of standardisation and mass production.[34]

The University of Cambridge School of Architecture
The appointment of Leslie Martin as the new head and the first Professor in Architecture made the 1960s the most eventful decades in the history of Cambridge School of Architecture. In addition to many changes, including the raised entry requirements, modifications in course structures, and appointments of new staff, the first research division was established in 1967 as the centre for Land Use and Built Forms Studies.[35] Amid the arrival of the very first computers in universities during the 1950s and the widespread excitement to explore the power of the Titan mainframe computer, architects sought to claim their part.

It would be wrong to think of Martin as a technocrat. Although the School of Architecture was part of the School of Arts and Humanities and shared facilities with the History of Art Department, Martin ensured that architecture under his leadership was neither a technical nor an artistic subject, but one that embraced both.[36] This was in the spirit of the Oxford Conference, at which a strong case was made for the necessary departure from the arts-sciences polarisation previously emphasised in the Beaux-arts tradition. In the Conference report, Martin highlighted the importance to 'establish a bridge between faculties: between the Arts and the Sciences, the Engineering sciences, Sociology and Economics'.[37]

In 1958, David Croghan became one of the first research students in the School. His research on daylight in buildings, under Martin's supervision, established a very important precedent in the field. In 1963, Croghan's thesis on 'the Measurement of Daylight and its effect on the design of buildings and layout particularly in housing development' became the first Cambridge PhD thesis in a scientific aspect of architecture. Not only was this significant in considering architectural questions in terms of building science, but it also marked the first time that an Arts faculty student secured a Research Studentship from the Department of Scientific and Industrial Research (DSIR). According to Croghan, the DSIR 'cavilled at aiding an applicant from an Arts faculty' and 'the corollary was that neither would any Arts body fund scientific work'.[38]

The research involved the construction of an 'artificial sky' in a Buckminster Fuller geodesic dome, later nicknamed the 'Skydome' *[3, 4]* constructed with grants from the Nuffield Foundation and the Science Research Council (SRC). From 1964, this work was developed into Daylighting Research Group (DRG) and was supported by the Building Research Station.[39] The Skydome remained, for many years, the most influential artificial sky in Britain.[40] Many studies made use of it, including Martin's designs for the Manor Road library and David Roberts's design of the Fitzwilliam Museum extension.[41]

In 1967 the centre for Land Use and Built Form Studies (LUBFS) was established as a research wing of the Cambridge School. Lionel March, who became director of the centre, had read Mathematics at Cambridge before being drawn into Architecture.[42] When, in the early 1960s, Martin approached him, March was undertaking doctoral research on Frank Lloyd Wright at Harvard MIT Design Centre.[43] His PhD was cut short and he came back to Cambridge in 1963 to work with Martin on the Whitehall Report, the controversial architectural project that proposed the demolition of much of historic Whitehall to be replaced by a brutalist megastructure.[44]

LUBFS began with three projects: the Universities Study, the Offices Study, and the Urban Systems Study. While the centre was formally established in 1967, the first project actually started in 1965 with Nicholas Bullock, Peter Dickens, and Philip Steadman working in the earliest days of LUBFS on the Universities Study. They were joined in 1967 by Dean Hawkes and Marcial Echenique as leaders of the Offices Study and the Urban Systems Study, respectively.[45] Hawkes came to Cambridge in 1965 as research assistant to the aforementioned Daylighting Research Group, working with Croghan and his research student Harold Pfitzmann. Echenique, on the other hand, came with a background in urban planning.

Although these studies focused on different topics, from university planning to constraints in offices and the computable models of medium-sized towns, themselves of considerable interest, there was a shared interest in the question of design, as understood in the most general terms.[46] As Steadman noted, the LUBFS members were aware that in pursuing their individual projects, they were participating in a long-standing debate with roots stretching back at least as far as the mid-nineteenth-century Functionalist Theory, evident in the work of thinkers as far apart as Viollet-le-Duc and D'Arcy Thompson.[47]

But the nature of the debate changed over time. In addition to taking part in the debates on design, researchers at LUBFS were also linked by an interest in computing and modelling, as a means to establish a 'science of architecture'. This science, according to LUBFS researchers themselves, was not part of a deterministic approach to design exemplified by Christopher Alexander's 'Notes on a Synthesis of Form' as many have misunderstood.[48] Alexander fell out with Cambridge and the book was written during

