CHARLES AND RAY EAMES: FURNITURE, ARCHITECTURE, INTERIOR DESIGN.

FILM AND PHOTOGRAPHY.

STANTON STEPHENS BA.

PHD.

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY.

LEICESTER POLYTECHNIC

DECEMBER 1991.
Abstract

Stanton Stephens
Charles and Ray Eames: Furniture, Architecture, Interior Design, Film Film and Photography.

This thesis looks at the main areas of work undertaken by Charles and Ray Eames, namely architecture, interior design, furniture design and their work as communicators. As such it presents an overview of the Eameses' work and shows that it was as innovative in the field of aesthetics as it was in the utilisation of new materials and technology. It also re-evaluates the work of Ray Eames (née Kaiser).

Chapter one, Early Lives and Independent Work, deals with the less well known work of Charles Eames and Ray Kaiser and discusses the lack of attention given to what were important formative periods for both of them. It discusses Ray's involvement with the New York avant garde art world at a time when it was developing a new approach to painting. This was to have great significance for her later joint work with Charles, particularly in terms of form and colour. Charles's early work is discussed in detail and the main influences upon it analysed.

Chapter two, Architecture and Interior Design from 1941, shows the Eameses at the forefront of Modernism in architecture with their utilisation of pre-fabricated frame architecture and argues that they humanised the interiors of those buildings. Chapters three, four and five (Plywood Furniture, Glass Reinforced Plastic Furniture and Metal Furniture) examine their influential furniture designs in plywood, glass reinforced plastic and metal. Hailed as innovatory in the technical sense, the furniture was also distinctive in aesthetic terms and the various influences upon it are discussed. Although much of the furniture has been attributed to Charles alone, these chapters detail the valuable contribution made to it by Ray.

The Eameses were also interested in the communication of ideas and achieved considerable fame with their use of film, multi-media and multi-screen presentations and also exhibition design. During the 1960s and 70s most of their work was in these areas and it is dealt with in chapter six. Chapter seven, the concluding chapter, draws together the various aspects of their work and addresses the main aims of the thesis in so doing.
ACKNOWLEDGEMENTS

Many people and institutions have helped in the preparation of this thesis. Firstly I wish to thank the British Academy for providing me with a travel grant which permitted me to visit Los Angeles, Santa Fe, Saint Louis, Grand Rapids, Miami and New York. I wish to thank a wide range of people in both the USA and Britain who have provided all manner of help with this thesis beginning with one of the main protagonists of the story, the late Ray Eames, Florence Bassett formerly Knoll (née Schust) and John Neuhart. The staff of archives and libraries throughout the USA willingly opened their collections and provided assistance when required including; Linda Folland (Herman Miller, Zeeland, Michigan), Carol A.Kim (Knoll International, New York), Aileen Chuck, (the Museum of Modern Art, New York), Mark Coir (Cranbrook Academy of Art, Bloomfield Hills, Michigan) and the staff of Saint Louis Public Library, Saint Louis, Missouri. J.A Panshall of the National Institute of Design, Ahmedabad, India. The staff at the Kimberlin Library, Leicester Polytechnic, to Pete Smith for willingly providing me accommodation in Leicester. To my travelling companions Simon Thackway and John Croft who each undertook a study tour with me, and finally my tutor Dr Pat Kirkham.
CONTENTS

Introduction .................................................. 1 - 30

Chapter One: Early Lives and Independent Works................. 31 - 72

Chapter Two: Architecture and Interior Design.................. 73 - 125

Chapter Three: Plywood Furniture............................... 126 - 183

Chapter Four: Glass Reinforced Plastic (GRP) Furniture........ 184 - 210

Chapter Five: Metal Furniture.................................. 211 - 253

Chapter Six: The Eameses As Communicators...................... 254 - 303

Conclusion ..................................................... 304 - 310

Illustrations .................................................. 311 - 370

Bibliography ................................................... 371 - 385
Index of Illustrations

Fig. 1. Photographs of Charles and Ray Eames c1941-76.

Fig. 2. 335 Bristol Place, Webster Grove, Missouri, 1933, Gray, Eames and Pauley.

Fig. 3. 101 Mason Avenue, Webster Grove, Missouri, 1933, Gray, Eames and Pauley.

Fig. 4. Chapel in a mountain village near Satillon, watercolour, 1934, Charles Eames.

Fig. 5. Skyscraper, Saint Louis, lithograph, c1927, Charles Eames.

Fig. 6. Town Gate Amberg, pen and ink, 1929, Charles Eames.

Fig. 7. Nude, pen and ink, c1935, Ray Kaiser.

Fig. 8. St Mary's R.C. Church, Helena, Arkansas, 1935, Eames and Walsh.

Fig. 9. St Mary's R.C. Church, Helena, Arkansas, 1935, West Front, Eames and Walsh.

Fig. 10. Meyer House, Huntleigh Village, Missouri, 1936-38.

Fig. 11. Table for Meyer House, 1936-38, designed by Charles Eames, manufactured by John Rausch.

Fig. 12. Form, oil on canvas, 1959, Hans Hofmann. (Tate Gallery, London).

Fig. 13. Composition with Yellow, oil on canvas, c1944, Ray Eames. (Exhibited Los Angeles Museum 1944).

Fig. 14. Cover design for Californian Arts and Architecture, December, 1942, Ray Eames.

Fig. 15. Collage, Arts and Architecture, September 1943, Ray Eames.

Fig. 16. Dot Pattern, c1950, with Ray Eames.

Fig. 17. Sea Thing, (also called Brown and Black Free Shapes on a White Ground, textile design 1945, Ray Eames.

Fig. 18. Carl Milles, Meeting of the Rivers, Alca Plaza, Saint Louis, 1933-40. The basin was designed by Charles Eames.

Fig. 19. Case Study House 11, 1946, J.R Davidson.

Fig. 20. Case Study House 20, Bailey House, 1947, Richard Neutra. Built on the same site as the Eames and Entenza Houses.

Fig. 21. Case Study House 14, Greenbelt House, 1945, Ralph Rapson.
Fig. 22. Case Study House 22, 1959-60, Pierre Koening.

Fig. 23. Case Study House 14, Greenbelt House, 1945, Ralph Rapson.

Fig. 24. Eames House, model of original bridge plan, 1945, Charles Eames and Eero Saarinen.

Fig. 25. Eames House, first plan, 1945, Charles Eames and Eero Saarinen.

Fig. 26. Plan of the site of the Eames and Entenza Houses showing the relative positions of the two houses.

Fig. 27. Eames House designs *Arts and Architecture*, December 1945.

Fig. 28. Eames House, interior arrangement. *Arts and Architecture*, December 1945.

Fig. 29. Eames House, view of facade.

Fig. 30. Eames House, living block.

Fig. 31. Eames House, living block.

Fig. 32. Eames House, studio block.

Fig. 33. Eames House, living block.

Fig. 34. Eames House, living block.

Fig. 35. Eames House, living room looking towards the seating alcove.

Fig. 36. Eames House, staircase.

Fig. 37. Eames House, window showing reflection of eucalyptus trees.

Fig. 38. Eames House, doorbell.

Fig. 39. Entenza House, model, 1945, Charles Eames and Eero Saarinen.

Fig. 40. Entenza House, original designs published in *Arts and Architecture*, December 1945.

Fig. 41. Entenza House, plan of interior arrangement.

Fig. 42. Entenza House, design for front facade, Charles Eames and Eero Saarinen, 1945.

Fig. 43. Entenza House, facade shortly after completion.

Fig. 44. Entenza House, interior view looking towards the fireplace.
Fig. 45. Entenza House, interior.

Fig. 46. Entenza House, interior.

Fig. 47. Herman Miller Showroom, Los Angeles, facade. Charles and Ray Eames, 1948.

Fig. 48. Herman Miller Showroom, side view.

Fig. 49. Herman Miller Showroom, entrance.

Fig. 50. Poster for the Organic Design in Home Furnishings Competition, 1940, E. McKnight Kauffer.

Fig. 51. Furniture for the Organic Design in Home Furnishings Exhibition, MOMA, 1941, designed by Charles Eames and Eero Saarinen.

Fig. 52. Relaxation Chair entered for the Organic Design in Home Furnishings Competition, MOMA, 1941, designed by Charles Eames and Eero Saarinen.

Fig. 53. 'Ala Kazam' moulding machine c1941 developed by Charles and Ray Eames.

Fig. 54. Moulded plywood sculpture c1943, Ray Eames.

Fig. 55. Moulded plywood splint c1942, Charles and Ray Eames and other members of the Plyformed Wood Company.

Fig. 56. Moulded plywood stretcher c1943, by Charles and Ray Eames and other members of the Molded Plywood Division.

Fig. 57. Experimental plywood chairs c1944, Charles and Ray Eames and other members of the Molded Plywood Division.

Fig. 58. Armchair utilising shock mounting developed c1952 by Cristiani and Fratino.

Fig. 59. Child's chair, 1945, Charles and Ray Eames.

Fig. 60. Plywood elephant, 1945, Charles and Ray Eames.

Fig. 61. DCM/LCM chairs, 1947, Charles and Ray Eames.

Fig. 62. DCW/LCW chairs, 1945, Charles and Ray Eames.

Fig. 63. DCM chair, circular moulded plywood coffee table and plywood folding screen Charles and Ray Eames. Photographed by Charles Eames c1950.

Fig. 64. Lounge chair and ottoman, 1956, with turned wooden stool, 1960. Charles and Ray Eames.

Fig. 65. Womb chair, 1948, Eero Saarinen.
Fig. 66. GRP armchair shells, 1950, Charles and Ray Eames, developed by the Eames Office, manufactured by Zenith Plastics, Gardena, California.

Fig. 67. GRP armchair, 1950, Charles and Ray Eames.

Fig. 68. GRP rocker, 1950, Charles and Ray Eames.

Fig. 69. La Chaise, 1948, Charles and Ray Eames.

Fig. 70. GRP side chair, 1950, Charles and Ray Eames.

Fig. 71. Upholstered GRP armchair and rocker, 1951, Charles and Ray Eames.

Fig. 72. Loose cushion armchair, 1971, Charles and Ray Eames.

Fig. 73. GRP stacking chair and trolley, 1955, Charles and Ray Eames.

Fig. 74. La Fonda del Sol side chair, 1961, Charles and Ray Eames.

Fig. 75. ETR (elliptical table rod base), 1951, Charles and Ray Eames.

Fig. 76. Bent wire chair, 1951, Charles and Ray Eames. Photographed by Charles with American Decoy Bird.

Fig. 77. Bent wire chair showing angular spacing of the wire.

Fig. 78. Bent wire chair with attached upholstery pads.

Fig. 79. ESU (Eames storage units), 1950, Charles and Ray Eames.

Fig. 80. ECS (Eames contract storage), 1954, Charles and Ray Eames.

Fig. 81. Sofa Compact, 1954, Charles and Ray Eames.

Fig. 82. Aluminium chair and ottoman, 1958, Charles and Ray Eames.

Fig. 83. Alcoa Solar Do-Nothing Machine, 1957, Charles and Ray Eames.

Fig. 84. Tandem Sling Seating, 1962, Charles and Ray Eames.

Fig. 85. Chaise, 1968, Charles and Ray Eames.

Fig. 86. Two piece secretarial chair, 1971, Charles and Ray Eames.

Fig. 87. Shannon and Weaver's theory of communication illustrated by Charles and Ray Eames in A Communications Primer, 1953.

Fig. 88. George Nelson lecturing at the second public presentation of A Rough Sketch For a Sample Lesson, UCLA, 1953.

Fig. 89. Interior of the IBM Pavilion at the New York World's Fair,
1964, showing the layout of the screens for the Think multi-screen show.

Fig. 90. Still taken from Tops, Charles and Ray Eames, 1969.

Fig. 91. Still taken from Parade; or Here They Come Down Our Street, Charles and Ray Eames, 1952.

Fig. 92. Still taken from A Communications Primer, Charles and Ray Eames, 1953.

Fig. 93. Still taken from Powers of Ten, Charles and Ray Eames, 1968.

Fig. 94. Timeline used in Mathematica: A World of Numbers and Beyond, 1961.

Fig. 95. Timeline used in Nehru: His Life His India, 1965.

Fig. 96. Three dimensional timeline devised for Computer Perspective, 1971.
INTRODUCTION

Charles and Ray Eames (1941-78) are considered by many to be amongst the most, if not the most, important American designers of the twentieth century. Charles Eames (1907-78) and his wife Ray Eames (née Kaiser 1912-88) worked in a wide variety of fields and achieved considerable fame in each (1). They were amongst the first to successfully mass produce modern furniture with their plywood furniture, which was extensively distributed by Herman Miller from 1948, and their glass reinforced plastic (GRP) seating range of the early 1950s. They also achieved considerable fame with the design of their own house in Pacific Palisades, Los Angeles, California (1945-49), which was admired both as an example of domestic pre-fabricated architecture as well as a very personal interpretation of the Modern Movement. The Eameses' concern with the communication of ideas led them to become involved in multi-media presentations, multi-screen shows, film making, exhibition design, for which they again received considerable critical acclaim (2). In 1985 Charles Eames was given the enormous accolade of being voted (posthumously) the most influential world designer at the Washington DC World Design Conference (3). Ray collected the award on behalf of Charles, an award which, in reality, honoured their joint work.

AIMS

The aims of this thesis are: firstly, to examine in detail the main areas of work undertaken by the husband and wife partnership of Charles and Ray Eames, namely furniture design, architecture, interior design,
exhibition design and film and to ascertain if there are any common concerns linking them; secondly, to examine the collaboration between Charles and Ray in an attempt to evaluate the individual contribution of each to the partnership; thirdly, to consider the extent to which and in what ways they were innovative designers, both technologically and aesthetically, and, fourthly, to examine the Eameses' undervalued work as communicators.

**SOURCES**

**Primary sources**

In the preparation of this thesis I have consulted a wide range of primary sources including the Eames Office Archive, Venice, California; the Herman Miller Archive, Zeeland, Michigan; the Knoll Archive, New York, and the Cranbrook Academy of Art Archive, Bloomfield Hills, Michigan. The exhibition catalogues and yearbooks of the American Abstract Artists (AAA) were consulted at the New York Public Library and a copy of the Eameses' *Indian Report*, 1958, was forwarded to me by J.A. Panshall of the National Institute of Design (NID), Ahmedabad. Very little archival material is available in Britain although over the years the Herman Miller Company has donated certain drawings of Eames furniture to the Victoria and Albert Museum, London (4). Contemporary architectural and design journals which commented upon the Eameses' work were also consulted, namely: *California Arts and Architecture*, (from 1942 *Arts and Architecture*), *Architectural Forum*, *Architectural Design*, *Progressive Architecture*, *Architectural Review*, *Domus*, *L'Architecture Aujourd'hui*, *Japan Architect*, *Canadian Architect*, *House and Garden*, *Film*.

Oral history

During my research visits to the United States, I met Ray Eames on four occasions, twice in the Eames House and twice in the Eames Office. I have also used interviews she gave to Dr Pat Kirkham, Linda Folland and Esther McCoy as well as three published interviews with Charles Eames (1958 and 1970) (5), the published speech by Charles at the first Aspen design Conference in 1951 (6) and a tape recorded lecture given by him there in 1978 (7). Video recordings of television interviews conducted with Charles and Ray also proved useful (8). I also interviewed John Neuhart, who proved a fruitful source not only because he and Marilyn Neuhart, his wife and fellow designer, were researching the catalogue raisonné of the Eameses' work but also because they curated the Connections exhibition of 1976-78 which gave an overview of the work of the Eameses (9). Furthermore, John Neuhart worked in the Eames Office from 1952-58 and is a designer whose own work and working methods have been influenced by those of the Eameses.

George Nelson, whom I had contacted, unfortunately died before I could interview him and a similar fate occurred with Reyner Banham, who had been greatly impressed by the Eameses' work in the late 1950s when he was a student at the Architectural Association in London. Although I visited Santa Fe, the home of Alexander and Susan Girard and a popular holiday spot for the Eameses, I was unable to interview Alexander Girard
because of his ill health at the time. I did, however, see the collection of folk art built up by him and his wife, in the Girard Wing at the International Museum of Folk Art in Santa Fe.

I interviewed Florence Bassett, formerly Florence Knoll (née Schust), a fellow Cranbrook colleague of the Eameses, who now lives in Miami. An influential furniture designer in her own right, she married Hans Knoll, the founder of Knoll Associates, New York, and became president of the company in 1951 after the death of her husband. She was happy to chat about the lives of 'Charlie' and Ray Eames as well as Cranbrook in a way which brought to life the atmosphere at the Academy where they had all been students together. I also talked to Henry S. Booth, son of George Booth the founder of Cranbrook, who gave me additional information about life on campus during the 1930s. Another useful conversation, was with Robert Venturi who managed to convey the excitement he felt at the Eameses' work in the 1960s (10).

Whilst I was considering ways of contacting people who knew about the Eameses' interest in India, there occurred what was, for me, a fortuitous event. In March 1986 J.A. Panshall of the National Institute of Design (NID), Ahmedabad, who was visiting Leicester Polytechnic's School of Industrial Design, called to discuss cane furniture with my tutor, Dr Pat Kirkham. Seeing a photograph of Charles and Ray Eames on her noticeboard, he mentioned that he had been a student at the NID at the time of the Nehru: His Life and His India exhibition in 1965 and had worked on its preparation. I remained in contact with Panshall after his return to Ahmedabad and he provided me with a copy of the Eameses'
India Report, 1958, and various Indian architectural and design articles related to the work and ideas of Charles and Ray Eames.

Archives and other primary sources

My first visit to the Eames Office took place in August 1986 at a time when the central work area was taken up with a large scale mock-up of the Eames/Neuhart catalogue (11). At that time the Eames Office formed a veritable Eames 'museum', with Ray as the unofficial curator (from the early days of the partnership, she had been responsible for deciding which parts of each project were retained for posterity). I was allowed to remove some of the dust sheets covering examples of Eames furniture and workshop tools so that I might study them and I also examined parts of film sets and exhibition stands as well as the large collection of objects used by Charles and Ray Eames for all manner of projects. However, like other scholars before me, I did not have access to much documentation beyond the architectural drawings and photographs shown to me by Ray. Whilst the amount of written material in the Eames Office Archive was of a limited nature, largely because Charles disliked written contracts and was a great believer in using the telephone for business (12), whatever one did see was always at Ray's discretion. No scholars were ever certain exactly what remained in the Eames Office. Ray constantly stated that she had transferred a great deal of the archive to the Library of Congress, Washington D.C, but it was not until after her death that this was done and, at the moment of writing, the papers are still not available to scholars (13).
Another useful source was the archive of the Herman Miller furniture company in Zeeland, Michigan, which is well cared for by its permanent curator, Linda Folland. The Eames/Herman Miller relationship was not contractual in that nothing was written down concerning the relationship between the Eameses and the company and therefore little documentary material is available. Furthermore, records and drawings relating to furniture design currently in production are not available for inspection because of the risk of industrial espionage and this applies to those designs discussed in this thesis which are still in production (14). But I was given access to drawings and production specifications relating to the GRP Rocking Chair, 1950, and the Eames Contract Storage project of 1961. The part of the archive relating to the Eameses comprises catalogues, brochures, magazine articles and photographs as well as correspondence detailing the legal battle between Herman Miller and Knoll Associates over the patent for the bent wire process used in the famous bent wire chair of 1951 (see chapter five) (15). Partly to investigate further the Herman Miller/Knoll Associates dispute, but also to get the 'feel' of Herman Miller's main competitors, I also used the Knoll Archive in New York. This proved most interesting, not least because, although Ray Eames and Florence Knoll (now Bassett) both insisted that the companies had a 'gentleman's understanding' of not infringing on each other's work, the Knoll Archive contains letters relating to legal disputes between them (16).

The Archive of the Cranbrook Academy of Art was another useful source, as was the Cranbrook Museum. The former, which is located in the English style country house which forms the centre of the Cranbrook
community, contains photographic records of the day-to-day activities at Cranbrook in the late 1930s and early 1940s when both Charles and Ray Eames were students there as well as registration details of all students and staff. The Cranbrook Museum, established as a repository of art and design from all periods to act as examples for the Cranbrook staff and alumni (17), today houses an outstanding collection of work by former students and staff, including Eliel and Eero Saarinen, Florence Knoll, Harry Bertoia and Charles and Ray Eames. The museum staff have made great efforts to treat Charles and Ray as individual designers in their own right and I was able to study examples of Ray's Cranbrook work and her later textile designs such as Patchwork (1947) as well as drawings by Charles for his Cranbrook architectural projects (18). Their joint work is mainly represented by furniture.

In order to further research the pre-Cranbrook work of Charles Eames I visited Saint Louis where he was born and educated. The records of Washington University, which he attended between 1925 and 1927, reveal little besides admission details but the fame of the Eameses and the recent interest shown in American design of the inter-war years has led to an increasing awareness on the part of the University's Department of Architecture of the importance of Charles Eames's work in his native city (19). There is now an active lobby in the city which attempts to preserve and protect those buildings but, there is still not a complete inventory of Charles Eames's work in Saint Louis. His most prolific year as an architect was 1937, but, unfortunately, because of a fire in the mid 1950s at the Saint Louis Public Library, few, if any, records remain concerning architecture in Saint Louis at that time. The Eames
file in the Saint Louis Public Library, which comprises newspaper cuttings and magazine articles, proved a useful source for the period 1935 to 1941, particularly The Saint Louis Post Dispatch clippings which cover Charles's early architectural work and his contributions to the paper. The Arts and Architecture magazine to a large extent guided the direction of Modernism in California and its outlook influenced the work of the architects and designers it sponsored. It proved a particularly useful source for the early design work and workings of the Eameses but less so from the mid 1950s when the Eameses' relationship with John Entenza cooled off after a dispute (20).

METHODOLOGY AND HISTORIOGRAPHY

This thesis is informed by those debates within design history which have attacked the (now former) hegemony of the Modern Movement and the marginalisation of women. Recent feminist analysis within the history of art, architecture, and design has made me aware of the sexist bias within much of the writing within the discipline of history and its sub-sections of art history, architectural history and design history (21). The sexist bias within most writings on Charles and Ray Eames privileges the input of Charles over that of Ray and colours the way in which the partnership is viewed. The patriarchal bias has meant that to a large extent Ray's role within the partnership has been 'hidden from history' (22). I am all too aware that it is insufficient to simply recover another woman designer from history and that one needs to understand the reasons why women's role in design in general has been undervalued, nevertheless, it remains important to establish Ray's important
contribution to the Eameses' joint work in order to better understand that work.

After the relative gains of World War Two when American women were actively encouraged to work, the immediate post-war period saw a return to emphasising women's role as homemakers. This was particularly so amongst the American middle class. This 'traditional' view of women was emphasised in all manner of women's magazines, Hollywood films and television programmes during the late 1940s and 50s, in which the man was shown as the chief breadwinner. It is wrong to assume that women did not work during this period because many working class women did so out of economic necessity and some middle class women also undertook paid work so long as it did not cut across the achievements of the male breadwinner. The Eameses stood aside from the more rigid gender division of their colour and class in that they formed a working design partnership. But their work was reviewed and written about mainly by white middle class male architectural and design critics who imposed a traditional gender division on the partnership and collaboration. Charles was almost exclusively viewed in terms of his interest in the application of new technologies to architecture and furniture design whilst Ray's influence was mainly seen in matters of colour, detail and decoration (23). This represented a traditional gender division with technological innovation (attributed to Charles) being considered the most important aspects of their designs, while the contribution of Ray was seen in areas that were closely related to women's role as homemakers.
Many critics blamed Ray for what they saw as the more whimsical aspects of Eames designs. What they failed to understand was that what they saw as mere whimsy, the Eameses took very seriously indeed, from the cut-out heart on the Child’s Chair (1945) to the painted faces on the eucalyptus trees in front of the Eames House (c1950). The Eameses perchant for whimsy did not just come from Ray, as the critics implied, but was also present in Charles’s early work (see chapter one). While the categorisation of the individual contributions of Charles and Ray to collaborative work was fairly accurate, writers and critics distorted the importance of Ray’s contribution by viewing her interests as of secondary importance. In this thesis, I will demonstrate that Ray’s concern with form, colour and detail were as important as Charles’s interest in technology and that without the input of Ray the products of the Eames Office would have been very different indeed. It must also be remembered that while they brought their differing interests and talents to bear on their joint designs, they discussed all aspects of their designs before any final decision was taken, especially in their early work.

The growth of feminism from the late 1960s began to challenge the patriarchal assumptions behind a great deal of historical and critical writing and laid the framework for historians to reclaim the role of women in history. Before Ray’s death, Christopher Wilk made some steps to re-evaluate her role in the partnership by getting the labels at the Museum of Modern Art (MOMA), New York, changed to read ‘Charles and Ray Eames’ rather than ‘Charles Eames’ but little else was done. It was as part of her work on women designers that Dr Pat Kirkham visited Los
Angeles in 1984 to interview Ray Eames, a visit which led, in part, to the writing of this thesis, but, by the time of Ray's death in 1988, little other revaluation of her role had been undertaken. Obituaries were, in the main, less than generous, but things are beginning to change (24). For example, the publication, Blueprints For Modern Living: History And Legacy of the Case Study Houses, which accompanied the exhibition organised by the Museum of Contemporary Art, Los Angeles, in 1989, included a case study of the Eames House which gave Ray Eames full credit for her part in it (25).

Charles and Ray Eames were devoted to each other and while Ray greatly admired Charles's talents, he too had great respect for her valuable contribution to the partnership and made it quite clear how he valued Ray's contribution, opening one speech by paraphrasing the popular song 'Anything I can do she can do better...' (26). At Aspen, Colorado in 1978, Charles, began one of his last public speeches with what appeared at the time as an eccentric prologue unrelated to the rest of his speech with the statement 'Ray can really do it; Ray can really do it' (27). In retrospect it is possible to view what was at the time considered a curious outburst as Charles attempting to put the record straight about Ray's important contribution to the partnership, a contribution which only now is being seriously examined.

But a sexist bias is not the only one which brings problems for the design historian. The pro-Modernist bias within design history has proved a strong one until very recently and has coloured the way in which the work of the Eameses has been written about. The dominance of
the Modern Movement between c1918-70 meant that, in the main, only those buildings and designs which fitted in with the tenets of that movement were discussed and those examples both within and without the movement which rejected or challenged the dominant orthodoxy were largely ignored (see definition below). In this thesis I have attempted to analyse the collaborative work of Charles and Ray Eames from a position which does not privilege either the Modern Movement or male protagonists therein.

**Literature review**

The survey of writings about the Eameses which follows reveals a strong pro-Modern Movement bias which manifested itself in a neglect of aesthetic issues and an obsession with technology and 'functionalism'. It also reveals the extent to which the work of Charles Eames was privileged over that of Ray; a great many articles referred simply to him revealing a lack of interest by the authors in, even awareness of, Ray as a collaborator. However, since their joint work was collaborative and, as is argued in this thesis, Ray's contribution was of vital importance, those publications which relate to joint work but are discussed in terms of Charles alone by critics and commentators will be dealt with as dealing with the work of both Charles and Ray.

The earliest published work concerning Charles Eames pre-dates his meeting Ray and is from July 1934. The 'Saint Louian's Mexican Diary', published in *The Saint Louis Post Dispatch*, which described Charles's trip to Mexico in that year is anecdotal but provides some information about the more colourful aspects of Charles's character and work in
these early years (see chapter one) (28). Charles Eames and Robert T. Walsh's St. Mary's Roman Catholic Church, Helena, Arkansas was illustrated in *Architectural Forum* in July 1935 (this drew the attention of Eliel Saarinen to Charles's work) but there was very little description or evaluation of the building (29). This church was also illustrated in *The Saint Louis Post Dispatch* (April 1936) in an article which emphasised the fact that the designers were local Saint Louians rather than evaluating the architecture (30). Although Ray's paintings were illustrated in the American Abstract Artists (AAA) yearbook of 1937, there was no discussion of her work (31).

From the time that Charles Eames and Eero Saarinen's plywood furniture won the *Organic Design in Home Furnishing* competition organised by MOMA in 1940, Charles Eames became a designer of international repute and his work attracted the attention of eminent designers and design critics such as Eliot Noyes (Head of the Department of Industrial Design at MOMA and later Design Director at International Business Machine Corporation (IBM)), Edgar Kaufmann (Noyes's successor at MOMA), Howard Meyer (joint editor of *Architectural Forum*) and Olga Gueft of *Interiors*, all of whom viewed the work of Eames and Saarinen, and later the Eameses, in terms of technological innovation. The first journals to take up the work of the Eameses were the Los Angeles based *Arts and Architecture* and the Boston based *Architectural Forum*. *Arts and Architecture's* discussion of the work of the Eameses began in September 1941 when it was included in a survey of modern design but the most important article appeared in September 1946 (32). It was written by Noyes who had organised the *Organic Design in Home Furnishing* competition and had been closely
involved with the Californian aviation industry during the war. He was to become a major champion of the Eameses' work and a lifelong friend of them both. He was extremely excited by the structural and technological innovations of the Eameses' plywood furniture claiming 'The structural innovations and technical solutions in these designs are so startling' (33). He emphasised three main innovations in the Eames furniture; the moulding of plywood through three dimensions, the flexibility obtained by the use of rubber shock mounts and the attempt to join the seat and chair back to the frame using cyclewelding, an industrial technique which had been highly developed during the war. As a champion of the Modern Movement, Noyes emphasised the mass-production possibilities of the furniture and how the plywood group 'for the first time exploited the possibilities of mass production methods for the manufacture of furniture' (34).

*Architectural Forum* also emphasised technological innovation, claiming, with reference to the 1946 retrospective exhibition at MOMA that, 'Eames's furniture...looked like the first real design exploitation of the possibilities of large scale machine production' (35). Similarly It went on to praise Charles Eames for developing 'the first flexible joint ever applied to furniture construction' (36). Also of great interest were the questions of 'standardisation' and 'interchangeability' as well as the use of new wood colouring methods (37). Both *Arts and Architecture* and *Architectural Forum* covered the Eameses' subsequent furniture designs and continued to delight in the technological inventiveness of the pieces and emphasise their functionalism.

Discussing the Eameses' use of glass reinforced plastic (GRP) in the
1950 armchair, *Arts and Architecture* referred to 'new technical means by which the best of mass production could be made available' and once again emphasised the interchangeability of the bases and the use of rubber shock mounts (38). In 1961 *Architectural Forum* welcomed the Eames Contract Storage as a 'technological' solution to college dormitory furniture (39).

Technological innovation and functionalism was also emphasised in other architectural and design magazines, such as *Progressive Architecture*, *Interiors*, *House and Gardens* and *Architectural Review*. *Progressive Architecture* in 1961, for instance, considered the most important feature of the Eames Contract Storage (ECS) to be its standardisation and interchangeability which allowed for 'variations in individual groups of units' (40). In later years this magazine was a forum for the writings of Esther McCoy, a confirmed Modernist who saw the Eameses' work as the fulfilment of the Modern Movement's commitment to quality mass produced furniture (41). Discussing the Eameses' furniture as a whole in 1975 she saw the Eameses' application of new technologies and mass production as fulfilling the vision of the Modern Movement (42).

*Interiors* first mentioned the Eameses in 1946 and listed the many technological processes used by them, from moulded plywood to the use of shock mounts (43). In the December 1952 issue Olga Gueft presented the Eameses' bent wire chair as an attempt to solve the problem of seating by 'industrial methods' and stressed the constructional advantages of using wire mesh in chair design (44). In November 1961 *Interiors*
focused on the prefabricated nature of the Eames contract storage units (45).

So all pervasive was the avant garde concern with technology that the fine art magazine *Art Digest* also delighted in the shock mounting, claiming it was 'usually applied to engines rather than furniture', and ignored the aesthetics of the moulded plywood chair (46). In 1973, nearly thirty years after the first Eames exhibition at MOMA, the museum remained bound by what had become an orthodoxy of Modernism and, when Charles was given a large retrospective exhibition, the catalogue emphasised the technological importance of the work (47).

A similar approach characterised most writing about the Eames and Entenza Houses. In 1950, shortly after the completion of these two houses, numerous articles appeared in the major architectural and design press (48). The titles of some, such as 'Steel on the Meadow' and 'Steel Shelf With a View', clearly delighted in the technological aspects of the architecture. *Interiors* praised the Eameses' use of 'standard light factory steel framing bolted together' (49) in their own home, as did 'Life in A Chinese Kite' published in *Architectural Forum* in September 1950:

"To create this generous cubage [sic], he turned to a steel fabricator's catalogue, found ready-fabricated parts for an open and well braced frame such is customary for light factory construction... bolted together like a Meccano set... but almost over night it gave him an industrial enclosure..." (50)
The aesthetic innovations of the Eameses, while not completely ignored by the major pro-Modern Movement magazines were, in the main, summarily dealt with. When discussing the plywood group in *Arts and Architecture* in September 1946, for instance Eliot Noyes referred to 'a composition of aesthetic brilliance and technological inventiveness' (51). Noyes recognised that the chair had 'the quality of a brilliant piece of sculpture' but did not comment further on the aesthetics preferring to concentrate on the technological innovations (as discussed above) (52). Olge Gueft in *Interiors*, July 1949, stated the DCM chair had a form with 'a distinct visual and artistic personality' but, again, did not discuss it (53). The British Modern Movement mouthpiece *Architectural Review* illustrated some of the Eameses' prototype plywood furniture in an article on the work of the sculptor Alexander Calder in August 1949 (54). It was wrongly attributed to Eliel Saarinen but it seemed that for once the aesthetic lineage and context of the Eameses' furniture was acknowledged, albeit obliquely, in an article which concentrated solely on the work of Calder. *Interiors* hinted at an aesthetic discussion in an article in the November 1949 issue entitled 'Eames and abstract art for the cafeteria' but no attempt was made to link the aesthetic of the DCM chair to abstract forms and the author emphasised the economies obtained using mass produced modern furniture (55).

The increasing use of colour photography in magazines during the 1950s and 60s affected the way in which the Eameses' work was presented and viewed. Whereas the black and white photographs of the Eames House used in the early 1950s emphasised the stark skeletal nature of the construction, the use of colour photography revealed more of the
Eameses' rich aesthetic. Although the magazines, including major European ones such as *L'Architecture d'Aujourd'hui* ('Maison de Charles et Ray Eames a Los Angeles' by Maurice Silvy, September 1962) (56) and *Domus* ('Dallo Studio di Charles Eames', May 1963) (57) continued to emphasise the technological aspects of the Eameses' work, the colour photographs themselves went some considerable way towards illustrating just how much the Eameses were reformulating the aesthetics of the Modern Movement (see chapter two).

Alison and Peter Smithson, the British architectural and design partners, were the first writers to produce a detailed evaluation of the Eameses aesthetic in the 'Eames Celebration' published in *Architectural Design* in May 1966 (58), twenty years after the appearance of the DCM chair. This was significant, not only in its approach, which discussed the Eameses' aesthetic innovations, but also because it presented the first and most comprehensive chronology of their work until that contained in the catalogue accompanying the *Connections* exhibition ten years later. The celebration was a collection of essays with contributions by Michael Brawne and Geoffrey Holroyd as well as Alison and Peter Smithson. These people, and particularly the Smithsons, retained a great faith in Modernism but were concerned with making it more appropriate to the post war era. Peter Smithson argued that the Eameses' work moved the Modern Movement away from:

"the machine aesthetic and bicycle technology, on which it had lived since the 1920s, into the world of the cinema-eye and the technology of the production aircraft; from the world of the painters into the world of the layout men." (59)
He still located it partly within a world of technology; but he also allowed for aesthetics. Smithson continued:

"The Eames-aesthetic, made definitive in the house at Santa Monica Canyon, California, 1949 (as the machine-aesthetic was given canonical form in the 'dwelling unit' in the Esprit Nouveau pavilion, Decorative Arts Exposition, in Paris 1925), is based on an equally careful selection but with extra-cultural surprise, rather than harmony of profile, as its criteria." (60)

Yet the older style Modernist approach lingered on; this 'harmony of profile' was, according to Peter Smithson (quoting Le Corbusier), based 'on simple geometries - on cones, on spheres, on engineering profiles' (author's emphasis) (61). Nevertheless the Smithsons were the first to recognise the shift in approach to the Modern Movement which 'made it respectable to like pretty things' (62). Indeed, Alison Smithson credited the Eameses as having influenced a new generation of artists and designers in Britain asking 'Does Peter Blake's generation at the RCA know the people who made so much of their ephemera acceptable?' (63).

Important though the Architectural Design collection of essays was, most subsequent writers continued to see the Eameses' work in architecture and design in terms of technology but once they were away from the 'hard' edge of industrial design or pre-fabricated architecture, writers seemed more able to focus on non-technological aspects of the Eameses' work. Exhibitions, for instance, were frequently reviewed in terms of aesthetic innovation rather than technology. Frances Stanfill, discussing the World of Franklin and Jefferson exhibition at the Metropolitan Museum of Art, New York, 1976 recognised how different the
Eames exhibition aesthetic was from the stark one usually associated with the Metropolitan Museum of Art (64).

The role of Ray Eames

The joint work of Charles and Ray Eames represented a close collaboration between two talented designers. From their collaboration on the plywood projects of the early and mid 1940s, certain critics acknowledged that the work was a result of the energies of both of them but then went on to discuss the work in terms of Charles alone. Prior to the 1946 MOMA showing of the plywood furniture, certain writers, including die-hard Modernists such as Serge Chermayeff and Rene D' Harncourt praised Ray's plywood sculpture but once the objects were defined as 'furniture' the emphasis changed (65). Although the author of 'Shock-Proof Furniture' (Architectural Forum, April 1946), claimed that Ray's main interest was 'abstract painting', no attempt was made to link this 'interest' to the forms of the furniture (66).

When her textile designs were featured in American Fabrics, 1951, it was acknowledged that she was a 'co-worker of her husband' but the article then went on to refer to Charles as the 'designer of the famous Eames chair' (67). The approach taken in Zodiac, 1961, gave Ray recognition but took the short-hand and easy way of focusing on Charles Eames because he was the public face of the partnership:

"Mr and Mrs Eames...is the proper title for a design team that has functioned since 1940, has functioned so smoothly behind the scenes that few people, if any, know who contributes what to which products. Since the privacy of the arrangement is something they obviously
prefer and enjoy, it is not only sensible to respect it but senseless to question it: any true collaboration is greater than the sum of its partners. Nonetheless, since they work as one and create as one, we shall discuss them in the singular—focussing [sic] on Charles Eames as the public figure of the team and its spokesman." (68)

Alison Smithson in 'And Now Dhamas are dying out in Japan' (1966) was the first writer to attempt to define Ray's role within the collaboration. She viewed Ray's influence on the Eameses' joint work as central, claiming:

"I can see the part played by Ray Eames in all that they do: the attention to the last detail of the collected material, the perseverance in finding what exactly is wanted." (69)

Many people found it easier to discuss her role in relation to colour and pattern; Doris Saatchi, for instance, in 1984 wrote that 'The intense combinations of colour and pattern in the house area is an expression in part of Ray Eames's talents as a colorist' (70). Ralph Caplan considered that Ray's role was crucial in certain areas but went on to state (like many others) that it was almost impossible to define. Writing in the catalogue accompanying the Connections exhibition, 1976, he claimed:

"Perhaps this is as good a place as any to call attention to the connection between Charles and Ray. They are husband and wife and they are full collaborators, as they have been since the early forties. This in itself is hardly remarkable: design is rarely a solitary activity, and husband and wife teams are not uncommon. But the collaborative nature of the Eames work is easily obscured by the enormous public recognition of Charles as an individual designer and thinker." (71)
Writing in 1989 Caplan argued that 'the problem is not correcting an imbalance, but finding a way (which neither I nor anyone else has so far done) to reflect Ray's crucial but subtle contributions to most of their designs' (72). In the same year John and Marylin Neuhart, as part of a revaluation of Ray in *Eames Design*, argued that:

"Ray was in a large part responsible for the Eames 'look'. Her extraordinary eye for form and color, which never deserted her, often made the difference between good, very good, and 'Eames'.'" (73)

**ECONOMIC/SOCIAL/CULTURAL CONTEXT**

The success of the Eameses' work was closely tied up with the economic, social and cultural changes which took place in the USA after World War Two. By the early twentieth century American products dominated certain markets and by World War Two the USA stood on the verge of world leadership. This position was secured by the Marshall Plan for Europe, established in 1947, by which the USA not only exerted its ideological influence over Europe but secured itself huge outlets for its products (74). America also began to dominate in matters cultural and artistic. The Americanization of European culture dates back to before as well as after World War One but intensified during the inter-war years when the European avant garde delighted in American jazz and cocktails and the general populace in Hollywood movies. In the main, however, most American 'high culture' was based on European precedent although in most cases it was adapted to suit American circumstances and conditions. In terms of architecture and design an important manifestation of this was
the Arts and Crafts Movement which spread across America in the late
nineteenth and early twentieth centuries and is best exemplified by the
California bungalow and the furniture of Gustave Stickley (75). That
aspect of the Arts and Crafts Movement which emphasised natural and
regional characteristics fused with the Hispanic Revival which seemed to
many architects and designers to offer a genuinely American
architectural style (76). At the same time Frank Lloyd Wright was
arguing for an American 'democratic' architecture free from European
influences (77).

The 1920s saw the arrival of European Modernism in its many forms
ranging from Art Deco to the International style. The former
established itself after the 1925 Paris Exhibition and the latter was
popularised in the 1930s by the newly established Museum of Modern Art
(MOMA) (78). In the 1930s artistic, cultural and academic circles
benefitted greatly from the arrival of many artists, architects, film
makers, composers and academics, escaping the ever lengthening shadow of
Fascism in Europe and the USA became a major centre of avant garde
debate and practice. By the late 1930s nearly all the major architects
of the European International Style were established in the USA: Walter
Gropius and Marcel Breuer taught at Harvard, Mies Van der Rohe at the
Armour Institute (now Illinois Institute of Technology) and Lázló
Moholy Nagy at the New Bauhaus in Chicago (79). Their emphasis on new
methods of construction, materials, and emphasis on a 'Machine
Aesthetic' use of new forms influenced countless young architects
including Charles Eames.
The 1920s saw some small scale exhibitions of Scandinavian Arts and Crafts objects in the USA (80). Mainly consisting of glass and ceramics, they were mainly shown in department stores on the East Coast. Nevertheless; they were not without influence, not least because of the strong continuing appeal of Arts and Crafts ideas. The latter partly accounted for the success found by Eliel Saarinen, the Finnish architect and designer, in the USA in the 1920s who offered a sophisticated fusion of pared down classicism and an interest in new forms and materials. From 1925 his influence was felt on a new generation of American designers when he moved his practice to Bloomfield Hills outside Detroit (81). It was a fellow Finn, the architect and designer Alvar Aalto, however, who was to prove an even greater influence on the 'Organic Modernism' evident in the work not only of the Eameses but of many other American designers from the late 1930s (82).

After World War Two the cultural boom which occurred in the USA was so powerful that Europe was forced to sit up and take notice of the new movements emerging from across the Atlantic, be it in painting, architecture, design or literature. The success of the Eameses was closely associated with the emergence of Modernism, in a variety of forms, as the dominant cultural expression of bourgeois America and was dependent upon the economic dominance of the USA which secured for their products a worldwide market.
Footnotes


(3) World Design 85 was hosted by the Design Foundation (USA) and included 2300 participants from 29 countries. I am grateful to Linda Folland for this information.