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3, 4 A Buckminster Fuller-type geodesic dome by David Croghan in the garden of Scroope Terrace.

his time in Harvard in opposition to the Cambridge approach, not as part of it.[49] Martin and the researchers at LUBFS did not see the world that way.[50] In particular, Sean Keller and Mary Louise Lobsinger portrayed Cambridge architectural research as an attempt to establish architecture as 'a field that would finally reject its artistic pretensions and produce a body of quantifiable results through research'.[51] This is a misrepresentation. A rebuttal by Steadman, who had been involved in the event in question himself, explained that Cambridge

researchers in fact sought to 'support design with an architectural science, not making the design process "scientific"'.[52] This links back to Martin's reflection in 1952 on the research aspects of the designs of the Festival and its Hall where he wrote: 'science can produce the facts but the art must show us the way in which they can be used'.[53] There, Martin had stated clearly that he did not believe that 'science can and will take over and replace the province of art'.[54] The same idea was addressed by March, Echenique, and Dickens for whom 'scientific' was defined to mean 'orderly, accumulative, and criticisable on a sound objective basis'.[55] Accordingly, the implication of 'science' in Cambridge's architectural research refers to the idea of being able to test, verify, and quantify architectural design propositions using calculations, modelling, or experiments.

Unlike mathematical and scientific problems, where quantifiable methods, supported by hard facts and certainties, had already existed in the 1960s, architectural problems remained largely non-formalised and lacked a systematic means of approach. Karl Popper's inductive conception of scientific method was referenced as a model for much of the work that Martin encouraged at Cambridge.[56] According to Popper, the scientific process is cyclical; a hypothesis creates demands for experiments, according to which the hypothesis could be tested and modified.[57] By borrowing Popper's scientific process, Martin and his researchers were constituting architecture as 'a true, socially responsible science based on empirical evidence and theoretical formulation and testing', which did not neglect the creative process.[58]

Despite the mutual interest in applying computing and modelling to architecture, it would be wrong to assume that Cambridge researchers had a unified view of architectural research.[59] Each individual member had their own interests as was evident in different ways in which computing and modelling were applied in the three projects. The Universities Study dealt with their data using operational and economic models, whereas the Offices Study opted for computer-based models and research based on building science.[60] The Urban Systems Study, being the largest in scale, made the most use of computers due to their larger amount of data. Computers may have been useful in allowing huge sequences of architectural forms to be tested but by themselves, computers were 'as much, and as little, a tool as a tee-square, a drafting machine, or a slide rule'.[61]

Although LUBFS was a dominating voice in the School, other kinds of research were also being developed under the same roof in the 1960s. During this period, theory also emerged as a key aspect of architectural education and research.[62] One of Martin's early appointments was Colin Rowe in 1958.[63] Before Cambridge, Rowe had been a student of Rudolf Wittkower, who supervised his thesis on 'The Theoretical Drawings of Inigo Jones: Their Sources and Scope'.[64] Wittkower's theoretical approach was evident in many of Rowe's written works, most notably two articles in the Architectural

Review: 'The Mathematics of the Ideal Villa' in 1947 and 'Mannerism and Modern Architecture' in 1950.[65]

Rowe's theoretical approach to architecture was passed onto some of his students, perhaps most notably Anthony Vidler and Peter Eisenman.[66] Vidler obtained both an undergraduate degree and a Diploma in Cambridge before leaving for Princeton University, whereas Eisenman came to Cambridge in 1960 to work on his PhD while also teaching in the studio.[67] Vidler, Rowe, and Eisenman went to the US in the early 1970s and collaborated on a magazine, *Oppositions*, which reappraised the modern movement in contemporary practice.[68] And with access to the University's excellent archives and libraries and being housed alongside the History of Art Department, history continued to be a focus. Catherine Cooke, for example, started in 1968 to work on the Town of Socialism and became a renowned expert on Russian and Soviet architecture.[69]