(4) Victoria and Albert Museum, Department of Designs, Drawings and Prints, press mark W115, revisions to the Lounge Chair and Ottoman in 1980.


(7) 28th Aspen Design Conference, 1978, Charles Eames spoke on 'The Making of Connections'. I am grateful to Linda Folland for sending me a tape recording of this speech.


(9) Held at the Wright Gallery, UCLA, 7th December 1976 to 7th February 1977. Tour'd the USA and Europe.


(12) Author's interview with Ray Eames, Los Angeles, July 1986.

(13) The archive is now under the curatorship of Ford Peatross and mainly contains photographs and slides. It is hoped that the archive will be available to scholars from the mid 1990s. Most of the furniture and prototypes from the Eames office are now in the Vitra Design Museum, Weil Aim Rhein, Switzerland.

(14) These include: LCM and DCM Chairs (1946/47); GRP Armchair (1950/53); GRP Side Chair (1950/53); LTR table (1950), Sofa Compact (1954); GRP Stacking Chair (1955); Lounge Chair and Ottoman (1956); Aluminium Group (1958); *Time Life* Stool (1960); Eames Executive Seating (1961); La Fonda Chair (1961); Tandem Sling Seating (1962); Tandem Shell Seating (1963); School Seating (1964); Segmented Base Tables (1964); Chaise (1968); Soft Pad Group (1969); Drafting Chair (1970); Two Piece Plastic Chair (1971); Loose Cushion Armchair (1971); Teak and Leather Sofa (1984).

(15) The details of the case are outlined in a letter from Peter Price of Price and Heneveld, Patent Counsel, Grand Rapids, Michigan and Vernom Poest, Herman Miller, Zeeland, Michigan, dated February 1 1961, in the Herman Miller Archive, Zeeland, Michigan.

(16) *Ibid*.

(17) It was established in 1927 by George S. Booth as an integral part of the Cranbrook Community.

(18) Including his plan for a studio for Frances Rich.
Author's correspondence with C. Michaelides, Dean of School of Architecture, Washington University, Saint Louis, 6 May 1987.

This apparently concerned the winding up of the wartime plywood production. See Goldstein, B., *Arts and Architecture: The Entenza Years*, Cambridge, Massachusetts, 1990, p. 15.


A similar sexist bias has until recently coloured the way in the design partnership of Charles Rennie Mackintosh and Margaret MacDonald Mackintosh has been viewed. A reassessment of Margaret MacDonald Mackintosh's work formed the basis of my B.A thesis: Leicester Polytechnic 1985.


Cited in Lacy, B. N., 'Warehouse Full of Ideas: Charles Eames was an architect, a furniture designer, a film maker and a photographer', *Horizon*, September 1980, p. 22.

Aspen Design Conference, 1978 (see note 7).

'Saint Louian's Mexican Diary', *Saint Louis Post Dispatch, Sunday Magazine*, July 1934.


'Saint Louis Art for Arkansas', *Saint Louis Post Dispatch*, April 1936.

AAA *Year Book*, 1937, p. 9.

(33) Noyes, E., op. cit., p. 44.

(34) ibid., p. 26.


(36) ibid., p. 10.

(37) ibid., p. 10.

(38) 'Chairs by Charles Eames', Arts and Architecture, October 1950, p. 31.


(41) Committed Modernist and close personal friend of the Eameses, she was a tireless advocate of the Californian Modern Movement. She wrote countless magazine articles and books including; Vienna To Los Angeles: Two Journeys, Los Angeles, 1979 and Modern Californian Houses: Case Study Houses 1945-1962, Los Angeles, 1962. See also McCoy, E., 'An Affection For Objects', Progressive Architecture, August 1973, pp. 64-67.

(42) McCoy, Esther, 'Charles and Ray Eames Design Quarterly, No 98/99, 1975, pp. 21

(43) 'Charles Eames Creator in Plywood Portable Furniture', Interiors, July 1946, pp. 52-59.

(44) 'Eames', Interiors, April 1957, p. 107.


(46) 'Applied To Chairs', The Art Digest, 1st April 1946, p. 12.


(49) Gueft, Olga, op. cit., p. 110.
(50) 'Life In A Chinese Kite', p.93.


(52) ibid, p.26.

(53) 'Material As Both A Structural and A Tactile Medium', Interiors, July 1949, pp.98-99.


(56) Silvy.M, L'Architecture d'Aujourd'hui, September 1962, pp.31-32.


(60) ibid, p.443.

(61) ibid, p.443.

(62) ibid, p.445.


(66) 'Shock Proof Furniture', p.10.

(67) 'Stimulus Range' American Fabrics, vol 20, pp.68-72.


(71) Caplan.R, Making Connections: The Work Of Charles and Ray Eames,
exhibition catalogue, Los Angeles, 1976, p.15.


(73) Eames and Neuhart, op.cit, p.10.


(75) For a discussion of the American Arts and Crafts Movement see Kaplan, W, The Art that is Life: The Arts and Crafts Movement in America 1875-1920, Boston, 1927.


(80) The most important of these exhibitions was Swedish Contemporary Decorative Arts which was shown at the Metropolitan Museum of Art and also visited Chicago and Detroit in 1927.


CHAPTER ONE: EARLY LIVES AND INDEPENDENT WORK

Charles Eames and Ray Kaiser met at the Cranbrook Academy of Art in Bloomfield Hills on the outskirts of Detroit in September 1940, when Charles was thirty three and Ray was twenty eight. Charles had already involved himself in a variety of creative occupations, including architecture, design, lithography, pottery and painting and Ray had been involved for nearly eight years with the avant garde art scene in New York. The period of their lives before they met has tended to be underplayed, partly because it pre-dates the designs which brought them fame and partly because the evidence does not sit comfortably with the notion of Charles as the Modernist architect and Ray the wifely adviser on colour and texture. Stepping aside from a pro-Modernist viewpoint helps one to view the early work of both afresh.

CHARLES ORMOND EAMES JNR

Born on June 17th 1907, Charles was the only son of Charles Ormond Eames and Marie Celine Adele Pauline Lambert, whose daughter, Adele, was then aged four. His father was a New Englander who settled in Saint Louis in the 1870s during the great shift of population to the Midwest and Great Plains after the American Civil War. His mother was a Saint Louian of French ancestry who ran the household in the French tradition (1). Shortly after Charles's birth the family moved East (2), spending sometime in Buffalo and Brooklyn before returning to Saint Louis in 1912 when Charles entered the David Glasgow Farragut Elementary School (3).
Charles's father was a Pinkerton security officer based at the Saint Louis Union Railroad Station, a job which involved long train journeys which frequently kept him away from home for considerable amounts of time (4). He had a strong sense of the dramatic and wrote letters to his young son signed with the pseudonym Victor Samuels (5). In 1915 Charles's father was injured in the course of duty (he was shot in a highly dramatic manner by train robbers in Roanoke, Virginia (6) and forced to retire from work thus enabling him to spend more time with his family. His enforced retirement allowed him to take up the pen and he contributed a variety of stories based on his experiences on the railroad to The American Weekly, a story magazine (7). He was a keen amateur painter and photographer but how much of his father's creative interests rubbed off on the young Charles is difficult to gauge. It was not until after his father's death in 1919 that Charles began to make use of the antiquated photographic equipment which had belonged to his father. Charles never forgot this experience and later stated that; 'I had been making wet plate pictures, mixing my own emulsions, for more than a year before I found out that film had been invented' (8). In a manner which prefigured Charles's work in other areas, he first learnt the techniques before he considered himself proficient in that media. Photography was to remain a great passion throughout his life (see chapter six).

Shortly after his father's death Charles, Adele and his mother moved in with two maiden aunts and, at the age of twelve, Charles began to work in order to secure the family some extra income (9). He took on a variety of jobs as well as continuing to attend school. The first of
these was at a printing shop where he learned the trade from the bottom up, cleaning presses and sorting type faces. Other jobs included working in a chemist's shop and a grocery store as well as in the steel industry (10). He enrolled at Yeatman High School in North Saint Louis in 1921 and had a distinguished school career. He was president of the class and captain of football in his graduation year of 1925 and the class year book described him as; 'A man with ideals, the courage to stand up for them and the ability to live up to them' (11). They were ideals he never lost.

At the same time as he started High School, Charles began work as a labourer (part-time during term and full-time during the vacation) at the Laclede Steel Company which was located across the Mississippi in Venice, Illinois. He not only learned a great deal but also enjoyed the work and was so proficient at it that he was entrusted with small engineering jobs. His ability and success so impressed a rival firm that he was offered a scholarship to study engineering (12). At this time engineers and their work were eulogized by the architectural avant garde which delighted in its technological and aesthetic potential. There were several impressive examples of steel engineering and architecture in Saint Louis, including James B. Ead's massive three span steel and wrought iron cantilevered bridge across the Mississippi (1868-74) and Louis Sullivan's magnificent steel framed Wainwright Building (1890-91), and it was to architecture that Charles next turned his attention.
ARCHITECTURAL TRAINING

Charles took up an architectural scholarship at Washington University in his home town in 1925 and was elected president of the first year class. At that time architectural training was dominated by the French Beaux Arts tradition, which placed a great emphasis on copying and imitating classical architecture as advocated by the École des Beaux Arts in Paris. Charles admired those architects and designers who were trying to break with historicism, especially Frank Lloyd Wright who argued for an American architecture free from the trappings of European historicism, which took note of its American context and acknowledged American historical precedents – witness his 'Mayan' and 'Aztec' houses in Los Angeles of the 1910s (13). Charles was awarded two first prizes for designs in an 'ultra modern' manner but was asked to leave in 1928 without completing his studies (14). It at first seems a strange paradox that Charles admired the discipline of the course to which he was in many ways antagonistic, but discipline was a quality he felt was essential to any good designer (15).

Charles appears to have had few worries about fending for himself financially; he had gained useful experience from previous jobs, including designing lighting fixtures in the summer of 1925, and from working throughout his vacations for the local architectural firm of Trueblood and Graf (16). His architectural work during the next ten years was a hybrid of 'traditional' and 'modern' in their many manifestations and was influenced by a variety of factors, including the
Arts and Crafts Movement, Frank Lloyd Wright and various manifestations of Modernism, particularly that espoused by Eliel Saarinen.

**FAMILY PRECEDENT**

Even though Charles left University without any formal qualifications, his confidence and appetite for architecture was so great that he set himself up in architectural practice. His decision was probably influenced by the career of his second cousin William S. Eames (1857-1915) who had been a very successful architect in Saint Louis and there seemed little reason why Charles could not do the same in a city which seemed thriving both economically and culturally (17). William S. Eames was a partner in the Saint Louis firm of Eames and Young which, from the mid 1880s, had a prolific practice in Saint Louis, being responsible for ten buildings at Cupple Railroad Station 1894-1914, referred to in the *Smithsonian Guide to Historic America* as 'an important grouping of turn of the century commercial buildings' (18). Other noted buildings by them in Saint Louis were the Gothic Revival Wright Building of 1903-08, and the Education Building at the Saint Louis World's Fair of 1904 (19). During the early 1900s the firm's national reputation grew and it won commissions in other cities, including the Custom House in San Francisco of 1906-11. But the crowning achievement of William S. Eames's career came in 1904, the year of the Saint Louis World's Fair, when he became president of the American Architectural Association (20). The young Charles, then, had a role model of a very successful architect in the family.
At a time of great economic uncertainty, it was difficult for a young inexperienced architect such as Charles Eames to work in avant garde styles such as the International Style. It could be argued, therefore, that Charles's lack of work in a pure Modern style before 1940 was as much due to the effects of the Depression as to any deliberate choice on his part. In favour of this argument is the fact that he had been impressed by the Weissenhof Siedlung in Stuttgart which he visited in 1929. Against this is the fact that he rarely did anything to which he was not fully committed. Nevertheless, the economic situation was extreme, with the Depression affecting all aspects of American life following the Wall Street crash of 1929. By 1932 manufacturing output had fallen to fifty four percent of what it had been in 1929: car manufacture stood at one fifth of its 1929 peak and the steel plants were producing at only twelve per cent capacity (21). By 1930 there were six million unemployed and in the building industry employment fell by sixty three per cent between August 1929 and March 1933. In New York alone eighty five per cent of all architects were unemployed in 1932 (22).

CHARLES EAMES AND EUROPE

During the inter-war period many American artists, sculptors, writers and poets who wanted to be part of European Modernism settled in Paris to escape the somewhat parochial atmosphere at home. Gertrude Stein termed them the 'Lost Generation' (23). Few architects followed this
exodus to Europe but many, including Charles Eames, did visit Europe even though, by and large, they failed to appreciate what European Modernists saw as the glories of American architecture (24). Charles's architectural horizons were further broadened when he travelled to Europe in 1929 on a honeymoon financed by his father-in-law after his marriage to Catherine Woermann in that year (25). In Europe he saw at first hand the work of Mies Van der Rohe, Walter Gropius, Le Corbusier in the International Style at the Weissenhof Siedlung in Stuttgart, an experience which he described as 'like having a cold hose turned on you' (26). Charles was greatly stimulated by what he saw and made many sketches of the buildings in the exhibitions. However, the effect that it had on Charles is difficult to gauge because, on returning to Saint Louis, his work did not reflect these new influences.

EAMES, GRAY AND PAULEY

On his return to Saint Louis, Charles went into partnership with a former Trueblood and Graf colleague, Charles M. Gray. They were later joined by Walter Pauley. One of the firm's earliest designs was for a house for Ernest O. Sweetzer, a Professor of Engineering at Washington University, in 1930. Located in the Wydown area of Saint Louis, the exterior of the house reflected the current interest in Colonial styles. Little else is known of the firm until 1933, when it designed two contrasting houses in Webster Grove, Missouri. The first, 335, Bristol Place, came complete with eighteenth century sash windows and a porch which suggests that either the client or the architects were keenly interested in the Colonial Revival (Fig. 2). The house formed an ideal
backdrop for the client's collection of American eighteenth century furniture (27) but it must be remembered that, in order for the successful completion of an architectural project, both architect and client must be in agreement as to the nature of the design and the client should not take the 'blame' for this revivalist design. Here Eames and his partners worked in a mode popularised by the recent restoration of Colonial Williamsburg (28). The second house at 101, Mason Avenue, a brick two storey suburban house, was similar in structure but more modern in character with a low, almost flat, roof, white painted brickwork and metal framed corner windows (Fig. 3) (29).

Eames, Grey and Pauley also worked on the restoration of the Saint Louis Pilgrim Congregational Church on North Union Boulevard. Originally built in 1907 by Mauran, Russel and Garden, it had been damaged by lightning and the firm restored the spire and the west door and, Eames together with Emil Frei, designed and manufactured the stained glass windows and mosaics (30). Again, just how far these various designs represented the artistic preoccupations and inclinations of the partnership and how far they represented the wishes of the clients is not clear. In later years at least, Charles Eames never took on any work with which he did not feel entirely happy and therefore one can only assume that at this date he had no moral objection to designing in a revivalist manner or to moving eclectically from one style to another. It is this eclecticism and lack of 'purity' which made, and still makes, his work of this period uninteresting and unpalatable to hard line Modernists.
The small amount of work which the firm secured was insufficient to sustain the partnership and in 1934 Charles found work with the 'New Deal' Works Progress Administration (WPA) documenting historic buildings in Saint Louis, Ste Genevieve and New Orleans (31). But, frustrated by the lack of opportunities, in 1934, at the height of the Depression, Charles left his home, wife and young daughter Lucia and set off on an eight month long trip to Mexico - a trip which he later referred to as his 'On The Road' tour (32). He made a little money by sending watercolours and stories about his colourful experiences to the Saint Louis Post Dispatch, which featured them in its 'Saint Louian's Mexican Diary in Watercolour' commenting:

"The architect confined his travels to the northern states of Coahuila, Nuevo Leon and San Luis Potosi. Part of the time he lived with people of the Peon class, eating and sleeping in their lowly homes, often repaying their hospitality by making pictures of them. Once he was the honoured guest of a mountain village, having won the friendship of the villagers by repainting a statue of St. Peter in their chapel. A fiesta was held in celebration of the event and solid-faced Peons thanked him with tears running down their cheeks." (33)

Charles had little money and spoke no Spanish and, in an area where locals were suspicious of strangers, was arrested twice. The most dramatic incident occurred in Linares, Nueva Leon, where he was arrested for having in his possession a book on Mexican antiquities which local officials considered showed their country in a bad light. His fate was to spend two nights in jail, and was only released after the intervention of the American Consular Office (34).
This trip introduced Charles to two aspect of art and design new to him; namely a native American tradition of architecture and an immensely rich craft tradition. So taken was he with the ethnic crafts that he returned to Saint Louis with a small collection of craft work, including a wand used in the rituals of the ancient Toltecs (35). This interest in and admiration of ethnic objects was to form an important aspect of the Eameses' later work in interior design (see chapter two).

Charles produced topographical oil paintings and watercolours executed 'en plein aire', viz Chapel in a Mountain Village near Saltillo (Fig.4). A skilled topographical artist, he had regularly produced views of his native Saint Louis, some of which he had made into prints on his own press (Fig.5), and on his European tour he had sketched the architecture of places such as Bruges and Amberg (Fig.6). His work cannot be called innovatory in style; indeed his Mexican paintings were highly derivative, being executed in the manner of the Spanish Impressionist artist Joaquin Sorolla, who was extremely popular in the United States in the 1910s and whose work hung in the Saint Louis Art Museum (36). Charles's Mexican paintings were exhibited on his return to the United States in Norfolk, Virginina, but a planned show for New York never materialised (37). Had it done so, the work would have looked 'dated' compared to that of Ray who, by then a student of Hans Hofmann, was producing decidedly avant garde pieces (Fig.7).
Once back in Saint Louis, Charles joined up with Robert T. Walsh, who had also worked at Trueblood and Graf, and they remained in partnership from 1935 to 1938. The full extent of their work during this period is difficult to gauge although they designed and built at least two churches and two country houses (38). While these designs were not in the Modern Movement style and have been ignored by historians, they go beyond the straightforward Revivalist designs so popular for domestic and ecclesiastical building during the 1930s. Eames and Walsh produced designs which were highly original and showed an awareness of the architecture of Eliel Saarinen.

The partnership received commissions for two churches in Arkansas; a small church in Paragould and the more impressive Roman Catholic church of Saint Mary at Helena (Fig. 8). Designed in 1935 'with the manifest intention of making the most simple and extensive use of brick surfaces' (39), this medium sized structure built to a traditional church plan and topped by a wooden spire is strongly influenced by Scandinavian National Romanticism. The exterior was of simple design with highly attenuated buttresses and narrow window slits, the most elaborate part being the west front (Fig. 9). There, confronted by a mass of bricks, the eye is drawn to an abstracted figure of Christ by Caroline Risque and the expressionist decoration above the door which indicates an awareness of Art Deco design (40). Eames and Walsh were involved with every aspect of the design from the construction of the building to the design of the interior fittings, vessels and vestments in an attempt to provide a
unified interior. The church attracted the attention of the architectural critic Howard Meyer who illustrated it in Architectural Forum (41) and it was through this that Eliel Saarinen came to contact Eames and Walsh (42).

The influences at work on Eames and Walsh on the Saint Mary's commission were carried through to their next commission, the Meyer House, (1936-1938) (Fig.10). This was the major achievement of Eames's Saint Louis period and more fully expressed the architectural ideas advocated by Eliel Saarinen. Eames enrolled at the Cranbrook Academy of Art, of which Saarinen was Director, and regularly visited him when the Meyer House was being designed and constructed in order to obtain advice and to liaise with other Cranbrook designers who worked up his designs for stained glass, rugs, metalwork, and fabrics (43).

Mr and Mrs John Philip Meyer who commissioned this medium sized country house with five bedrooms, servants quarters, library, nursery and wine cellars, located in Huntleigh Village, Missouri, wanted it to look up-to-date (44). Mrs Meyer recalled that 'we had met Charles Eames through his first wife Catherine Woermann, who had been a classmate of mine. We knew we wanted a contemporary house, we'd seen the houses that Charles had designed, and decided to give him the commission' (45). It was designed late in 1936, but the first set of drawings were rejected by the clients; 'I can't remember, why, now, but they just weren't what we wanted' (46). It may have been that they were not considered sufficiently 'up-to-date' because Eliel Saarinen suggested that certain details, such as the niches in the dining room, which were based on an
eighteenth century prototype, be changed with the result that the clients found the second designs less 'traditional' and much more to their liking.

Typical of much 1930s architecture, the house was a combination of the modern and traditional, with traditional materials disguising a modern construction. It used a steel frame with brick infill, had concrete and aluminium sash windows, which Mrs Meyer mistakenly claimed as the first such windows in Saint Louis although Eames and Walsh had used them in an earlier house in Webster Grove (47). Modern and traditional elements were mixed in the interior in which the main staircase was built of marble, a traditional and luxurious material, while the balustrade was made from aluminium, a very modern material. The interior design relied on historical precedent. The entrance hall had an elaborate maple inlaid parquet floor, based on eighteenth century French examples, and a rich colour scheme of terracotta walls and silver leaf ceiling which was thought to have an eighteenth century precedent (48).

The two most important interiors of the house were the living room and dining room, for which Eames also designed the furniture. The former, a long rectangular space with a classical coffered ceiling, had as its central focus a large marble fireplace which was flanked by two niches and on which was placed a bust designed by the Cranbrook sculptor Carl Milles (49). The walls were in the fashionable colours of pink and grey which were also found in the furniture, upholstery and curtains designed by Loja Saarinen, wife of Eileen Saarinen, and were offset by terracotta coloured rugs designed by Stanilus V'Soske (50). The designs for
curtains and rugs, with their geometric forms added a contemporary feel to the interiors. The furniture was all designed by Eames, including a veneered card table and four armchairs in a Classical Revival style of which has an Art Deco flavour (Fig.11) (51). The classical theme of the living room was completed by the use of co-ordinated classical motifs based on the acanthus leaf and clam shell, the former being found on the light fittings and the latter on door pulls and fire irons (52).

The dining room was even more formal in spirit than the living room, although it too conformed to contemporary fashionable colour schemes; the walls were painted plaster grey, offset by yellow curtains and brocaded upholstery in coral and silver whilst the Eames designed carpet was white (53). Eames designed a chandelier and an inlaid sideboard for this room. It was only these two main rooms for which Eames submitted complete interior schemes. Elsewhere genuine antique furniture was used, although he did design a sectional sofa, specifically to fit a bay window in the library, as well as rugs and draperies which were made up by Cranbrook staff and students (54).

The house was designed as a dwelling for a wealthy family with an interest in the arts. Indeed Eames and Walsh made reference to the Meyers' interest in the arts by incorporating a Mozart memorial carved in the bricks of the terrace (55). Eames and Walsh also injected a touch of humour into the design by incorporating precast concrete gargoyles on the exterior of the building (56). In the joint work of the Eameses this sort of detail was usually attributed to the hand of
Ray but here we have an example of Charles introducing 'whimsy' into his work before he had even met Ray.

The house is similar to the Saarinen House at Cranbrook, designed by Eliel and Eero Saarinen in 1928–30. Both the Cranbrook House and the Meyer House feature abstracted forms from a variety of sources and were designed as a series of interlocking forms. The interiors of the Saarinen House were less historically specific than those of the Meyer House but the colour schemes were very similar and both had furnishings, textiles and ironwork made up in the Cranbrook studios. Charles Eames based his furniture designs on those in the Saarinen house; witness the similarity of Saarinen's design for a table in veneered walnut and Eames's in veneered cherry. Although there are formal differences in that Saarinen made use of stretchers and Eames utilised an abstracted fluted motif at the top of the tapered legs, the proportions and restrained classicism of the tables are remarkably close. The Meyer project brought Eliel Saarinen and Eames into close contact and Charles was offered a Fellowship to study at the Cranbrook Academy of Art, arriving there in the autumn of 1938 (57).

**RAY KAISER**

Bernice Alexandra Kaiser was born on December 15, 1912 in Sacramento, California. Affectionately known as 'Ray-Ray', she had her name changed legally to Ray in 1954 (58). The third child of Alexander and Edna Burr Kaiser, Ray had an elder brother Maurice, and a sister Elizabeth, who died in infancy. Her father worked at a variety of jobs including
jeweller, variety theatre manager and insurance salesman (59). Ray, showed an early aptitude for art during her schooling in Sacramento. After attending Sierra Elementary School from 1918 to 1925, she moved to Sutter Junior High School, where she remained until 1928 (60). She then entered Sacramento High School, joining the Art Association and chairing the decoration committee for the High School annual football dance (61). While art remained her favourite subject she also enjoyed French and English. After graduating in 1931, Ray spent one term at Sacramento Junior College before she and her widowed mother moved to New York to be near her brother who was a cadet at West Point Military Academy (62).

**NEW YORK**

In 1931 Ray began studying at the May Friend Bennet School, Mill Brook, New York, from which she graduated in 1933 at the age of twenty one. By that time she knew that she wanted to develop further her interests in art, an interest which had been greatly stimulated since her arrival in New York which in the early 1930s was an exciting place to be for a young artist. Ray was a popular figure within the avant garde, earning the nickname 'Budda' which somewhat unkindly referred to her chubbyness and diminutive size (63).

The 1930s saw a polarization in the fine arts, as in architecture, between the avant garde and the traditional, but within these camps there were many factions each composed of strange bed fellows. The traditionalists, who countenanced only the use of realist forms, for instance, included left wing social realists such as William Cooper and
Ben Shahn as well as the isolationist regionalists such as Thomas Hart Benton, John Steuart Curry and Grant Wood, whilst the avant garde, was fragmented into several groupings (64). Ray became closely involved with two of these groups including, the American Abstract Artists (AAA) and Hans Hofmann's school. This put her firmly at the centre of important artistic developments which were to have a great impact on the later work of herself and Charles Eames.

Hans Hofmann was the seminal figure in the development of what came to be called Abstract Expressionism, a form of abstraction that came to dominate avant garde circles in the immediate post war years. Hofmann has been called the most important teacher of Modern Art in America, and this despite his appallingly poor English (65). Clement Greenberg, the preminent art critic, claimed that 'he had brought a new liveliness of surface to American painting' and went on to claim that:

"Hans Hofmann is in all probability the most important art teacher of our time...He has, at least in my opinion, grasped the issues at stake better than did Roger Fry and better than Mondrian, Kandinsky, Lhote, Ozenfant and all the other who have tried to 'explicate' the recent revolution in painting...This writer...owes more to the initial illumination received from Hoffmann's lectures than to any other source...I find the same quality in Hoffmans painting that I find in his words—both are completely relevant. His painting is all painting.... asserting that painting exists first of all in its medium and must there resolve itself before going on to do anything else" (66).

Hofmann, who had lived in Paris from 1904 to 1914, was the bridge between Parisian Modern Art and that of New York. He combined the two main aspects of Modern Art, namely abstract form and colour. He drew on the colour of the Fauves, the structure of Cubism and the brushwork of
the German Expressionists, as can be seen in *Pompeii*, 1959, (Fig. 12).
In many ways Hofmann reemphasised the tenets of Modern painting which
had developed with Cezanne, in that painting must find a new way of
expression rather than attempt to recreate 'reality' on the canvas.
Unlike most of the later Abstract Expressionists, Hofmann emphasised the
need for artists to study and find inspiration in nature and to
reinterpret their findings with the utilisation of dynamic colours and
brushwork pitted against the flat nature of the canvas; indeed Ray Eames
later remembered well the countless naturalistic drawings Hofmann made
his students execute (67).

In *Pompeii*, Hofmann manipulates the rectangles by means of differing
colours, overlaps and different sizes thereby causing a perceivable
tension within the picture, sometimes referred to in terms of a 'push
and pull' aesthetic (68). A similar 'push and pull' aesthetic is seen
in the seat and backs of the Eameses' DCM chair, 1946, and appears to
come from Ray's early training with Hofmann (see chapter three). Ray
joined his school in 1933, in its first year in Greenwich Village, the
bohemian section of New York, and went on its regular summer trips to
the long established art colonies of Provincetown and Gloucester,
Massachusetts, until she enrolled at Cranbrook in the autumn of 1940
(69). It was this circle around Hans Hofmann which was to spearhead
that most significant leap in American painting, namely the transition
from styles based on European developments to one which was seen as
genuinely American and which saw the baton of Modernism pass into the
hands of the School of New York and pave the way for the artistic
revolution created by Jackson Pollock and the other 'action painters'

- 48 -
However, during the period 1933 to 1940 Ray's work generally owed more to the AAA than to the ideas of Hofmann. She was one of the founders of the AAA, established in 1936 to promote abstract art in general, although it favoured work which was derived from the Bauhaus or Parisian non-objective painters (70). The artists within the AAA, Ray included, used cleanly edged forms in flat colours thoughtfully knitted together and contained within the picture frame but their work was criticised as being imitative:

"Intent on keeping abreast of the European avant-garde, the AAA produced work that was largely derivative and eclectic. They were often attacked for this, and to counter criticism, tried to make a virtue of imitation." (71)

One of the great heroes of the AAA was the Dutch Neo-Platonist artist Piet Mondrian, who developed a rigorous system of rules for Modern Art which appealed to a whole generation of American artists, including Ray Kaiser, who were striving to come to terms with abstraction (72). Irving Sandler claimed that 'Mondrian's painting was probably better understood and appreciated by a larger group of artists in America than anywhere else in the world' (73). The use of Mondrianesque composition and colours is clearly seen in some of the later work of Charles and Ray Eames, particularly the exterior of the Eames House and the Eames Storage Unit (ESU) (74).

Increasingly AAA members turned to more organic forms derived from the later work of Pablo Picasso and from Paul Klee, Hans Arp, Joan Miro, and the colour washes of Wassily Kandinsky in order to break out of the Cubist mould which held them back from experimenting with form and
technique (see Ray Kaiser's series of abstractions c1935 Fig. 7).

Although not as formally daring as the Hofmann group, the AAA was a vociferous and militant body which fought for the right to exhibit non-representational art, organised petitions and picketed galleries which refused to show the work of its members. They organised exhibitions at the Riverside Galleries in Manhattan, where Ray Kaiser showed work in the very first AAA exhibition of 1937, and produced regular catalogues in which they expounded their views on painting. In 1938 they claimed that 'To understand abstract art is... no more a problem than understanding any and all art. And this depends upon the ability of the individual to perceive that which is called universally significant' (75). Their most active year was 1940 when they mounted a large show at the New York World's Fair and picketed MOMA which was accused of concentrating on European art. The AAA declined after the entry of the USA into World War Two in 1941 because some members went to work as war artists while others were involved in the war effort in different ways.

While in New York Ray attended modern dance classes led by the well respected choreographers Martha Graham and Hanya Holm (76). In short, she was a Modernist through and through by the time she met Charles. When Ray Kaiser chose to identify with the avant garde purist Modern camp there was an increasing polarisation between the 'traditional' and the 'Modern' in America. Her siding with the avant garde as early as 1933 contrasts with Charles Eames who, at the same time, was working within more traditional parameters. When Ray's mother died in 1940 she was encouraged by Benjamin Baldwin, a fellow Hofmann pupil, to study at the Cranbrook Academy of Art to which she moved in the autumn of that
year. It was there that Ray Kaiser and Charles Eames met, and formed one of the most important design partnerships of the twentieth century.

**Graphic Design**

Although Ray's own paintings did not break new formal ground she absorbed the ideas of Hans Hofmann and developed them in her own work. After her move to Los Angeles with Charles in 1941 she continued to paint, exhibiting *Composition with Yellow* at the Los Angeles Museum in 1944 (Fig. 13). Increasingly she turned to sculpture which represented an independent aesthetic exercise and was also important in terms of the development of the plywood technology and therefore vital to the entire plywood undertaking (see chapter three). At the same time she began to design graphics for *Arts and Architecture* producing some twenty four covers between 1942 and 1947. Prior to this Ray had never involved herself with graphic design but her fine arts training was a great boon to her work as a graphic designer. Her cover for April 1942 is clearly derived from the biomorphic shapes of Hans Arp, while the August 1944 cover reflects the forms of Joan Miro with its use of elongated black forms placed against a lighter background and the December 1943 cover, with its use of ink splashes, reflects the more automatist ideas of Surrealism and contrasts with her more usual objective use of images. The December 1942 cover is derived from the aesthetic theories of Hans Hofmann and her use of overlapping squares compares well with anything that Hans Hofmann had produced by that date (Fig. 14) (77).
Of the greatest importance for Ray Eames's work as a graphic designer, however, was her contact with the Swiss émigré Herbert Matter who worked for the Eameses from 1943 to 1946 (78). Together with Alvin Lustig, he was responsible for altering the layout of Arts and Architecture and giving it a more modern look (79). Matter was at the forefront of avant garde graphic design and was responsible for showing Ray Eames and others new and exciting ways to juxtapose images. Increasingly Ray favoured images for the magazine that referred to the contents of the issue, as can be seen in the August 1943 cover with its depiction of a Modern house heralding the Designs For Post War Living competition of 1943.

Her covers combined images of new technology, science and art in a visually exciting way, be it electric pylons (March 1947) or a cross section of an aircraft wing juxtaposed against a graph explaining a mathematical equation (November 1943) (80). Ray's most dynamic use of juxtaposition was in her collage of May 1943 which included images such as Picasso's Guernica (1937), electric pylons, shock mounts (as used in the furniture projects), army helmets, parachutes and a skyscraper design by Le Corbusier (Fig. 15). It was strongly reminiscent of the work of Matter, most particularly his collage for an article on 'Industrial Housing' (81). Her covers also utilised Charles's drawings and photographs all of which added to Arts and Architecture's modern image of concern with utilising new technology in the cause of post war architecture and social change.
Her concern with graphic presentation did not end with the cooling off of the Eames and Entenza friendship (82). She worked for Herman Miller from 1946 and was greatly assisted with the graphics for that company by the young designer Charles Kratka (83). Together they applied the dynamic juxtaposition of images to the commercial product literature of Herman Miller. In the graphics for the Eames Storage Unit (ESU) of 1950, for example, one particular illustration shows the piece bent and contorted in order to give an all round view, a position greatly favoured by the Cubists (84). However, because of its Mondrianesque grid, the graphic presentation took on a very abstract look, probably more abstract than desired. The Eameses increasingly favoured more realistic representations of their products, contrasting them against personal and ordinary objects such as flowers and plants, toys and folk art but they also became less involved with the advertising of the products (85). During the 1950s as Ray's role diminished staff designers, particularly John Neuhart and Deborah Sussman, undertook a great deal of the graphic work which came into the office, although her influence on the work remained important (86).

CRANBROOK

George G. Booth and the Cranbrook Community

The Cranbrook Academy of Art was the vision of the philanthropic Detroit newspaper baron George G. Booth (1864-1949) who was greatly influenced by William Morris, the English design reformer and socialist who was one of the main founders of the Arts and Crafts Movement (87). In 1927 Booth established on his farm estate at Bloomfield Hills on the
outskirts of Detroit an educational community which included a Greek theatre and a religious meeting hall (88). A confirmed Anglophile, his love of things English was reflected in the naming of his country estate after the village of Cranbrook in Kent, the home of his forebears who were craftworkers:

"In Cranbrook, Kent my father was born, and my grandfather and great-grandfather lived and worked as craftsmen. My grandfather, whom I as a child remember seeing only once or twice was a coppersmith, and a master of the craft. He made those wondrously-formed ewers, kettles, and flagons of which the antiquarian is so proud — made them by hand as his father before him did. He was proud of his handiwork, and this characteristic has clung tenaciously to each branch of the family since, and I am certain it accounts for my own love for the artistic work of the handicraftsman." (89)

All the early buildings on the estate reflected Booth's taste for English architecture — witness the country house built for his family by Albert Kahn in 1906 along Arts and Crafts lines and Christ Church (which formed the spiritual centre of the community) designed by Bertram Grovenor Goodhue (1924-28) in an amalgam of English Gothic styles. In 1900 he established the Cranbrook Press which was based on William Morris's Kelmscott Press and used Morris typefaces (90).

His interest in the Arts and Crafts movement spurred him to champion design reform, but, in the manner of Henry Cole half a century earlier, he was concerned with the quality of design in the commercial manufacturing sector. His main target for reform was his adopted city of Detroit, a city which was fast becoming the centre of motor car production in the United States but which did not have an art school (91). Booth was involved in the founding of the Detroit Society of Arts
and Crafts, which ultimately led to the establishment of the Detroit School of Design in 1911 (92). By the mid 1920s Booth realised that it would be impossible to reform design from within the existing Arts and Crafts institutions and his growing disappointment with the current state of architectural and design education available in the USA was fed by the experience of his son as an architectural student at the University of Michigan, Ann Arbor (93).

There was a great deal of discussion about design reform in America during the years after World War One. One of the clearest expressions of American ideas came in Charles R. Richards's *Art In Industry*, 1922, which surveyed the state of American applied arts and argued that, although America was gearing itself for world leadership, it lagged behind Europe in terms of design. In a section entitled 'industrial art education in Germany' Richards argued for reforms on the German model, stating that:

"The Arts and Crafts Movement has had little influence in raising the general level of design. This is in contrast with the history of such work in Germany, where instruction in the arts and crafts is not only carried on very effectively in the schools but, what is more important, exerts a very large influence in the production of the factory and of the workshop" (94).

This book had a considerable impact in America, not least because it indicated the ways in which some of the ideas of the Arts and Crafts movement could be used in a progressive manner to further the mass production of well designed goods.
It was through the design reform debate that Booth became convinced he could best serve design in Detroit by using his vast fortune to establish his own educational community rather than support existing institutions. Booth and his wife, Ellen Warren Scripps Booth, travelled far and wide to find an institution on which to model theirs. It was the American Academy in Rome, established in 1894 as a centre for American artists and academics to study in Europe, which the Booth's visited in 1922 which most impressed them. One observer put it thus:

"The primary objective is to afford to persons of advanced training an opportunity for residence and study in Rome and Europe, generally under conditions such, that while they are given every freedom for individual development, each member is brought into contact with other members working in the various allied arts. This fellowship of the students among themselves, and their informal contact with members of the faculty, are the means by which influence is brought to bear on them rather than by formal instruction." (95)

Ironically, the architectural department of the academy was a highly conservative institution which, in many ways was responsible for promoting classical Beaux Arts styles in America but the progressive communal and collective aspects of the training impressed the Booths.

It was through his student son that Booth met the future architect of the community and its first President, Eliel Saarinen, who was a visiting professor at the University of Michigan. In Saarinen, Booth found an architect committed to Arts and Crafts ideals but prepared to take on contemporary issues and in 1925 asked him to prepare a plan for the educational community, although the academy did not formally open until 1932. The original scheme was rejected by Booth because he
considered it over ambitious but after several major revisions, construction began in late 1925 (96).

The structure of education at the Cranbrook Academy of Art during the 1930s was fairly loose and based on the notion that 'self education under good leadership will lead towards the wisdom of life' (97). A museum and library were established as resource centres to show examples of good design past and present and a series of self financing workshops, including woodwork, silversmithing, ironwork, bookbinding and weaving, which sought outside commissions and offered extramural classes were established. However, the Depression seriously affected these workshops and all except the textile one were closed down by 1933 (98).

Booth wanted the craft studios to be based on a master-pupil relationship within a so-called guild system and, to a certain extent, Saarinen concurred with this view stating that:

"during the passing years I had become accustomed to the conviction that any art education must grow from personal experience with the life problems of today, and under the good guidance of a creatively alert mind. Mere theoretical study could not bear proper fruit." (99)

But, as Davira S. Taragin has argued, Saarinen regarded Booth's interest in the guild system as somewhat old fashioned and considered that a more pluralistic approach to education was needed, even if studios and departments were headed by respected 'masters' (100). The relaxed and informal nature of the academy was reflected in the fact that students were not given academic awards although credit was given for outstanding work.
Eliel Saarinen's standing as an architect of international importance meant that he was able to attract notable artist and craftspeople as teachers including Carl Milles, Director of Sculpture, Zoltan Sephesy, Director of Painting, Majlis (Maija) Grotell, Instructor of Ceramics and Loja Saarinen and Marianne Strengell, Instructors of Weaving (101). Most were of European origin and brought to Detroit the progressive aspects of the Arts and Crafts Movement as well as various strands of Modernism. One of the most important influences brought to bear on Cranbrook students was that of the Finnish architect Alvar Aalto (1898-1976) who was associated with Organic Modernism, a style of architecture and design which had a major influence on post war America (102).

While Aalto's furniture designs were firmly established as Modern because of its emphasis on the utilisation of new technologies and the development of a new aesthetic, they differed from those of the mainstream Modern Movement in that he used wood, a traditional material commonly used in his native Finland, and favoured organic forms rather than geometric abstractions (103). Through Eliel Saarinen, with whom Aalto was in close and regular contact, Aalto's ideas and works were well known to the students at Cranbrook and, indeed, Aalto was invited to visit the academy (104). It was also found in the work of other Scandinavian designers including Bruno Mathsson (witness his Eva Chair, 1934) and Hans Wegner (witness his Three-Legged Chair, 1949).

Another manifestation of Organic Modernism which affected the work of the Eameses and other designers came from Surrealism (105). Both Charles Eames and Ray Kaiser would have been aware of the excitement
generated in New York by the arrival of the Surrealists in the late 1930s. There were two main strands of Surrealism. Firstly, there was the almost academic strand which delighted in the juxtapositioning of realist images and is most eloquently expressed in the work of Salvador Dalí and René Magritte. The other strand represented by the work of Joan Miro, Paul Mason, Roberto Matta and Hans Arp, was far freer in style and delighted in abstract and organic forms. In terms of design the most influential part of the movement was that represented by two English sculptors working on the fringe of the movement, namely Henry Moore and Barbara Hepworth. The impact of Surrealism speeded up the acceptance of organic forms and it was during the period that Charles Eames and Eero Saarinen were working on their innovative entries for the MOMA's Organic Design in Home Furnishings Competition, that the Surrealists burst onto the New York art scene.

After the war, Organic Modernism became very popular in the USA because it offered a more accessible and acceptable form of Modernism and it was known by a variety of names including Contemporary, Danish Modern and Scandinavian Modern. It influenced all aspects of architecture and design but its greatest manifestations were found in the work of the Cranbrook designers such as Eero Saarinen (see his TWA Terminal at JFK Kennedy Airport, New York, 1956-62 and his furniture designs) as well as the work of Harry Bertoia and Charles and Ray Eames. It even affected the work of the 'Geometric' Modernists, particularly the work of Le Corbusier at the Chapel at Ronchamp (1950-54).
Certain American designers such as Russel Wright, who achieved considerable commercial success by applying organic forms to ceramics, furniture and exhibition displays during the 1930s witness his Focal Foods exhibitions stands at the 1939 New York World's Fair. Wright shared the Scandinavian designers belief in the suitability of organic forms for everyday objects and his work paved the way for the more widespread acceptance of organic form in product design in the 1940s and 50s. The relationship of Organic Modernism to the work of the Eameses will be discussed later in this thesis.

Cranbrook Academy of Art and Design

Because of the impressive list of Cranbrook 'old boys and girls' who were students there in the late 1930s and early 1940s - many of whom had an impact on American design in the post war period - Cranbrook is considered very highly in the history of twentieth century design. There was a free mix of ideas; taking from the Arts and Crafts movement a respect for tradition and from the Modern Movement an interest in new form and techniques. The younger Saarinen, who had studied architecture at Yale, was extremely enthusiastic about the Modern Movement, particularly the work of Eric Mendelsohn, and, in his role as assistant to his father, introduced a whole generation of Cranbrook students to Modern Movement ideas. It was the Cranbrook tradition of combining different approaches to design rather than a strict adherence to any one style which, to a large extent, coloured the work of Charles and Ray Eames.
Charles Eames left Saint Louis to study at Cranbrook in September 1938 remaining there until May 1941 (106). Ray Kaiser, by contrast, arrived at Cranbrook in September 1940, remaining there for only nine months. Charles learnt a great deal while at Cranbrook but Ray’s relatively brief sojourn was also important in her development as a designer. Whereas her period in New York saw her at the forefront of avant garde art, Cranbrook introduced her to the ideas of the Arts and Crafts Movement and the joys of handicraft production. She began weaving under the direction of Marianne Strengell, producing some splendid rugs one of which was to take pride of place in the Eameses’s Los Angeles home (107).