The Bartlett

While Cambridge had Martin, Richard Llewelyn-Davies was the moving spirit at the Bartlett. Llewelyn-Davies read Engineering in Cambridge in the 1930s before transferring to Architecture.[70] Having been an active member of the RIBA Board of Architectural Education, Llewelyn-Davies was eager to bring the Bartlett in line with the Oxford Conference proposals. As the new Professor in Architecture and Head of the School, he introduced both minor and major changes to the Bartlett, from raising the entry requirements and putting a greater emphasis on research.[71] Although he arrived at the Bartlett four years after Martin had taken over at Cambridge, Llewelyn-Davies was able to get things going more quickly as the Bartlett was in a better position to change, having been much larger in size and better-established as an institution.

Llewelyn-Davies's inaugural lecture in 1960 made it clear that he had no intention of abandoning his engineering inheritance but instead he intended to build on it. Architecture under his headship, he said, would consider the 'mathematical side of engineering design' and his students would be 'sufficiently literate in physics and chemistry to relate materials and methods of construction to the needs of any particular job'.[72]

The Bartlett under Llewelyn-Davies was driven by the intention to reunite the arts and the sciences, hitherto treated as separate domains in the Beaux-Arts approach of Hector Corfiato.[73] Strides were taken towards the creation of a 'Renaissance Man', a return to an architect trained in a variety of disciplines. In 1965, the undergraduate degree course was reorganised and renamed 'Architecture, Planning and Building'.[74] This was complemented by the appointments of two new Chairs in 'Environmental Design and Engineering' and 'Building'.

Professor Ralph Hopkinson – an active researcher at the Building Research Station in the 1950s and 1960s – had just been elected as President of the Illuminating Engineering Society when Llewelyn-Davies invited him to take the Bartlett's Chair of

Environmental Design and Engineering.[75] Hopkinson's research not only contributed to the understanding of lighting, but also to how lighting design could be applied in actual buildings, particularly hospitals and schools. Hopkinson's emphasis on 'sound engineering' and 'principles of practicality' was a vision shared by Llewelyn-Davies.[76]

Professor Duccio Turin was appointed to the Chair of Building in the same year.[77] While Hopkinson's inaugural addressed the potential for lessons learnt in laboratory experiments to be taught in architectural courses, Turin's inaugural lecture defined building in economic terms.[78] Turin acknowledged the difficulties that might arise from bringing together Architecture, Planning, and Building stating that 'the members of the building team have one thing in common, and that is that they all handle money'.[79] In this respect, both Turin and Hopkinson shared with Llewelyn-Davies a perception that architecture could be perceived through other lenses: economics for Turin; engineering for Hopkinson; and multidisciplinary research for Llewelyn-Davies. In Turin's words, the ultimate purpose of the new Bartlett course, which would train architects, builders, surveyors, planners, and engineers together, was to produce none of these specialists but a 'creative builder'.[80] It is perhaps worth noting that they chose the word 'builder' rather than 'designer'.

In 1968, the RIBA asked Llewelyn-Davies to explain the theoretical background to the changes made at the Bartlett as well as predicting the role of architects in the future. In collaboration with Lord Esher, the resulting report, 'The Architect', noted that the Bartlett's Architecture, Planning, and Building course was 'comparable in general character to the Oxford courses in politics, philosophy and economics'.[81] The idea was that the new Bartlett course would benefit not only architects but related professions and industries in the same manner that Oxford's PPE prepared students for various careers in government and administration.[82]

By 1970, this commitment to bring together different disciplines resulted in the establishment of the School of Environmental Studies, combining the Schools of Architecture and Planning. At this point, there were seven professors: in Environmental Design and Engineering, Building, Architecture, History of Architecture, Planning Studies, Economics of Environmental Planning, and Country Planning.[83]

As a well-established figure himself, Llewelyn-Davies was able to attract notable figures to the School. To initiate research activities, Llewelyn-Davies brought in people who were already scholarly in their architectural approaches. In 1960, the first Honorary Research Assistant, Peter Cowan, was appointed to study hospital design.[84] Reyner Banham joined the Bartlett in 1961 as a Visiting Lecturer and became the first Professor of Architectural History in Britain.[85] Before coming to the Bartlett, Banham had been a member of the Independent Group, written extensively in the *Architectural Review*, and published his bestselling *Theory and Design in the First Machine Age*.[86] And, in 1963, the School welcomed Jane

Abercrombie, a biologist by training with a background in Zoology, as director of the Architectural Education Research Unit and lecturer in 'Perception and Communication'.[87] Her research investigated the teaching at the Bartlett during the 1960s, the period of a radical transformation under Llewelyn-Davies's direction.