Textile design

In 1947 Ray produced the textile designs Crosspatch, Dot Pattern and Brown and Black Free Shapes on a White Ground (also known as Sea Things) apparently independently of Charles (Figs. 16-17). They reflected the most up-to-date thinking in terms of textile designs at that time and show the influence of Angelo Testa, a graduate of the New Bauhaus, who attempted to reclaim printed textiles and wallpapers for the Modern Movement (108). Testa recognised that wallpapers and wall textiles had been ignored by Modernist architects, who preferred glass, metal, wood and plain coverings and argued that it was possible to produce textiles suitable for Modernist interiors, taking note of function, two-dimensional appearance and the utilisation of modern technology. Of the
utmost importance in terms of validating Ray Eames's interest in
decoration was Testa's insistence that decoration rather than utility
was the central function of most furnishings (109).

In Sea Things a great variety of marine forms placed on a single plane
provide visual interest whilst Crosspatch derives its aesthetic forms
from the fine arts, particularly the 'Myth' paintings of Adolph Gottlieb
of the early 1940s. Crosspatch was possibly Ray's most important
textile design. Not only was it exhibited in the 1950 Good Design show
in Chicago and New York but was hand produced by Schiffer Prints in its
Stimulus range which included the work up and coming designers such as
Edward Wormley and well known artists such as Salvador Dali (110).

Students were admitted to Cranbrook on condition that they had already
undertaken some professional training and were expected to work on large
scale design projects usually related to their home communities and
Charles Eames's collaboration on 'The Meeting of The Waters' fountain in
Saint Louis with the sculptor Carl Milles fell into this category
(Fig.18). Part of a WPA (Works Progress Administration) programme of
urban renewal in Eames's home town, the fountain, which personifies the
confluence of the Missouri and Mississippi rivers, was originally
commissioned in 1931 by Mrs Louis B. Aloe in memory of her husband and
remains one of the great fountains of twentieth century America (111).

After only one year at Cranbrook, Eames was appointed as an Instructor
of Design in the Intermediate School of Design which had been
established to teach fee paying students who lacked experience and the
ability to master the main courses (112). Eames so impressed Eliel Saarinen that he was promoted in the following year to become Head of the Department of Industrial Design (113). He also worked in the Saarinen architectural office, helping both father and son with various projects, learning an enormous amount in the process. He later recalled: 'It really wasn't until I started working for Eliel Saarinen and with Eero, that I had any conception of what 'concept' was' (114).

He also collaborated with Eero Saarinen on three important projects. The first and most important of these was their joint entries for MOMA's Organic Design in Home Furnishings competition of 1940. Saarinen and Eames developed a 'new look' for furniture by bending plywood in three dimensions and won first prize in two separate categories (see chapter three). The second project on which Eames and Saarinen collaborated was the furniture for the Klienhans Music Hall, Buffalo, of 1939-40. The building was the work of the elder and younger Saarinen and Charles helped Eero produce the seating furniture, in particular an armchair for the chamber music hall which was made out of bent plywood supported on a maple frame. This chair, which is Eero and Charles's first known design in this 'new' material, shows the influence of Aalto in the moulding of the plywood to fit the contours of the sitter. Although Eames had been aware of Aalto's work prior to 1938, it was only at Cranbrook that the direct influence of the Finn can be seen on the young Saint Louian (115).

The third of these collaborations was for an exhibition at Cranbrook Pavilion of Graduate Design in 1939, the forerunner of the exhibitions
with which the Eameses made their name in the 1950s. The Cranbrook exhibition reflected the avant garde ideas of the European designer Herbert Bayer, in that Charles and Eero broke up the space by using the exhibition stands themselves to divide the hall. They created further dynamic visual interest by suspending objects from the ceiling on wires, a method of display which had been made fashionable in European avant garde exhibition design (116). The exhibition reflected the most advanced Modern Movement ideas concerning exhibition design and illustrated how far Charles's outlook had advanced in the preceding two years.

It was due largely to Eliel Saarinen that Cranbrook staff and students stood back and looked at the many manifestations of Modernism, not just the International Style and the Bauhaus. This meant that they were aware of the work of architects and designers such as Alvar Aalto and Frank Lloyd Wright as well as the more purist Modern Movement heroes such as Walter Gropius and Mies Van der Rohe. The atmosphere at Cranbrook encouraged open discussion and a continual interchange of ideas and the work of Eero Saarinen, Charles Eames and others illustrate an openness to many different design ideas. Eames's plan of 1940-41 for a studio for Frances Rich (117), for example, resembles Eero Saarinen's Wermuth House of 1940. There is also a marked similarity between the preliminary designs by Ralph Rapson for the William and Mary Theatre competition of 1938 and Charles Eames's entry for an Architectural Forum competition for a City Hall in 1943, which was designed after Charles and Ray left Cranbrook for California (see chapter two) (118).
The Eameses' approach to architecture and design from 1941 onwards, with their emphasis on humanising modern architecture and design, is best understood in terms of the Cranbrook design philosophy of never forgetting the human dimension. The following chapters detail some of that work and reveal how great was their joint debt to Cranbrook.
Footnotes

(1) Author's interview with Ray Eames, Los Angeles, July 1986.

(2) Charles vividly recalled watching the Titanic survivors arriving in New York on the 6th April 1912. Tape recording of speech given at 28th Aspen Design Conference. I am grateful to Linda Folland for sending me this tape.


(9) Ray Eames interview 1986.


(14) Eames and Neuhart, *op cit*, p.20. The awards were for a bandstand and park pavilion.*Ibid.*, p.20.


(17) The city had hosted the 1904 Saint Louis Exposition to commemorate the centennial of the Louisiana Purchase. Many of the famous Chicago architects found patrons in Saint Louis, including Louis Sullivan who worked for the wealthy Wainwright family which commissioned the Wainwright Building, 1890-91 and the Wainwright Family Tomb, 1891.


(19) Other Eames and Young buildings in Saint Louis include: the Frisco Building, 1903-08; the Liggett Building, 1903-08; the Wright

(20) The first Saint Louian to hold the post.


(22) ibid, p.197.

(23) Stein's salon comprised painters and writers including many Americans either visiting or living in Europe such as T.S.Eliot and Ernest Hemingway.

(24) Le Corbusier was greatly excited by Canadian and American grain elevators, see Vers Un Architecture, (1987 translation), pp.25-33.

(25) Eames and Neuhart, op cit, p.21, She was a Vassar graduate.


(29) ibid.


(33) 'Saint Louian's Mexican diary in Watercolour', Saint Louis Post Dispatch, July 1934.

(34) ibid.

(35) ibid.

(36) Sorolla's work was extremely popular in the USA in the 1910s and 20s. He had an influential patron in Arthur Huntington, the founder of the Hispanic Society of New York. Sorolla's work was greatly sought after by American museums and private collectors. His most famous painting, Otra Margarita, 1892, hangs in the Saint Louis Museum of Art. Other work by Sorolla in...

(37) 'Saint Louian's Mexican Diary in Water Colour'.

(38) Unfortunately no architectural records survive in Saint Louis for the mid 1930s. Author's correspondence with C. Michaelides, Dean of School of Architecture, Washington University, Saint Louis, May 6 1987.

(39) 'Saint Louis Art for Arkansas', *Saint Louis Post Dispatch*, April, 1936.

(40) Cubism was, of course, one of the sources of Art Deco in architecture and design was mainly confined to Eastern Europe and Paris. It delighted in the use of the zig-zag line which gave a sense of animation to both buildings and designs. The use of different coloured brick in a step pattern above the west door suggest Cubism as a source for this design. See Margolius, Ivan, *Cubism In Architecture and the Applied Arts*, London, 1979.


(42) It was probably the similarity to his own work that made Eliel Saarinen contact the unknown Saint Louian architect. Eames and Neuhart, *op cit*, p.23.

(43) Charles Eames to Eliel Saarinen, 24th January 1938, Alumni Records, Cranbrook Academy of Art.

(44) Mrs John Philip Meyer has remarried and is now Mrs Leigh Gerdine.

(45) Duffy, Robert, W, *op cit*.

(46) ibid

(47) ibid


(49) ibid, p.109.

(50) ibid, p.109.

(51) The furniture was made by John Raush, a Saint Louian cabinet maker. Eames and Neuhart, *op cit*, p.23.


(53) ibid, p.109.

(54) ibid, p.109.
Most chronologies claim that Charles went to Cranbrook in 1937 and even Charles claimed that he attended Cranbrook earlier than the records indicate, see 'Nelson, Eames, Girard and Propst: The Design Process at Herman Miller', Design Quarterly, No 98/99, 1976, p.56. However, student records at the Cranbrook Academy of Art, Registrar's Office, indicate that Charles did not enrol until the autumn of 1938, the date given in Eames and Neuhart, op cit., p.23.

Eames and Neuhart, op cit., p.18.

Ray Eames interview 1986.

Ray Eames interview 1986.


Ray Eames interview 1986.


Ray Eames interview 1986


Hofmann's first New York school was established in autumn of 1933 on Madison Avenue. In October 1934 he opened the Hans Hofmann School of Fine Arts at 137 East 57th Street, New York. The school moved to 52 West 9th Street in 1936 and to 52 West 8th Street in 1938. His summer school was held at Gloucester in 1933 and 1934 and moved to Provincetown in 1937. Hofmann's school remained open until 1958, Hunter, S, Hans Hofmann, New York, 1964, passim.


(72) ibid, p.18. Irving Sandler argues that Piet Mondrian and Neoplasticism represented the ideal model for many American artists struggling to come to terms with abstraction.

(73) ibid, p.18.

(74) It must be remembered that Charles also admired the work of Piet Mondrian. Ray Eames interview 1986.


(76) Distinguished avant garde choreographers, the latter was also concerned with incorporating American folk dance into her work.

(77) Hans Hofmann's compositions using squares began c1946, although his most geometric paintings were executed after 1952, see Combinable Wall 1 and 2, 1961, University Art Museum, Berkeley, California.

(78) During the 1930s Matter had been at the forefront of avant garde developments in graphic design.

(79) The new 'look' was launched in issue of February 1942 with a cover designed by Alvin Lustig.

(80) The equation was provided by the Eameses' friend Hamilton Wright, a Physicist who advised them on their 1953 film A Communications Primer. Eames and Neuhart, op cit, p.31.

(81) The Matter designs were not published until July 1943.

(82) This was caused by the winding up of the Molded Plywood Group. John Neuhart interview 1987.


(84) The Cubist viewpoint had developed from the work of Cézanne and attempted to reproduce three dimensional space on a two dimensional canvas.

(85) Much of the later graphic design work for Eames furniture was executed by George Nelson's Office. Author's correspondence with Linda Folland August 1988.


(87) Toronto born Booth married into the newspaper business, his wife Ellen Warren Scripps, was heiress to the founder of the Detroit based Evening News Taragin. D.S 'The History of the Cranbrook Community', in Design in America: The
Booth was a keen supporter of the little theatre movement which was at the height of its popularity in the 1900s and 10s. The Cranbrook Community eventually consisted of the Episcopal Christ Church, Brookside an elementary school, two prep schools, Cranbrook School of Boys, Kingswood School for Girls and Cranbrook Institute of Science, as well as Cranbrook Academy of Art.

At this time there was considerable cultural rivalry between the cities of the Midwest and Great Plains including Chicago, Saint Louis and Detroit. See Harris, N, 'North by Midwest', in *Design in America: The Cranbrook Vision 1925-1950*, op cit, pp. 15-19.

Booth was well established in Detroit cultural circles, he served as a trustee of the Detroit Museum of Art between 1908-14. Taragin, D.S, op cit, p.36.

The Detroit School of Design closed for economic reasons only seven years after being established in 1918, ibid. p.36


Taragin, D.S, op cit, p.38.

ibid, p.42.

ibid, p.42.


ibid, p.42.


Organic Modernism has recently been the subject of numerous books and exhibitions See Jackson, L, *The New Look: Design in the Fifties*, 1991.

(104) Taragin. D. S, op. cit, p. 44.


(106) Eames and his wife and daughter were given one of the faculty houses. John Neuhart interview 1986.

(107) Ray Eames showed me this rug on my visit to the Eames House in July 1986. Another rug attributed to Ray is kept in Cranbrook House.


(109) ibid, p. 85-86.

(110) In 1960 Ray applied her hand to designing choir robes for the Hope Choir, Holland, Michigan in a striking geometric style. Eames and Neuhart, op. cit, p. 245.


(112) Davira. D. S, op. cit, p. 43.

(113) Eames and Neuhart, op. cit, p. 24.


(115) Although it also owes a debt to a chair designed by Gilbert Rohde. Miller. C. R, op. cit, p. 61.

(116) In this they were influenced by Herbert Bayer who worked on graphic and exhibition design while at the Bauhaus. His move to New York in 1938 and his involvement with exhibition design at MOMA brought an avant garde influence to American exhibition design.

(117) Frances Rich was the daughter of the film actress Irene Rich and the studio was to be built in California. John Neuhart interview 1987.

(118) Eames and Catherine Woerman were divorced in May 1941. Eames and Ray Kaiser were married in Chicago on 21st June 1941, en route to Los Angeles.
CHAPTER TWO: ARCHITECTURE AND INTERIOR DESIGN

It was in the field of architecture and interior design that the Eameses' attempts at humanising the Modern, were most clearly expressed. Their own home in Pacific Palisades, on the outskirts of Los Angeles, made from standardised steel components, has been described as 'playful', 'whimsical', and 'poetic' - words not usually associated with the architecture and interiors of the Modern Movement (1). The Modern Movement delighted in the use of Modern materials particularly steel framed architecture, which allowed for the use of curtain walls, large areas of glass and open plan interiors. As Modernists, the Eameses were interested in using new materials and new methods of construction and produced forthright expressions of form and structure. At the same time they were concerned with humanising the interiors of their buildings by adding plants, flowers and objects for decorative effect. This represented a decisive point in the development of the Modern Movement in that objects, which had largely been banished in the interior designs of Marcel Breuer, Le Corbusier, and Mies Van der Rohe, were reintroduced.

The Eameses' own personal brand of Modernism was given its greatest expression in their own house (1945-49). Attention has focused so firmly on the house, that the other architectural projects with which they were involved have tended to be overlooked. These included Charles's design for a City Hall (1943) on which he collaborated with John Entenza. Charles Eames and Eero Saarinen's Entenza House (1945-50), the Eameses's Jefferson National Expansion Memorial Competition.
entry (1948), Herman Miller Showroom, Los Angeles (1949), Wilder House (1950), Kwikset House (1951), Max De Pree House, Michigan (1954), Griffith Park Model Railway (1957), a proposed Birthday House for Hallmark Cards (1959) and proposed glass housing for the Smithsonian Carousel (1966). Although architecture concerned the Eameses less than other matters from the 1950s, they still retained a great interest in the subject; indeed, one of the reasons they went into film making was to find ways of communicating a wide spectrum of knowledge to professional architects (see chapter six).

Ray's role in the interior design work of the Eameses has been fairly widely acknowledged (2). In contrast, her role in the architectural work is less clear (3). Undoubtedly Charles, who had practiced as an architect since 1929, drew on a wider architectural background than Ray. He also had a considerable understanding of the nature of steel after his period of work in the steel mills but, nevertheless, it is important to acknowledge the part played by Ray in particular designs, especially in the house in which she was to live from 1949 until her death nearly forty years later. While her role in the other architectural projects is more difficult to establish, she claimed that she played a major part in the design of the Wilder House and her sketches for it seem to support this (4).

The Eameses' architecture emerged from four architectural strands: firstly the ideas advocated at the Cranbrook Academy of Art, secondly, the architecture of the Modern Movement, particularly the International Style, which had a major impact in America after the arrival of the
Bauhaus émigrés in the late 1930s, thirdly, Organic Modernism which rapidly increased in popularity in the USA in the 1930s and, finally, the architectural traditions and preoccupations of Southern California.

TOWARDS THE POST WAR HOUSE

Before the war there had been a feeling that architecture and design should be socially responsible. In war time America the focus of this discussion shifted to a concern with the nature of the post war world and in particular the nature of the post war house. The Case Study House Program was one of the most technologically and aesthetically daring fruits of this discussion. The mood of looking forward and away from the devastation and hardship of war included a vision of a new and better world. It was obvious even before the Second World War that the nature of family life and house size was changing because families were smaller and more mobile (5).

The middle class had increasingly large amounts of disposabale income which they spent by embellishing their homes and the great expression of this was in the wealthy state of California where people wanted not only new houses that reflected this new lifestyle, but furniture and other trappings of middle class living. All manner of architects expressed their opinions as to how the post war home should develop (6). Many argued that it should be completely different to the housing of the pre-war period and most agreed that use should be made of new technologies and new materials, but the ways they envisaged using them differed considerably. To many architects this meant providing air conditioning...
and numerous so-called 'labour-saving' devices rather than utilising new materials and developing new methods of construction.

One of the best known and successful post war houses was the Californian Ranch style house which sprang up all over Southern California in the late 1940s. Derived from an open plan model house designed by Cliff May and Chris Choate, they were easy to build being based on a frame structure with a variety of infills (7). Built on a large scale by Stern and Price and costing from $7,500, they combined just the right amount of historical reference to meet the desires of those who wanted a 'traditional' feel to their 'modern' home; a 1945 advertisement emphasised 'this free-flowing, beautifully functionalized house born of our 19th century west' (8). The houses were sheathed in stucco, board, or shingle and characterised by low pitched roofs with overhangs, horizontal windows, sliding doors inside and out, open plan interiors and a two car garage.

During the immediate post war period, Modern Movement ideas continued apace as architects built private commissions for luxurious houses which combined new technology and new methods of construction within a machine aesthetic style. One of the main means by which the Modern Movement was popularised in the years immediately after World War Two was through architecture and design magazines such as Architectural Review, Progressive Architecture, Architectural Forum, Interiors, Industrial Design. One of the most influential in promoting ideas about what the post war home should be like was California Arts and Architecture.
edited and owned by John Entenza from 1938 to 1962 and on which both Charles and Ray Eames worked.

JOHN ENTEZNA AND ARTS AND ARCHITECTURE

In 1938 Entenza acquired the Los Angeles arts magazine California Arts and Architecture and changed the direction of this regional organ by giving it a more Modernist emphasis and international outlook (9). During the 1940s he enlisted a veritable 'who's who' of the Los Angeles avant garde to contribute to the magazine including Neutra, Ain, Julius Shulman and Esther McCoy (10). In 1941 Charles Eames became an editorial associate, and Ray Eames, apart from working as a graphic designer for the magazine, was on the editorial advisory board. Arts and Architecture became the mouthpiece for Entenza's Modern Movement ideas and a platform for the Californian avant garde. In true Modernist style it advocated an equality between the arts, regularly featuring film and art, but it was undoubtedly its emphasis on architecture and design which secured its fame.

Arts and Architecture found an appreciative audience in Los Angeles, as well as other parts of the USA and abroad. Los Angeles boasted a large culturally minded élite, many of whom worked in or were associated with the film industry in the 1930s and 1940s. These included people such as the film stars Vincent Price, Edward G. Robinson and the artist William Brice, all of whom supported attempts to establish a Modern Art Museum in the city in the mid 1930s (11). The ranks of the cultural intelligentsia were swelled by the arrival of the European émigrés.
during the 1930s, including such distinguished figures as Josef von Sternberg, Oskar Fishinger, Igor Stravinsky, Man Ray and Billy Wilder, who was to become a great friend of the Eameses (12). Wilder had been a patron of the Modern Movement before he left Germany after the rise of National Socialism, leaving behind his collection of modern paintings and furniture (13). The Pacific Palisades area of the city - where the Eameses lived from the late 1940s - was the Los Angeles left bank in the 1930s and 1940s, becoming home for writer Thomas Mann as well as John Entenza and the Eameses (14).

Long before the initiation of the Case Study Program in 1945, Entenza's magazine did much to promote Modern architecture in Los Angeles, starting with a series of articles on small low cost modern houses (15). In 1943 John Entenza organised a competition, Design For Post War Living, and invited Charles Eames to be one of the judges (16). It was clear that the task of developing ideal post war housing would not be easy and Eames was aware that mere architectural styling and stock responses would not be enough. One entry in particular made him think hard:

"One entry, very unarchitectural, came from a housewife whose principal contribution consisted of 15 very significant things she would not include in her post war house. If her list indicates what the attitude of the post war client will be, and in many ways I believe it does, then the architect had better soon start finding out what living could really be like today and tomorrow. It will take more than architectural cliches." (17)

The competition confirmed to Entenza that there was still a great deal of work to be done:
"To the magazine this has been a hectic and stimulating experience, and it is our hope that we will soon be able to announce a continuing series of such competitions, believing that American designer-architects will welcome an opportunity to send further trial balloons into the modern air." (18)

CASE STUDY HOUSE PROGRAM

The programme which began in 1945 aimed 'to make a beginning in the gathering of the mass of material that must eventually result in what we know as "house post-war"' (19). Entenza decided that through the magazine he would commission architects to design and build houses, which would be illustrated in the magazine, opened as show houses and finally sold. In this, the Case Study Program fitted into a long history of demonstration dwellings stretching back to the Great Exhibition of 1851 with Prince Albert's Model Cottage to the Weissenhof Siedlung of 1927 and subsequent Worlds' Fairs.