Under Llewelyn-Davies, the Bartlett witnessed a growing body of research across a wide range of specialised areas. In 1963, the Architectural Education Research Unit was established; in 1964, the Joint Unit for Planning Research, in collaboration with the London School of Economics; in 1965, the Environmental Design and Engineering Research Group; in 1966 Building Economics Research and the Planning Methodology Research Unit; and in 1967 the Unit for Architectural Studies.[88] In parallel with the research at the Bartlett a number of publications were produced by individual initiatives, especially by Banham whose distinguished publications included *The New Brutalism: Ethic or Aesthetic?* in 1966 and *The Architecture of the Well-tempered Environment* in 1969.[89]

Bartlett students also attended lectures by celebrated figures including Buckminster Fuller, Cedric Price, James Gowan, and James Stirling and crits were given by visiting staff such as Basil Spence, Max Fordham, and Nicholas Grimshaw, among others.[90] According to Llewelyn-Davies, these people were brought in to introduce modernism – with an emphasis on science – to his students. According to Robert Maxwell, one of the first full-time lecturers in the 1960s, Llewelyn-Davies's mission was 'to initiate a revolution in the name of science and common sense'.[91]

Arguably, Llewelyn-Davies's appointments of these specialists and experts proved less useful to students' design work.[92] Unlike at Cambridge, where science and technology were used to support design, it has been suggested that they did the opposite at the Bartlett, actively undermining it. Architectural Design at the Bartlett was governed by Llewelyn-Davies's belief that writing, speech and other communication could represent design just as well as drawing.[93] It has been suggested that this belief, combined with the School's emphasis on sciences and specialisms, created a rift between research and creative design in this period. To quote Andrew Saint,

> no figure in post-war British architecture is now more despised than Llewelyn-Davies. His crime in his critics' eyes was simple but heinous: he challenged the studio's autonomy.[94]

Cambridge and the Bartlett in comparison

Research in the British universities had largely been funded by the government, most notably through the University Grants Committee (UGC).[95] As research ceased to be a priority in the aftermath of the war, there had been major constraints in funding allocations.[96] Within the context where hopes were increasingly laid in science and technology, it became clear that architecture must stretch out its knowledge base from the realm of the arts into that of the sciences in order to keep up with the modern world.

Looking back in retrospect, the two approaches developed at Cambridge and the Bartlett had more in common than they might realise. First, both attempts had shared one and the same underlying purpose: to institute architecture as a serious university subject.

Moreover, despite many available options, they both went about architectural research by adopting a quantifiable model of research that was typical of a scientific subject. Both Cambridge and the Bartlett were committed to the agenda for modernisation adopted at the Oxford Conference that their heads proposed but this was implemented differently. Richard MacCormac, a former student at both Cambridge and the Bartlett, concluded that Cambridge 'believed in the primacy of form and synthesis', whereas the Bartlett 'emphasised analysis in the belief that architecture is sustained by a broad base of knowledge'.[97]

Conclusion
Both Martin and Llewelyn-Davies had suffered from widespread criticism for being too 'scientific' in their architectural approaches. By putting science and technology before design, Llewelyn-Davies, in MacCormac's words, 'sucked the design heart out of the school'.[98] Martin's approach at Cambridge also faced criticism though perhaps, as this article has shown, less fairly.