Entenza did not consider his project to represent grandiose attempts at universal solutions yet it was hoped that the project would contribute to workable solutions for mass housing:

"While these houses are not to be considered as solutions of typical living problems; through meeting specific and rather special needs, some contribution to the need of the typical might be developed. The whole solution proceeds from an attempt to use space in direct relation to the personal and professional needs of the individuals revolving around and within the living units in as much as the greater part of work will originate here. These houses must function as an integral part of the living pattern of the occupants and will therefore be completely 'used' in a very full and real sense 'house' in these cases means centre of productive activities." (20)
What Entenza did aim at was to provide a forum for Modern architects to produce contemporary solutions to the problem of designing a house. Eight houses were originally commissioned from nine designers including the 'old masters' of the California Modern Movement Neutra, J.R Davidson, William Wurster and Sumner Spaulding as well as a group of designers in their late thirties including Ralph Rapson, Don Knorr, Whitney R Smith, Thorton Abell, Eero Saarinen and Charles Eames (21).

The Eames and Entenza Houses will be discussed in detail below, but, in general, the Case Study houses built between 1948 and 1950 were all based on a rectangular plan whilst differing in materials and modes of execution. The designs by Davidson and Neutra (Case Study Houses 11 and 20) were based on wooden frames (22). The Davidson House (the first to be built) was finished off with stucco and wooden panels whereas Neutra utilised redwood panels and brick although both designs incorporated large areas of glass and open plan interiors (Figs.19-20). The most ambitious design of the early group was Rapson's Case Study House No 4, (never completed, and nicknamed the 'greenbelt' house because it was an urban house with an indoor garden, it was the only one of the early Case Study Houses to be planned for a city site), which could be based on either a wood or metal frame with infill panels of plywood, glass or brightly painted cemestos board (Fig.21). It was hoped that this would be a prototype for city site house design (23).

The Case Study houses built after 1950 were commissioned from a yet younger generation of architects in their late twenties, including Raphael Soriano, Craig Ellwood and Pierre Koening, whose major interest
was to use the very latest steel technology. The first architect to express this was Raphael Soriano who, in 1950, utilised a steel frame, corrugated steel roof and large areas of glass but masked the industrial nature of the material in the interior by concealing it in wood, stucco and brick. Nevertheless, the exterior, with its stark use of a steel frame led the way forward towards the ever more minimum structures of the 1950s (24). Craig Ellwood and Pierre Koening followed the lead of Soriano. The former was trained in engineering and this shows clearly in his work. Both delighted in the use of steel frames and made a feature of showing the structure of their buildings. Between them they built five Case Study houses, all being pavilion constructions with open plan interiors and a variety of infills (Fig. 22) (25). The Eameses were also interested in the use of steel frames but differed in their aesthetic. Soriano, Ellwood and Koening followed in the footsteps of Mies and his dictum of 'less is more', whereas the Eameses added extra visual interest and stimuli to the basic frame, especially in their own home (see below).

While today the term Case Study House Program conjures up the Eames House and/or the minimum structures of Craig Ellwood and Pierre Koening, other architects played an important part in the project in the 1950s and early 1960s, namely Sumner Spaulding, John Rex, William Wurster, Theodore Bernardi, Thorton Abell, Kemper Nomland, Kemper Noland, Rodney Walker, Conrad Buff 111, Calvin Straub, Donald Hensham, Edward Killingsworth, Frederick Emmons, Beverley Thorne, John Gardener Campbell, Worley Wong, Allen Don Fong, Alfred N Beadle (26). These architects preferred to use wood and their work is referred to as the
'USC' (University of Southern California, Los Angeles) style reflecting the influence of that particular school of architecture, or the 'Pasadena' style because they were influenced by the 'Craftsman' tradition. This work had a far greater influence on mass suburban housing than did the other better known steel framed Case Study Houses.
On arrival in Los Angeles in 1941, Charles and Ray Eames rented a modern open plan apartment designed by Neutra and located in the Westwood area of Los Angeles. The Strathmore Apartments were home, at varying times, to a mixture of the Los Angeles avant garde including the film maker Orson Welles and the film star Louise Rainer as well as John Entenza (27). Although the Eameses liked living in this showpiece Modern Movement apartment, they also wanted to build their own home. Entenza commissioned nine architects to design houses, including Charles Eames and Eero Saarinen who were to design Case Study Houses 8 and 9, that is, a house for the Eameses and a house for Entenza. No mention was made of Ray Eames in the commissions although, as built, the Eames house in particular, reflects a considerable input on her part.

Although the Case Study House Program represented a progressive and liberal approach to the designing of modern houses, Dolores Hayden has pointed out that as far as the role of women was concerned the Case Study architects differed little from the designers of tract housing (28). A woman's place was still viewed as being in the home; looking after children, doing housework, and preparing meals. This sexist attitude is clearly visible in the architectural sketches which often illustrate the husbands using modern gadgetry while the women are depicted doing mundane household chores (Fig.23). J.R Davidson claimed that 'the kitchen is adjacent to the dressing-bedroom wing, and by this arrangement Mrs X can attend easily to the preparation of breakfast or quick meals while dressing or working at the bedroom desk' (29).
such a climate it was difficult for Ray to be given credit for her considerable role in the design of the Eames House.

While the Eames House was firmly within the parameters of the Modern Movement in its use of new technologies and machine aesthetics, much of the uniqueness of the design comes from its use of Mondrianesque colours and shapes on the exterior of the building. A similar use of colour is seen in the designs of the De Stijl group and the forms are clearly derived from the paintings of Mondrian who greatly influenced the American Abstract Artists (AAA), the group in which Ray was active (30). Ray had strong views on all aspects of design, from furniture to the arrangement of flowers, and was particularly obsessive about aesthetics, and it is therefore possible to argue that she would have had a tremendous input into the design of her own home. She would want a say in how the house would work externally and internally for her as a wife, housewife, and full time designer. Although the original design of the Eames House dated 1945 was largely the work of Charles Eames and Eero Saarinen, the house (1947-49) as built was designed by Charles and Ray together. The cantilevered design proposed by Eames and Saarinen used the latest structural ideas and was at the forefront of the Modern Movement but was less original than the second design (Fig. 24). With the Eames House, as with the plywood furniture, it was only when Ray became involved in the project, that the work developed that unique quality which led critics to praise it for its originality (31).
In many ways the Eames House stands out from the other Case Study Houses not least of all in that it was not designed for a 'family'. In devising the Program Entenza had written:

"It is only necessary to invent a fairly typical American family of the type that has, in large numbers, indicated its wish to enter the post war building market. Let us then presuppose a Mr and Mrs X, both of whom are professional people with mutual business interests, the family consisting of a teenaged daughter away at school and a mother-in-law, who is an occasional welcome guest in the house." (32)

In contrast to this, the Eames House was designed as a home and studio accommodation for two practising designers. The brief they set themselves was stated succinctly in Arts and Architecture:

"For a married couple both occupied professionally with mechanical experiment and graphic presentation. Work and recreation are involved in general activities: Day and night, work and play, concentration, relaxation with friend and foe, all intermingled personally and professionally with mutual interest. Basically apartment dwellers, there is a conscious effort made to be free of complications relating to maintenance. The house must make no insistent demands for itself, but rather aid as background for life in work. This house-in its free relation to the ground, the trees, the sea-with constant proximity to the whole vast order of nature acts as re-orientator and "shock absorber" and should provide the needed relaxations from the daily complications arising within problems." (33)

Ray vividly recalled the great number of animated discussions she and Charles had about their future home. To begin with they spent countless hours surveying their plot, a meadow with eucalyptus trees, wild flowers and mocking birds. Their concern for the site played a crucial role in the development of the Eames House and in later years Ray spoke with great affection of it:

"It is wonderful to see all the changing seasons in it
even in Southern California... In July it is yellow and dry whereas in Spring it is high and full of flowers. We cut it once a year in late May or June." (34)

In the first plan the Eames House dominated the site, in the second revised plan, which was published in *Arts and Architecture* in May 1949 and was the joint work of Charles and Ray, did not. The main change which occurred in the two designs was not in the forms of the house and studio, which remained in many ways the same, but in the house's relationship to the site. In the second plan the house and studio were placed behind a row of eucalyptus trees at one end of the plot, a move which cost an extra $5,000 because of the necessity to cut into a hill and build a retaining wall some 175 feet long by 8 feet high at the rear of the studio and house.

The landscaping was another way in which the Eames House differed from houses by other Case Study architects, the majority of whom used the services of the landscape gardener Garrett Eckbo. Eckbo was part of a landscape movement which argued that the forms of a garden should emerge from the type of site and climate (35). Yet, his landscaping for the majority of the Case Study Houses was distinguished by the use of concrete slabs, wooden boards, small stones and pebbles used to create walkways, walls and patios, with an emphasis on sharp angles and diagonal lines. Within this ordered environment, plants were combined in clashing colour combinations, but the overall impression was of harmony in a manner which resembled the landscape gardening of the Japanese. By contrast, the Eames and Entenza Houses were located in an environment that was deliberately left wild in order to 'gather the
leaves and pods and bark' (36) and the artificial mound, built using the earth moved to create the retaining wall, to hide the Eames house from the Entenza House was made to look as 'natural' as possible. A distinctive Eames touch occurred in the first year of living in the house when Charles painted faces on the trunks of the eucalyptus trees (37).

The original designs by Charles Eames and Eero Saarinen emerged during 1945 and were published in the December edition of Arts and Architecture (Fig. 25). The design was based on two separate blocks, a large living block which cantilevered out across the meadow and a smaller block which was to contain power tools and a photographic studio. The latter was almost located in the same position in the second design (Fig. 26). In the first design Eames and Saarinen relied on the structural expertise of Edgardo Contini to work out the cantilevered structure (Fig. 27) (38). Such structures had been a major feature of the European Modern Movement and increased in popularity in California after Neutra's dramatic use of the cantilever in the Lovell Health House, 1929. Charles described the structure of the bridge house thus:

"The house is built between two trusses. The floor and ceiling help to stiffen the top and bottom card of the truss, and together with the truss form a box beam. The end walls keep the box beam from collapsing sideways. The structure rests on two steel supports, these being set in so that the end of the box forms a cantilever. This shortens the span and develops a negative moment over the support which makes for a more economical truss. Cross bracing between the steel supports gives added strength." (39)
The open plan interior was as inventive as the exterior and the design included many of the features used in the second design, including folding and sliding doors, spiral staircase and built-in sofa (Fig. 28).

In November 1947 MOMA held an exhibition on Mies and Charles was dispatched to New York to record the exhibition for *Arts And Architecture* (40). At this exhibition Charles saw the entire range of Mies's architectural work, from his paper architecture of the 1920s to his pavilion houses of the 1930s. Derived from his influential Barcelona Pavilion of 1929, the Tugendhat House, Brno, 1930 and the Model House, Berlin, 1931, were based on simple pavilion forms supported by steel frames with infills of glass giving a full view of the outside. Mies divided the interior space by means of partitions as opposed to fixed walls and the simplicity, precision and clarity of these designs probably made Charles reconsider his and Saarinen’s design for a complex bridge house in favour of the simple yet highly sophisticated pavilion forms of Van der Rohe.

Another source for the pavilion form of the second design was a design by I.M.Pei and E.H.Duhart in *Arts and Architecture Designs For Post War Living* competition, 1943, for which Charles was one of the judges (41). The Pei/Duhart design, like the subsequent Eames House, was to be built from mass produced standardised parts, although in this case the sections were to be specially manufactured for the design rather than ordered from steel fabricators’ catalogues (42). Pei and Duhart suggested a single two storey pavilion structure, in their competition entry drawings, and the house is located in a similar meadow-like site.
to the Eameses' plot. Other similar features include a large open plan living room at the front of the house with views out across the meadow. Pei and Duhart used an 'industrial' metal staircase similar to that used by the Eameses and a similar overhang to that providing cover off the living area of the Eames House.

The Eameses' decision to alter their proposed house also occurred because of a sharp rise in the price of steel, caused mainly by increased transportation costs between the Midwest and California. Although the Case Study House Program delighted in the use of new methods of construction, in particular steel frames, at the same time it was concerned with economy of construction and building decent housing within an agreed budget. For the Eameses the prime consideration was the maximum enclosure of space. Charles, who had worked in the steel industry constantly asked himself questions such as: 'How cheap is space? How industrial is our building industry? How light is steel?' (43). To answer these questions the Eameses looked at steel fabricators' catalogues and found that the industry offered ready made parts which were used in the construction of light factory units. The Eameses' final solution of two pavilions constructed from a light steel frame lined up against a row of eucalyptus trees created a genuine stir, not only because of its concern with its setting, but because of its use of modern pre-fabricated materials (Fig. 29). Even in Los Angeles the use of factory-type constructions in a residential context represented a bold move at that time. Another problem was that Charles was not registered as an architect in California and the Eameses' friend Kenneth
Acker was registered as the architect on record (44). His name was also used for the Herman Miller showroom design.

One of the reasons why the Eameses chose steel was that it was cheaper than using traditional wooden construction. Whilst it initially cost more than wood and the cost of transportation to California had risen sharply, its use reduced the amount of hand labour needed in house construction. Charles argued that the cost of a traditional wooden framed house in terms of materials and labour was about $11.50 per square foot and considered that, because of the great amount of space enclosed and the reduction in manual labour required, the cost of the Eames House worked out at as low as $1 per square foot (45). Because of the frank exposure of the steel frame in the Eames House, in contrast to the concealing of it in the Entenza House, money was saved on the former because there was less internal finishing and detailing required.

Steel also offered a more modern solution to home design which appealed to the Eameses. The revised design of their own home was published in *Arts and Architecture* in May 1949 (46). Charles decided that the original design, enclosed a smaller amount of space than was desirable, considering the amount of steel involved. Indeed, the steel for the frames of the original house was already on the site when Charles decided to change the design to two pavilions placed on the ground. The frame was constructed from 4 inch steel H columns and 12 inch steel open web joists; the former which could rise 17 feet without support and the latter which could span more than 20 feet. Added strength was provided by diagonal cross bracing of tension rods. The roof was formed out of
ferro board steel decking. Steel allowed a quick construction, in fact the 'raising' of the frame took just under two days (47). The frame could then be fitted with steel framed windows and doors, which also came from manufacturers catalogues', and filled in with a wide variety of sheet material at the Eameses' discretion. Several problems, including the need to protect steel from the weather (even in sunny Southern California), the scarcity of skilled steel workers who could provide the finish required and the installation of residential wiring and plumbing in a factory-type structure, had to be overcome before the house was completed.

Notwithstanding the problems, which were more or less satisfactorily solved, both Charles and Ray were happy with the finished structure, later only regretting that the steel joists ran crossways rather than length ways and that they missed a chance to reduce the steel members needed (48). The design and construction of the house represented the apex of Charles's interest in steel, an interest which began years earlier when he worked at the Laclede Steel Mills, Venice, Illinois. As far as Ray is concerned, her role in determining the structural form of the house is difficult to gauge. While she was less knowledgeable about the technical development of the project, she was always intensely interested in structure and Charles regarded her sense of structure as quite exceptional. There can be little doubt that the decisions about structure were only taken after full consultation with Ray, even if the original ideas did not originate with her. She was always eager to give her opinion on every aspect of design and would have had her say about the construction of this particular house, her own home.
The Case Study houses were financed in part by the donation of materials and equipment to the project. The steel framed sash windows used in both the Eames and Entenza houses, for instance, were donated to the project by the Truscon Steel Co. Many firms donated items free because *Arts and Architecture* associated their products with apparently progressive and worthwhile design and social causes (49). The full cost of the programme was never known because of such arrangements and because Entenza considered 'the experiment in designing and building...too wearisome a process to be analysed in cold figures' (50).

As built, the house consists of two rectangular steel cages connected by a brick patio; the larger (51 feet long) is the living block while the smaller (37 feet long) forms the studio (Figs. 30-32). Each block is about 20 feet wide and together they provide about 3,000 cubic feet of space. The structure of the house was unique not only in its use of a light steel frame but in its frank exposure of the frame, all members of which were painted grey to create a unified look.

The Eames House is important because of the ways it expressed the machine aesthetic. While the Eameses firmly believed in the dictum 'form follows function' and expressed the qualities of 'truth to materials' and 'honesty of construction', the uniqueness of the design lies in their very individualistic interpretation of the machine aesthetic, particularly in their use of bright colour on the facade (Fig. 33). To a large extent the Modern Movement refuted the use of external colour (51). While the structure of the house was firmly within the parameters of the Modern Movement with its utilisation of
modern materials, new technologies and new methods of construction and machine aesthetic, it also offered a way out of the 'Miesian block' in that the Eameses used a bold and a dominant colour scheme on the exterior of the building. While it is wrong to assume that architects such as Mies banished colour completely from their work, none of the Modern Movement architects had, to that date, produced such a dynamic mosaic of colour or one so heavily reliant on the fine arts. This can be seen by comparing the Eames House with Mies's almost contemporary Farnsworth House (1950) located on the outskirts of Chicago, the plan of which emerged at the same time as that of the first plan of the Eames House (52). Like the Eames House, the Farnsworth House is a simple pavilion form which, in this case, is raised above the ground. Built on a steel frame filled with large panes of glass, the house represents Van der Rohe's greatest expression of 'skin and bones architecture' yet, aesthetically it is the exact opposite of the Eames House, in that all the steel members were painted off-white, a colour which was repeated in the curtains which provided privacy. Its monotone colour scheme contrasted with the exuberance of the Eames House.

Once the shell of the house was completed the Eameses turned their attention to the infill panels. These were formed from a combination of translucent and opaque materials, the former made up of a variety of sash windows filled with different types of glass, while the latter utilised stucco, cemestos, asbestos and plywood panels in a variety of colours including white, blue, red, black and grey, as one observer wrote:

"The two part house rests among the eucalptus"
trees like a pair of fragile, framed paper boxes
decorated with oblongs of brilliant blue, red, gold,
black, warm grey and white, and with lots of frames
left empty. The grey frame-trusses, sash, corrugated siding,
and roof deck are painted steel. The clear sections are glass,
the warm grey panels cemestos, the painted and gilded panels
stucco. White tension rods cross over a black stucco
panel." (53)

The Eameses used ordinary household paint from the local Sears-Roebuck
department store (54). The idea was that if they did not like the
colour, then it could be easily and cheaply changed but as it was, the
composition as originally completed remained unchanged (55). Although
it was Ray who had the formal training as the abstract artist and her
early work had been influenced by Mondrian (see chapter one), both she
and Charles admired the work of this artist, and as, in other aspect of
their work, they were in full agreement before the scheme was executed.
The skeletal nature of the design, into which the panels where inserted,
referred back to traditional Japanese domestic architecture which
utilised pre-fabricated pavilion structures and emphasised lightness,
elegance, minimalism, and rectilinear geometric forms (Fig.34).
Japanese architecture and design had a significant impact on the West
Coast in the post-war period and several of the Eameses' designs show a
marked Japanese influence.

The interior construction of the Eames House is spacious, light and
flexible. The main living room utilises the full height of the two
storey structure (17 feet) although, at the end where the living and
dining areas divide, an overhanging sleeping area comprising two
separate bedrooms (which can be closed off to allow privacy, by a
sliding screen made of translucent laminated glass plastic) forms a
balcony under which is an intimate alcove, with built-in sofa, storage cabinets and radio (Fig.35). The back wall of the room is lined with vertical panels of birch providing a warm contrast to the machine finish of the other materials in the manner of Aalto, although Charles always claimed that he used the wood so that he had 'something to nail into' (56). The structure of the ceiling is clearly visible to the eye with the Eameses using the details of the ribbed ferroboard steel decking supported on open truss joints as a visual feature. The sources of light are simple and do not detract from the industrial nature of the ceiling which is so high that visitors' eyes might get lost were they not drawn down by strategically placed objects such as paper kites or large modern paintings.

Access from the ground to the first floor was by a spiral staircase, formed of steel wedges fastened to a central column and covered with plywood treads, which, like the other structural elements of the house, was ordered from an industrial building catalogue (Fig.36). Light filtered down over the simple staircase via a skylight. The north of the living block was taken up by the kitchen and dining area which were fitted with the most up-to-date equipment which still works well today. The smaller block of the house was envisaged as a studio. It, like the house, was built on two levels connected by a metal staircase, the lower level housing a darkroom and a bathroom while the upper level comprised a sleeping and general work area. With the expansion of the Eameses' projects during the 1950s into the world of film and exhibition design the studio soon became too cramped for serious work which was mainly
done at the Venice office and thereafter the studio was used mainly as extra living space.

The interior details are of equal interest to the architectural details and give this house its uniqueness, ranging as they do from the etching of a tree outline on the panels above the living room sliding door to complement the view of the real trees outside, to the strategic placing of a variety of decorative objects (Fig. 37). The latter included a cherub hanging from the staircase and a bell hanging by the main door as well as toys displayed in the living room, all of which helped to soften the stark industrial nature of the building materials (Fig. 38).

The Eameses had considered putting a fireplace in the living room, indeed it was drawn in the first plan of the house (57). The fireplace in American domestic architecture had traditionally been seen as the focus of the home, a belief reinterpreted by Frank Lloyd Wright. To the Modern Movement the fireplace was seen as a sentimental gesture, and most architects preferred to utilise more modern forms of heating (58). While heating was not the most vital consideration in a house in Southern California, there are often chilly mornings and evenings in the winter months when some form of heating is required and the Eameses used gas heated forced air to warm their house, a modern solution considered adequate at the time. Yet, both Ray and Charles came to the conclusion that a fireplace would have added to the house had it been built (59).
The Eameses moved into their house on Christmas Eve 1949. It soon became well known; Reyner Banham claimed in 1971 that it shared with Simon Rodia's Watts Towers the distinction of being the building in Los Angeles best known to British architects (60). Widely illustrated in numerous journals over the next few years, most critics agreed that the Eameses (or rather, it was Charles who was mainly credited) had made an important statement in terms of Modern architecture. On the one hand the house was firmly within the parameters of the Modern Movement with its stark use of structure. At the same time its setting behind a line of eucalyptus trees and its forceful use of colour on the facade, made this design stand out as something new and exciting. Olga Gueft commented in 1950:

"In a sense Eames has exorcised Frankenstein. He has demonstrated that the machine need not degrade or dehumanize or denaturalise us, but that it can serve as the sensitive instrument of a poetic conception - in a wooded meadow as well as on asphalt." (61)
Charles Eames collaborated with Eero Saarinen, on the house designed for John Entenza who ten years earlier had had a new house built in the Streamline style by Harwell H. Harris (62). By 1945 that seemed out-of-date and Entenza became one of the first clients in the Case Study Program organised by his own magazine. Eames and Saarinen worked to the following brief:

"In this house activities will be of a more general nature to be shared with more people and more things. It will also be used as a returning place for relaxation through reading and music and work - a place of reviving and refilling, a place to be alone for preparation of work, and with matters and concerns of personal choosing. A place for the kind of relaxed privacy necessary for the development and preparation of ideas to be continued in professional work centres. The occupant will need space used elastically where many or few people can be accommodated within the areas appropriate to such needs. Intimate conversations, groups in discussions, the use of a projection machine for amusement and education, and facilities for self-indulgent hobbies, i.e. cooking and the entertainment of very close friends." (63)

Unlike the Eames House the Entenza House was built as designed in 1945 without any changes (Fig.39). They used the same structural elements (4 inch H columns and 12 inch open-web joists) in the Entenza House as in the Eames House, yet certain critics came to the conclusion that the design lacked the aesthetic inventiveness of its neighbour:

"Next to this ineffably blithe, elegant, and original architecture [Eames House], the low flat box of the Entenza House can only invite invidious comparisons, though it is neat enough, the patterns of louvers and fixed panels in the glass area are handsome, and there is some nice applied decoration... the light steel truss frame of the Entenza House is perhaps even more of an engineering triumph than that of the Eames House, but the eye is not permitted to enjoy it, a thick steel and concrete covering and a lining of wood prevent even a suspicion of its existence. The structure has no more steel
Skeleton in its character than an adobe hut. In fact it has very little character at all until one gets inside." (64)

The exact nature of the collaboration between Charles Eames and Eero Saarinen on this house is difficult to gauge, although in later years Ray insisted that most of the ideas were Charles's (65). In reality it was probably a more equal collaboration, with both architects bringing different elements to the design from their different backgrounds and interests. Saarinen, in his and Oliver Lundquist's Pre-Assembled Component (PAC) House designed for Arts and Architecture's 1943 competition Designs For Post War Living, proposed many of the features that later appeared in the Entenza House (66). As with the Entenza House, the PAC House was square in plan, with three sides closed off by a variety of opaque infills such as plywood, stone and concrete, while the fourth side was taken up with a picture window. The PAC House was dominated by a large open plan living room with smaller enclosed rooms acting as private areas leading directly off. Other similar features between the two houses are the sunken seating area and the open fireplace. The extensive use of wood, particularly for the ceiling covering was probably Saarinen's idea and is indicative of his interest in Organic Modernism, particularly the use of wood to add 'warmth' to modern architecture. Charles Eames, who was extremely interested in the use of steel frames, was probably mainly responsible for the actual structure of the Entenza House, once again relying on the technical expertise of Edgardo Contini (67).

The structure of the house was very ingenious, in that the weight of the steel frame was supported on twelve steel columns, with the bulk of the
weight being carried on the four internal ones. Only one of the 
internal columns was visible to the viewer. The top of the frame was 
divided into four separate areas, each crossed by braces in order to 
increase the frame's strength (Fig. 40). The outer columns were placed 
away from the corners of the house and hidden behind the plaster walls 
and wooden ceiling. The roof was covered with a single slab of 
insulating concrete pierced by the chimney and a skylight to provide 
natural internal lighting. The side walls were formed of building 
blocks covered in ferroboard siding. The service entrance to the house 
was through a distinctive steel framed canopy, topped with ferroboard 
siding, which in its use of geometric painted panels resembles the 
exterior of the Eames House.

Entenza, a life-long bachelor, used his home as a refuge from the 
pressures of work and as a place to entertain. The interior layout of 
the house reflected this duality, with over a third of the house given 
over to a large open plan living room surrounded by a series of smaller 
more private spaces including a kitchen, dining room, 2 bedrooms, 
bathroom and a completely enclosed study (Fig. 41). The most dynamic room 
in the house was undoubtedly the living room which was some thirty six 
feet across and occupied the whole of the front of the house (Figs. 42- 
43). In contrast to the Eames House, all the glass was left 
translucent, providing a panoramic view of the flat tree-dotted meadow 
and the Pacific Ocean beyond. The sensation of occupying that space has 
been compared to 'looking out of a broad-mouthed cave' (68).

-100-
Taking note of the undulations of the ground, the floor dropped by means of steps which on one side formed a sunken seating area, with a brightly painted fireplace as its central focus (Fig. 44). The concern with the breaking down of the indoors and outdoors was expressed in the extension of the tiled floor in the seating area to the garden. By contrast, the top part of the living room was heavily carpeted and formed a suitable space for the display of sculpture or the setting up of a large formal dining table (Figs. 45-46).

In comparison to the large living area, the other rooms were very small. The main bedroom only provided enough room for a double bed, but the panels between it and the living area could be pulled back allowing Entenza to see out across the living room to the view beyond. The guest room was even smaller in size and shared the only bathroom which led onto a side terrace where Entenza could enjoy the morning sun. Space was found, however, for a two car garage with automatic door, a feature not used in the house next door. An unusual feature of this garage was the use of corrugated glass to separate it from the living room. The most unusual room was the small womb-like study. It was soundproofed (the occupant was accessible only on an inter-com system) and designed without any windows in the belief that more work would be done without the distractions of light and sound and to provide a contrast with the open plan of the rest of the house (69). The utility rooms and kitchen were located on the opposite side of the house and the long narrow space was designed so that it could be used as one long room or have each of the various areas closed off.
Entenza did not remain long in his house and in 1955 it was sold to Eddie Lipps, a well known engineer (70). Today it is only possible to visualise the original design from photographs because, over the years, the interior has been much altered and the exterior shielded by the growth of creepers. Esther McCoy has suggested that in many ways the house was unsuitable for Entenza because he was a very private person and not given to entertaining on the lavish scale to which the house was geared (71). Nevertheless in this house Charles and Eero Saarinen had succeeded in fulfilling the aims of the Case Study Program in that they had produced a unique design from standardised components. As one critic noted:

"To those who hold that there is no freedom of design within standardised building systems, this plan—a portrait, almost of its owner—is about as good an answer as anyone could find." (72)

Herman Miller Showroom, Los Angeles, 1948

In 1948 the Eameses were involved in the design of a showroom for the Herman Miller Furniture Company in Los Angeles (Figs. 47-49). This was to be its first showroom on the West Coast and joined a trio of distinctive showrooms designed by George Nelson in Chicago, New York and Grand Rapids. It was built in West Hollywood at 8806 Beverly Boulevard, then the centre of the city's fast growing trade in the manufacture and distribution of furnishings. From the start Charles aimed at a 'minimum of architecture' (73) claiming, in true functionalist language, that the building was important only to the extent and in the way that it served the main commercial purpose of the building.
The showroom was rectangular in shape, with two brick side walls painted white on the interior and fronted by an industrial steel frame fitted with sash windows and decorative panels made up of plaster and composition. The Mondrian-like quality of the facade related to the composition of the Eames House. By arranging the infill panels on the facade, the showroom could be completely open and act as a giant shop window or it could be closed off. Additional lighting was given by three large circular skylights.

One of the most intriguing features is the way the open plan floor (some 5,000 square feet) was divided into separate areas by means of a grid which allowed for an almost infinite number of positionings for the display panels which were supported on pipe style poles which could fit into holes located in the floor and ceiling (74). The showroom also provided office accommodation, reception area and toilets. It represented a solution which allowed for countless changes. In the showroom, as in the Eames House, the Eameses had shown that Modern architecture need not mean uniform boxes.

**Max De Pree House, Zeeland, Michigan, 1954**

This house was designed by Charles and Ray Eames in conjunction with Eames Office staff for the son of Hugh De Pree, President of Herman Miller (75). It continued the traditions of the Case Study Program with its utilisation of frame construction (in this case a timber frame) and open plan. Taking note of the Michigan climate of severe cold winters and humid summers, in contrast to the mild climate of Southern
California, the use of large areas of glass, one of the common features of most Modern Movement houses, let alone the Case Study houses, was dispensed with. The house was a simple two story pavilion with a flat overhanging roof, a balcony on one side which provided a sheltered seating area underneath and a sun deck on top.

Zeeland and its surrounding area was originally settled by the Dutch who brought with them many craft skills. Conscious of this tradition, craftspeople who had been trained in Holland were used on the construction of the house (76). Wood was also used as the main infill as well as the frame, giving something of the feel of a simple log cabin. The garden was in a Dutch style, with lawns and plenty of flower beds suitable for the bulbs which are such a feature of the Michigan countryside. The house was designed so that as the family increased rooms could be added on to the building without destroying the original design - a concept which many of the Case Study architects had failed to take into consideration only to find in later years the destruction of their original idea by external additions and internal alterations (77).

The interior was finished off with wood panelling and filled with Eames furniture (78). In this house the Eameses' humanised the Modernism of the house by emphasising the cultural tradition of the Zeeland area. They did not simply produce a pastiche of Dutch Colonial architecture, as did many architects working in the locality, but rather utilised radical modern forms whilst incorporating traditional features which they felt embodied the spirit and 'feel' of Dutch design.
Griffith Park Railroad, 1957.

Griffith Park is one of the main parks in Los Angeles and a popular spot for residents and tourists alike. A miniature railroad - one fifth life size - was owned by the park authority but was leased out to Sam Bernstein who, in a highly bold move, approached the Eames Office to redesign the station at which the trains picked up and set down passengers (79). This project instantly wetted the appetite of the Eameses who set their office to redesign not only the station but also the tickets, posters and station signs. That Charles and Ray, who by this time were designers of international standing, should take on board a project which was little more than a fun fair ride says a great deal about the Eameses. They considered this type of architecture just as important as an office block or private house (80).

Under the direction of Charles the entire office became involved with the project. Don Albinson and Dale Breuer designed the station and the railway yard including the engine sheds, water tower and signals, Deborah Sussman was in charge of graphic design, producing the station signs and tickets, while John Neuhart designed the poster (81). One of the most distinctive features of the project was the graphic design which was derived from a nostalgic view of turn of the century American typography, most commonly associated with circuses and carnivals. The Eameses used this type of typography in some of their exhibitions, films and multi-media presentations as a way of humanising modern technology. The railroad was held in great affection by many Americans, including Charles, who had a particular fascination with trains; his father had
worked on them and they feature in some Eames films (chapter six). This nostalgia viz à viz trains was very strong in the USA in the post World War Two period when trains were threatened and partly superceded by the car and the aeroplane. This project represented the only executed example of the Eameses using architecture to conjure-up a world of fun and nostalgia, although this was an ambience they created in some of their later exhibition designs (see chapter six). A further miniature railway was planned for Swope Park in Kansas City but was never built (82).

**UN-REALISED ARCHITECTURAL PROJECTS**

In 1943 Charles Eames, encouraged by John Entenza, entered a competition organised by *Architectural Forum* to design new public buildings for the post-war period (83). The competition provided an opportunity for Modern Movement architects to explore contemporary solutions for building types which were still viewed as being most suited to monumental historical styles. The Neuhart have suggested that this was the first of many proposed 'information centres' which Charles designed as a way of communicating ideas (see chapter six) (84). It also reflected the interests of John Entenza who had a strong belief in the social role of architecture, more so than many American architects who tended to concentrate on the office building and private house. Entenza believed, architecture should concern itself with a whole range of social issues, issues which were expressed in the pages of *Arts and Architecture*. Charles came to share these values and his design for a city hall expressed them.
The Eames plan for a City Hall combined government offices, courts, a police station, a welfare centre and an entertainment complex. Charles Eames's thinking behind the project was articulated in the accompanying text which began by stating 'in a typical American community with 70,000 people, about 27,000 are registered voters. In 1943 only 12,000 voted in a municipal election' (85). The problem lay in the fact that Government was something more than a body of people who administered the town and Eames considered that successful government should take place in a building 'in which provision is made not only for the administration of rules and regulation, but a building which must contain facilities for the expression of the idea of government' thus the design was to combine all the departments of local government with leisure facilities such as cinema, theatre and exhibition space (86). Furthermore, Eames and Entenza proposed to combine child welfare facilities with the juvenile court, arguing that 'it should be impossible to think in terms of the juvenile court without thinking in terms of the children's clinic, without thinking in terms of a Board of Education' (87).

Four years later in 1947 Charles Eames entered the Jefferson National Expansion Memorial Competition sponsored by the city of Saint Louis for a monument to Thomas Jefferson and to celebrate the city's role as the gateway to the West. The site for the monument was located on the banks of the Mississippi and included several historic buildings such as the cathedral and courthouse which were to be incorporated into the design. Both Charles and Ray Eames had been great fans of Thomas Jefferson since childhood and were greatly stimulated by the project (88). As
Modernists, they wanted to get away from the traditional memorial such as a classical column or Gothic monument and produce a modern solution. At the same time they wanted to do more than just commemorate the memory of Jefferson.

Their monument was divided into four sections; firstly a public park, including an amphitheatre and a memorial mound, secondly a museum, and thirdly what they referred to as a 'living memorial' housing a library, design laboratories, printing plant and accommodation for visitors and researchers. The fourth element linked the two main parts of the memorial and was a walkway lined with abstract sculptures symbolising the life and ideas of Jefferson and also Westward expansion (89).

By far the most important of the post 1950 house designs was the proposed house for Billy and Audrey Wilder designed in 1950. The house was to be built on a hill top in Beverly Hills and is in many ways an extension of the Eames House. The proposed design, with drawings by both Charles and Ray, was rectangular and, at 4,600 square feet, was larger than the Eames House (90). It incorporated within an open plan interior a two storey living area, a dining area, a study, three bedrooms and bathrooms and also a large utility area whilst, on one side, the roof extended to form a verandah. It was planned to be constructed from the same components as the Eames and Entenza Houses using 4 inch steel H columns and 12 inch open-web bar joists, with infills of glass and a mixture of opaque panels, although less of the guts of the building was revealed than in the Eames House.
Ray claimed that the house was conceived as a simple enclosure which the Wilders could fill with their collection of Modern art and design and consequently the Eameses produced a highly original and dynamic space in which no architectural feature was allowed to dominate, although the main entrance was signified by a large entrance porch-cum-carport (91). Externally the grounds were far more formal than the land surrounding the Eames House, in that the house was surrounded by concrete slabs and flower beds (92). The interior elaborated upon many elements from the Eames/Entenza Houses, including a free standing fireplace, sunken seating area and free standing storage wall. Unfortunately, the Wilder house never left the drawing board and was, arguably, one of the greatest losses to American domestic architecture of the post war years (93).

The original aims behind the Case Study Program had been to lead the way forward to the 'house post war'. While the houses were mainly one-off luxury solutions, several of the architects, including the Eameses, were also concerned with providing 'mass housing'. In 1951 the Kwikset Lock Company of Anaheim, aware of the Eameses work with 'off the peg' standardised architecture and mass produced furniture, commissioned them to design a low cost prefabricated house to be manufactured in large quantities and sold as a kit (94). By this time the Eameses had lots of confidence from the success of their low cost mass produced furniture and they eagerly took up the challenge to mass produce low cost housing.

They approached the project in a manner similar to that adopted when designing their own house, setting as the main priority the enclosing of
as much space as possible within a maximum budget, in this case $8,000 (95). They found that, by using a wooden shell with posts carrying a curved roof made of plywood, the space could be double that obtained in a masonry house of the same price. The main facade was made from a metal frame into which panels of translucent and opaque glass could be inserted. As in the Eames House, all the structural elements were exposed. It was only after they had designed the exterior that the Eameses turned their attention to the interior. Here they divided the plan into separate areas (including living and dining areas, kitchen, bathroom and two bedrooms), by means of moveable partitions and units in order to provide ample room and facilities for a family with two children (96). The Eameses took a great deal of advice from Don Albinson on this project because he had lived for several years in a prototype wood frame prefabricated house designed by Konrad Wachsmann and Walter Gropius and manufactured by the General Panel Corporation of California (97).

The Eames design carried on the aims of the Case Study Program in that it was a prefabricated house with a minimum of interior detailing. Although the Kwikset Lock Company had wanted a design suitable for use anywhere in the country, the Eameses' proposal was really only suited to the mild Southern Californian climate. Although models were made of the house, complete with miniature Eames furniture, the project did not get beyond the prototype stage because the Kwikset Company was taken over and the project abandoned (98). While the idea behind the project was to make decent Modern architecture available to a large group of people, its severe Modern Movement aesthetic may have been seen as a negative
factor by the new company at a time when the 'general public' hankered after a Californian Ranch style house.

Prefabricated modular architecture and the utilisation of Modern Movement forms were given further expression albeit on a smaller scale in a dolls house designed for Revell Toys in 1959, which was also designed to be used by Herman Miller as a layout device and marketing tool (99). As with many of the Eameses' designs, this involved the updating of a traditional object, in this case a typical nursery toy, and giving it modern form and expression. The design was based on structural frames and infill panels made from injection moulded plastic (100). Different houses were constructed from these frames, ranging from a simple pavilion shape to a horizontal construction of three or more frames. A set of miniature Eames furniture including the GRP chairs, the Aluminium Group and Sofa Compact, as well as a pedestal table which was never produced on a large scale, graced the interiors as did small scale rugs, trees and flowers (101). The relationship between the Eames Office and Revell was the least harmonious of all the client relationships and finally, because Charles and Ray Eames both considered that so many questions concerning production and marketing remained unanswered, they decided they would not push ahead (102). The Eameses were perfectionists and if there was ever any doubt about a project they considered it best to abandon that project rather than come up with a result which was less than satisfactory.

Two other projects deserve discussion including their proposed Birthday House for Hallmark Cards (1959) and the Smithsonian Carousel (1966).
The Eameses were great believers in celebrating birthdays and important anniversaries. The Eames Office photographic archive is full of records of such events, whether it be celebrating Charles or Ray's birthday, donning Easter bonnets or celebrating the Fourth of July, the Eameses never let an anniversary pass by. Hallmark Cards, based in Kansas City and the world's largest producer of greetings cards, approached the Eames Office to design a structure suitable for a backdrop for birthday photographs (103). The Eameses proposed a permanent bandstand sized carousel structure with all the accoutrements of a fairground ride including banners and flags. As with all projects, further development only took place if the Eameses were in complete agreement with the firm. With this commission this was not the case and this delightful project was abandoned.

In a similar vein was their proposed covering for the Smithsonian Carousel in 1966 which was commissioned by the History and Technological Division of the famous museum which wanted to produce a shelter to enable a nineteenth century carousel to be erected on the National Mall and operate as a fairground ride yet be protected from the capital city's extremes of weather (104). Near to the Eames Office, on Santa Monica Pier, was located a similar carousel ride which was enclosed in a structure which shielded it from the elements (105). The Eameses, who had a great love of circuses and fairgrounds and their distinctive design forms, did not want the architecture of the shelter to take away from the forms and colours of the carousel and also wanted to make it a feature of the Mall (106). They therefore proposed to cover the ride in a glass pavilion which echoed the shape of the ride. Its glass doors
could be opened during the day and the whole structure illuminated at night to allow the ride to be seen (107). Unfortunately the whole project was shelved because it was considered too costly.

**INTERIOR DESIGN**

Of equal importance to their work as architects, was the ways in which the Eameses tempered the hard edged nature of prefabricated factory-inspired interiors. The first generation of Modernists argued for interiors where the architectural emphasis on abstraction was continued. They also upheld their abhorrence of applied decoration. Interior fittings were kept simple, with lighting and essential fittings delighting in the presumed machine based nature of their aesthetic (108). After the Second World War, the architecture of the Modern Movement had a tremendous influence on America but some American architects and designers, including the Eameses and Alexander and Susan Girard felt that the interiors did not permit enough freedom for people to use these spaces as they wished. They turned the 'machine à habiter' into more personal space (109).

It was in this area that Ray's talents greatly flourished. She spearheaded a movement to add decorative objects and abundant flowers and plants. It was this aspect of the Eameses work which brought them the admiration of Alison and Peter Smithson who recognised its importance as representing something new and exciting in interior design (110). The Eameses never doubted the potential of Modern Movement architecture but wanted to give it a more human face and it was
in the interior design of their own home and in the showroom designs for Herman Miller that this aspect of their work was given its greatest expression. What was important was the way in which they used hand-made or novel objects collected on their travels to Europe, trips to Santa Fe or shopping jaunts to Woolworths, to contrast with or complement the machine based nature of the furniture and the industrial elements of the architecture. Ray, in particular, had a great ability to use objects in strange and unusual juxtapositionings, as with the cherub hanging from the industrial staircase in the Eames House, which proved simple yet effective ways of humanising the industrial nature of the structure (Fig. 36). A tile placed on the living room floor became a canvas for Ray to arrange a disparate collection of objects, including a Victorian candle stick, plants, wooden toys and a nineteenth century decoy bird (Fig. 35). This was a simple idea but a highly effective way of decorating interior spaces that were in the main perceived as cold and barren.

The uniqueness of the Eameses' vision vis-à-vis interiors is best understood in terms of a comparison with the Farnsworth House (discussed above) in which Van der Rohe utilised expensive materials such as marble and a hand crafted steel frame provided the main visual interest. The interior was open plan and filled with Mies's own furniture and little else. It was an aesthetic of reduction in contrast to the Eameses' aesthetic of addition.