What Martin and Llewelyn-Davies did, within and beyond their individual interests, was to ensure research was moving on from the interest of the lone scholars to an activity that embraced all kinds of knowledge and expertise. By the end of the 1960s, there were institutions of researchers in architecture schools that did not exist before and architectural research was firmly established. But, as the near closure of the Cambridge School in 2004 showed, the position of architectural research and the place of architecture in research universities remains precarious just as the appropriate nature of architectural education remains a subject of continual debate. The position of architecture as a subject straddling the arts and sciences is both a strength and a problem. Maxwell summed this up very nicely in 1980:

> there is no single theory of architecture, because there are in fact two theories. [...] One is in a Llewelyn-Davies world, the other veers towards a Martin universe. Both claim to have a complete answer. They are not the same, but if we recognise this, we can perhaps learn to deal with both together, and with the narrow margins where they do indeed overlap.[99]

Notes
1. 'Will Cambridge Fall Down?', *Independent*, 20 January 2005 <https://www.independent.co.uk/news/education/higher/will-cambridge-fall-down-487332.html> [accessed 20 November 2019].
2. Research Assessment Exercise (2008) <http://www.rae.ac.uk/aboutus/history.asp> [accessed 20 November 2019].
3. Luke Layfield, 'Architecture Under Threat at Cambridge', *The Guardian*, 29 October 2004 <https://www.theguardian.com/education/2004/oct/29/highereducation.cutsandclosures> [accessed 19 November 2019].
4. The Polytechnics would add to this debate in the 1970s when many argued that architecture was more suited to the vocational stance of polytechnics than Universities. See John Pratt, *The Polytechnic Experiment, 1965–1992* (Buckingham: Society for Research into Higher Education and Open University Press, 1997).
5. The Bartlett School of Architecture and Planning, 'The Bartlett 175' <https://issuu.com/bartlettarchucl/docs/bartlett_175_lo/77> [accessed 10 December 2018].
6. Rowena Hay, Neal Shasore, Flora Samuel, 'Research at the RIBA: An Institutional History, 1958–71', **arq:** 21:4 (2017), 328–37.

7. Ibid., p. 329.
8. John Smith, 'The Bartlett Exhibition', *Architect's Journal* (July 1958), 47–50 (p. 49).
9. The Cambridge riot in February 1970 is widely used as an example of the radicalisation of Cambridge students. See William Ham Bevan, 'Riot at the Garden House', *Cambridge Alumni Magazine*, 61 (2010), 22–7.
10. Mark Crinson and Jules Lubbock, *Architecture: Art or Profession?* (Manchester: Manchester University Press, 1994), p. 89.
11. *Doctors' and Dentists' Remuneration*, Royal Commission Report, 1957–60 (London, 1960); G. Routh, *Occupation and Pay in Great Britain, 1906–79* (London, 1965), p. 67.
12. Verbatim report remains missing from the RIBA collection.
13. Leslie Martin, 'Conference on Architectural Education', *RIBAJ* (June 1958), 279–81.
14. Ibid., p. 279.
15. Evidence that Sir Edward Bridges was suggested can be found in RIBA Archive 7.1.1, 'Board of Architectural Education Committee Minutes: 1950–1965', D.306/57 and A.A. Part in D.675/57.
16. RIBA 7.1.1 D.1118/57, 'Board of Architectural Education Meeting on 27 May 1957', p. 3.
17. D.458/57, 20 Feb 1957, p. 6.
18. D.452/57, 11 Feb 1957, p. 7.

19. D.418/57, 'Proposed Conference on Architectural Education: Preliminary Programme', p. 1.
20. Frederick Measham Lea, 'History of the Building Research Station' (London: H.M.S.O., 1971).
21. Roger Courtney, 'Building Research Establishment: Past, Present and Future', *Building Research and Information*, 25:5 (1997), 285–91 (p. 285).
22. Hay, Shasore, Samuel, 'Research at the RIBA l', p. 330.
23. John R. Gold, '"A Very Serious Responsibility"? The MARS Group, Internationality and Relations with CIAM, 1933–39', *Architectural History*, 56 (2013).
24. Peter Willis, 'Education: The Development of a Process', in *Architecture, Education and Research*, ed. by Peter Carolin and Trevor Dannatt (London: Academy Editions, 1996), pp. 113–17 (p. 113).
25. Nicholas Bullock, *Building the Post-War World: Modern Architecture and Reconstruction in Britain* (London: Routledge, 2002), p. 170.
26. Ibid.
27. For a bibliography, see: C. M. Kohan, *History of the Second World War: Work and Buildings* (London: HMSO, 1952).
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