Esther McCoy has shown that the real significance of the Case Study Program was the way in which on 'open days' many Angelenos saw modern
furniture by contemporary designers in a domestic setting (111). In many ways the Eames House differed from the other Case Study interiors and this can be seen by comparing the interiors of the Eames and Entenza Houses. The former clearly expressed the Eameses' notions of displaying objects and throughout the years the Eameses, particularly Ray, added more and more. By contrast, Entenza's house was more spartan in the tradition of Van der Rohe and Gropius, the main visual effect coming from the neutral tones of the beige carpet, the wooden ceiling and the plaster walls although this was relieved by certain brightly coloured fittings such as the orange fireplace and furniture. While it contained paintings and sculptures it had none of the decorative groupings of the Eames House (Figs. 44-46).

The Eameses were not the only designers to delight in this type of 'additive' interior. Their great friends, Alexander and Susan Girard, had a tremendous interest in folk art from around the world and they used it to provide visual interest in their interiors, whether it was an old adobe house, as in their Santa Fe home, or a showpiece Modern Movement house, as in the Irwin Miller House, Columbus, Ohio. The Eameses' catholic taste was greatly influenced by the Girards (112).

This approach to interior design was also seen in their designs for the Herman Miller showrooms. During the 1950s and 60s they produced seven installations, collaborating with the Girards and George Nelson. The Eameses took the task of selling Modern furniture very seriously and attempted to show potential customers how to use it in their own homes. Much emphasis was given to decorating the showrooms so that their
furniture looked good. They utilised a variety of personal objects - borrowed from friends, their own home and various galleries all over Los Angeles - one particular favourite being a whale made by Native Americans from the Pacific North West which appeared in several showroom designs. As with their own home, it was more than just a simple arrangement of objects, its success relied heavily on the visual juxtaposition of objects and Ray's superb ability at arranging them. Another striking aspect of their work in this field was the use of unusual objects including radar antenna and seed packets, the latter used to great effect to cover a wall in a 1952 showroom design. They also used blown up photographs of objects photographed from unusual angles.

One of their distinctive displays that launched the Herman Miller Los Angeles showroom in 1949 featured furniture by George Nelson and Isamu Noguchi as well as themselves (113). The space was defined by partitions on which photomurals were placed. The furniture was set out to show the public how it could be used in their own homes, with magazines and bowls of fruit left casually on tables and plants and flowers liberally placed throughout the groupings. Other points of visual interest were created by the careful placing of a variety of disparate objects, including a Matter photograph, a Hofmann painting, an early American weathervane and a stove which seemed more at home in a Zane Grey novel rather than a furniture showroom (114). Humour was a great way of humanising Modernism and over the bedroom setting a board was covered with cut out stars and a moon to indicate a romantic night
sky. This general type of display was continued in the 1952 showroom designs by Charles and Ray Eames.

For the launches of the Aluminium Group in 1959 and the Tandem Sling Seating in 1963 the Eameses, assisted by the Girards, created two remarkable designs each centred on a particular theme. In the former, in order to illustrate the outdoor as well as the indoor nature of the Aluminium furniture, the showroom was dominated by a large papier mâché tree (115). The tree motif was echoed in other aspects of the interior, including a torn paper collage and small shrubs in pots. The window display was a complete contrast, being composed of objects acquired by the Eameses on their recent trip to Moscow. Their 1963 showroom design, which was installed in Chicago and New York as well as Los Angeles, was dominated by a photomural of a German train shed blown up from a photograph taken by Charles (116). This nineteenth century point of departure for transportation was therefore juxtaposed with the seating used in modern airport buildings, a twentieth century form of transport. This was one of their most successful visual juxtapositions. A cafe-like ambience was created around the showroom by the placing of the La Fonda chairs and tables laden with food from around the world.

The Eameses' last involvement with an interior for Herman Miller was in 1966 when they collaborated with George Nelson and the Girards on the occasion of Herman Miller moving to larger premises in New York (117). Each designer worked on one particular aspect of the project; Nelson was in charge of the overall architecture of the showroom, the Girards arranged the textiles while the Eameses concentrated on the display of
the furniture. Unlike the previous two displays, which had developed a single theme, this was a more general exhibition of Herman Miller furniture and textiles, containing a display designed by George Nelson of Herman Miller's 'classics' including the Eameses plywood group. One of the most distinctive features of the showroom was the covering of the internal columns of the roof by a variety of photomurals of differing objects, ranging from a cracked mirror to a stack of seats. Even though this was their last new interior for Herman Miller, the Eameses occasionally acted as consultants for the interiors of the Los Angeles showroom until 1976 when Herman Miller moved its showroom into the Pacific Design Centre.

The Eameses' architecture of the late 1940s and early 50s, from the designs of the Eames and Entenza Houses to the Max De Pree House (1954), were amongst the most important statements of Modern Movement architecture in the USA. Their plans and structures were firmly in the Miesian mould and their 'honest' use of structure and form won many admirers. The commitment of the Eameses to Modernism was revealed in their concern with the social role of architecture as seen in the design for a City Hall and the Kwikset House (1951). But their work had another important aspect - the humanising of the modern. The Eameses's recognition of the general perception of Modernism as stark and inhuman and their way of remedying this, particularly in their interior designs, won them many admirers and followers in the USA, Europe and Japan. Their solution never questioned Modernism, indeed their architecture and interior designs represented an attempt to change Modernism from within rather than to challenge its underlying premises.

-118-
FOOTNOTES


(2) Smithson, A, 'And now Dhamas are dying out in Japan', Architectural Design, September 1966, p.447.

(3) In later years Ray claimed she played a considerable part in the architectural work. Author's interview with Ray Eames, Los Angeles, July 1986.


(9) The magazine was originally founded in 1910 as a regional House and Garden type journal, Smith, A.T.E, 'Arts and Architecture and the Los Angeles Vanguard', Blueprints For Modern Living: History and Legacy of the Case Study Houses, op cit, p.145.

(10) Entenza also secured leading Modernists from outside California to serve on the editorial board including Edgar Kaufmann, Walter Gropius and Serge Chermayeff, ibid, p.164.


(12) During the 1930s Santa Monica became a centre for exiled European intellectuals. Heilbut, A, Exiled in Paradise: German Refugee Artists and Intellectuals in America, Boston, 1982.

(14) Thomas Mann lived in a Modern Movement house designed by J.R Davidson in 1941. See Gebhard and Winter, op.cit, p.48.


(16) 'Designs For Post War Living', Arts and Architecture, August 1943, pp.23-37.

(17) ibid, p.25.

(18) ibid, p.23.

(19) Entenza.J, 'Case Study House Program', Arts and Architecture, January 1945, p.54


(22) ibid, pp.19-21.

(23) ibid, p.21.

(24) ibid, p.29.

(25) ibid, pp.29-33.

(26) ibid, pp.33-37.


(29) 'Case Study House No 1', Arts and Architecture, 1945, p.44.

(30) Ray was a founder member of the AAA (1936) see Chapter One.


(32) 'Case Study House No 1', p.43.

(33) Eames.C & R, 'Case Study Houses 8 & 9', Arts and Architecture,
December 1945, p.42.

(34) Dr. Pat Kirkham interview with Ray Eames, Los Angeles, July 1984.


(38) Contini also worked on the structure of the Entenza House. In an interview recorded in Smith, E and Jones, A, 'Thirty-Six Case Study Projects' *op. cit.*, p.53.


(41) 'Designs For post War Living', pp.32-34.

(42) *ibid*, p.34.

(43) 'Life In a Chinese Kite' *Interiors*, September 1950, p.90.

(44) Eames and Neuhart, *op. cit.*, p.112.

(45) 'Life In a Chinese Kite', p.93.


(48) 'Life In a Chinese Kite', p.96.

(49) Including, laundry equipment from Blackstone Manufacturing Company, forced air heating from Affiliated Gas Equipment Incorporated, *ibid*, p.95.


(53) Gueft, O, p.110.

(54) Dr Pat Kirkham interview with Ray Eames July 1984.
(55) ibid.


(57) Eames C & R, *Case Study Houses 8 & 9*, op. cit, p.51. A fireplace was also detailed in one of the early plans of the second design. *Architectural Review*, October 1951, p.230.

(58) Ray Eames claimed that it was Eero Saarinen who put them off the idea of having a fireplace because he told them they were being absurdly romantic in wanting one. Dr Pat Kirkham interview with Ray Eames, July 1984.

(59) ibid, there was little consistency in the use of fireplaces in the Eameses architectural work, as shown they suggested one in the first plan for the Eames House and Charles and Eero Saarinen made the fireplace a central feature of the Entenza House. Ray admitted to Pat Kirkham in 1984 that it would have been difficult to fit one into the Eames House as built.

(60) Banham R, op. cit, p.223.

(61) Gueft O, op. cit, p111.

(62) See Gebhard and Winter, op. cit, p.44.

(63) Eames C & R, *Case Study Houses 8 and 9*, op. cit, p.43.

(64) 'The Castle Cabana of John Entenza', *Interiors*, December 1950, p.94.

(65) Ray Eames interview July 1986.

(66) 'Designs For Post War Living', pp.28-31.


(68) 'The Castle Cabana of John Entenza', p.92.

(69) ibid, p.98.

(70) Eames and Neuhart, op. cit, p.123.


(74) ibid. p. 49


(76) ibid, p. 189.

(77) Witness the fate of the Entenza House, which has frequently changed hands and been greatly altered over the years.


(79) ibid, p. 219.

(80) Ray Eames interview 1986.


(82) ibid, p. 219.

(83) 'New Building For 194X', *Architectural Forum*, January 1943.


(85) 'City Hall', *Architectural Forum*, May 1943, p. 89.

(86) ibid, p. 89.

(87) ibid, p. 89.

(88) They also designed an exhibition about Thomas Jefferson and his circle for the Bicentennial celebrations of 1976, see Chapter Six.


(92) ibid, pp.136-37.


(96) ibid.


(100) Eames and Neuhart, *op.cit.*, p.235.

(101) ibid, p.235.

(102) ibid, p.235.


(104) ibid, p.308.

(105) The Neuharts claim that the structure was based on circular wooden buildings that Charles had seen in New England, Eames and Neuhart, *op.cit.*, p.308.


(107) The glass structure was designed by Philo Jacobson, Eames and Neuhart, *op.cit.*, p.308.


(109) The Girards were great collectors of folk art and filled their houses with their collections. The Girards had a very scholarly approach to their collecting which now forms the Girard Wing at the Museum of International Folk Art, Santa Fe, New Mexico.


(114) ibid, pp.91-92, Zane Grey was a popular writer of folksy Westerns during the 1930s and 1940s.

(116) Ibid, p.278.

CHAPTER THREE: PLYWOOD FURNITURE

In 1948 the well known American furniture manufacturer Herman Miller began marketing Eames plywood furniture. One year later they took over the manufacture of the furniture and went on to make it one of the great success stories in the history of modern furniture design. This furniture was to change the accepted look of modern furniture as well as set high standards in the application of new technology to furniture design. The success of the venture came after eight years of development work by the Eameses and their collaborators.

BENT/MOULDING PLY AND LAMINATED WOOD

Wood can be bent and moulded in a variety of forms using a number of methods. Solid wood can be bent by the application of steam and pressure. Wood can also be bent or moulded in laminated form. Laminates are made by slicing solid wood and layering the slices between a bonding substance, the bending or moulding being achieved by the use of heat and pressure, heat being supplied by steam or, more recently, electrically heated elements and pressure by clamps or a press.

Plywood is a form of wood laminate, with the grain of each succeeding layer running in the opposite direction to the preceding one, and is the most suitable laminate for bending into complex shapes and moulding because its composition allows for greater flexibility and strength than ordinary laminates. Bent and moulded solid and laminated woods have a
far longer history than is usually supposed and, before looking at the Eameses' work with moulded plywood, these precedents will be outlined.

**BENT AND MOULDED WOOD FURNITURE BEFORE 1940**

The bending of wood for furniture can be traced back to the ancient world, although the evidence relating to the processes used is limited. The bending of both hard and soft woods was used to a limited extent in Egyptian furniture making but it is not until the eighteenth century that much detailed information is available concerning the technology and processes used in the bending of wood (1). The best known example is the widely produced Windsor chair in which the curved back sections and arm rests were bent by steam from about 1750 (2). Bent veneers were also used in furniture making by the 1750s. Laminated base woods, topped with more exotic wood veneer had originally been used as a money saving alternative to the use of laminates made exclusively of expensive imported woods (3). There was much use of bent laminates during the late eighteenth century to decorate pieces such as card tables and sideboards (4).

Further development in the use of bentwood techniques occurred in the early nineteenth century with the work of the furniture makers Jean-Joseph Chapuis and Samuel Gragg, the former a Belgian and the latter an American furniture maker. Chapuis's 1805 Greek style armchair was formed from solid wood and cane, as well as bent laminated wood which was used for the legs and armrests. It is not known, however, how Chapuis bent his wood (5). Gragg's chairs were also in the Greek style.
He was well acquainted with the design of the Windsor chair and during
the 1800s and 1810s used bent laminated wood shaped by steam and
pressure to form the backs and legs of several chairs (6).

The major technical innovations in the use of bentwood occurred with the
work of Michael Thonet (1796-1871) (7). He began working in the
classically derived forms of the Biedermeier style in the 1830s and
developed a process of steam bending wood, the high point of which is
illustrated in the flowing forms of the Bopard chair of 1836 (8).
Thonet's main technological achievement was to bend solid wood by using
steam and pressure thus reducing the amount of labour involved and
facilitating mass production. Thonet set up several factories to mass
produce his chairs, including his famous No 14 chair. His exclusive
rights to the bentwood process expired in 1869 and over the next forty
years countless factories were established to manufacture furniture
using the process, including Jacob and Josef Kohn, Vienna, D.G.Fischel
Söhne, Vienna, and Sächsische Holzindustrie-Gesellschaft, Rabenau,
Saxony (9).

During the 1870s, under the direction of Thonet's son August, further
experiments were carried out with bending and moulding laminated wood.
One result was an experimental moulded chair of 1880 formed from plywood
(10). Although this chair was never mass produced, it illustrated the
potential for plywood in moulded form. Thonet's experiments with
plywood occurred at a time when the company was looking for alternative
materials to cane to use for seats. Plywood fitted the bill because it
could be easily and cheaply moulded into comfortable forms and was
widely used for seats in the late nineteenth and early twentieth century. Thonet also produced a tip-up theatre chair made from moulded plywood in 1888 (11). Plywood was increasingly utilised during the late nineteenth century as a substitute for more expensive woods in parts of furniture which were not visible to the eye, including drawer interiors and the backs of chests and cupboards (12). It was also used to make crates and tea chests. In the main, however, there was little attempt made to explore the moulding potential of plywood. During the late nineteenth and early twentieth century, plywood was also used for tram and railway seating, with one of the largest manufacturers of such items being the A.M Luther Company, Tallin, Estonia (13).

The Eameses have been wrongly credited with being the first designers to mould laminated wood (in their case plywood) through three dimensions in order to form compound curved forms because John Henry Belter, together with lesser known figures, did so with varying degrees of success in the USA from the mid-nineteenth century (14). Belter achieved considerable technical and aesthetic success with his moulded laminates during the 1850s and 60s, a success that was not equalled until the 1930s with the work of Alvar Aalto, nor improved upon until the work of the Eameses in the 1940s. Unlike Thonet chairs, Belter's pieces were aimed at the top end of the market and stylistically fell within the Rococo Revival. Given that his work was stylistically the antithesis of Modern Movement design, it is not known whether the Eameses knew of Belter's work and if they did, it is most unlikely that they would have approved of Belter's highly decorative pieces.
Belter achieved a high degree of technical perfection and, using steel moulds and steam, developed a method of bending laminated rosewood through two and even three dimensions (15). His most technically ambitious piece was a laminated rosewood bed designed in 1853, which was formed from two large pieces of laminated rosewood each bent into a complex multi-directional serpentine curve and held together by a metal frame. To obtain such forms, Belter moulded laminates comprised of nine layers of rosewood laid at right angles to each other and coated with glue and pressed between hot cauls for seven hours (16). The innovations of Belter were so widely copied that he was forced to take out patents in 1847 and 1858 in an effort to protect himself (17). During the latter half of the nineteenth century there were very few advances on the work of Belter, one exception being a bent plywood chair designed by Issac Cole in 1874 (18).

**Plywood in the 'First Machine Age'**

The major development in the application of plywood came after the outbreak of World War One when plywood, with its inherent strength and lightness, was used in the construction of aeroplanes, airships and boats. After the Armistice in 1918, the avant garde increasingly turned to plywood as a material suitable for furniture making. Modernist designers greatly admired Thonet's more simple pieces and wanted to mass produce well designed cheap furniture in new materials. Plywood was seen as a suitably new material and as an ideal material for creating new forms for furniture. Bending and moulding were seen as suitably modern ways of working a traditional material.
In 1927 and 1928 the Deutscher Werkbund held two important exhibitions in Stuttgart, at the Wiessenhof Siedlung, namely Die Wohnung (the dwelling) and Der Stuhl (the chair), both of which were showcases for modern furniture; indeed, the former premiered Mart Stam's as well as Mies Van der Rohe's cantilevered chairs of tubular steel (19). But new forms were not the preserve of the designers working in tubular steel and the exhibition included a number of plywood chairs, beds and case furniture designed by Heinz and Bodo Rasch and manufactured by L & C Arnold Gmbh. of Schorndorf, Germany. In their designs for seating, the Rasch brothers used single sheets of bent plywood to form seats supported in a variety of frames made from metal or laminated wood (20). Plywood was also used in the designs of Gerrit Rietveld, most notably in his red and blue armchair of 1917-18; although in this case it was not bent or moulded (21). Ten years later he followed up this design with a moulded plywood armchair supported by a steel rod frame, very much in the manner of the Rasch brothers. Several Bauhaus designers also worked with plywood in the late 1920s at a time when the Bauhaus was more famous for the tubular steel chairs of Marcel Breuer. Breuer himself produced a group of hand crafted case furniture from plywood in 1922-23 and Peter Bücking and Josef Albers designed a side chair and armchair utilising plywood, the former incorporating a moulded back and seat supported by a wooden frame (22). By contrast, Albers 'knock down chair' combined plywood and tubular and steel (23).
Alvar Aalto (1898-1976)

It was the Finnish architect and designer Alvar Aalto who, in the 1930s, successfully brought the language of Modernism to the production of plywood furniture (24). His designs excited a whole generation of designers in Europe and America including the Eameses. In common with the first generation of Modernists, Aalto wanted to produce furniture utilising new materials and techniques as well as new forms. In the first instance he turned to tubular steel and produced designs which were highly derivative of the work of Breuer, Stam and Van der Rohe (25). He was the first Modernist to question the use of tubular steel in terms of its suitability for furniture and because he wanted to produce furniture more generally acceptable to the population at large he turned to the vernacular material of his native Finland, namely wood and particularly birch.

In 1940 he wrote thus:

"The tubular steel chair is surely rational from technical and constructive points of view...But steel and chromium surfaces are not satisfactory from the human point of view...The rational methods of creating this furniture style have been on the right track, but the result will be good only if rationalisation is exercised in the selection of materials which are most suitable for human use" (26).

For Aalto wood was 'the form-inspiring, deeply human material' (27). Utilising laminated wood frames and moulded plywood, he produced a highly original series of seats for the tuberculosis sanitorium, at Paimio, Finland (1929-33), including a lounge chair, cantilevered
armchair and stacking stools. Aalto used steam to mould his chairs, a slow and time consuming procedure in comparison to that developed by the Eameses (28). The forms of Aalto's plywood seats related to the moulded plywood seats produced in large quantities for use as tram car seating by the firm of A.M. Luther, based in Tallin, Estonia, which Aalto, visited in 1921 (29). This shows Aalto clearly under the influence of the Modern Movement in his admiration of everyday objects.

The Paimio furniture demonstrated the technological and aesthetic potential of laminated and plywood which was strong enough not to be supported by a frame, suitable to being moulded into aesthetically pleasing shapes and, with its light pleasing colour and texture, did not need to be covered in upholstery or cushions. Aalto's most striking design was his lounge chair, model No 14, which derived from the Paimio armchair and comprised a laminated wood frame and a seat and back of moulded plywood. Based on organic forms derived from nature this design was a new departure for Modernism. As shown in chapter one, Aalto was one of the pioneers of Organic Modernism nevertheless, in the use of modern materials, mass production (albeit on a limited scale), honesty of construction, truth to materials and avoidance of applied decoration, his designs were in the spirit of the Modern Movement.

However, it needs to be remembered that Aalto was not the first designer to visualise using an undulating sheet to form the seat and back of a chair because as early as 1931 Mies Van der Rohe produced drawings pointing to a similar solution (30). But it was Aalto who fully developed this type of furniture which became fairly widely available,
being manufactured from 1929 by the Finnish firm of Oy. Huonekalu-ja Rakennustyötiedhdas Ab based in Turku and from 1935 by his own company, Artex, of Helsinki, which distributed it internationally. Through illustrations in magazines and displays such as MOMA's 1938 Aalto retrospective exhibition, it was to have a great impact on the Eameses and other designers (31).

A lesser known side to Aalto's work is his experiments with moulding plywood through three dimensions to obtain compound curves. Although Aalto had been involved with mass production at the Oy. Huonekalu-ja Rakennustyötiedhdas AB firm, the moulding of plywood through more than one plane remained highly problematic because it was not technically possible to produce well finished forms. Nevertheless, Aalto attempted to mould plywood into compound curves, witness his plywood and laminated wood armchair of 1931-32 (32). However, partly because the technology was so primitive, the form of the chair was less dynamic than the forms of Belter or the later forms of the Eameses. Utilising one piece of moulded plywood, the chair's seat and lower back were moulded in one direction while the upper back was moulded in another direction to form a grooved headrest. Although exhibited in Helsinki in 1932, the chair was never mass produced. An upholstered version of a similar chair, known as Artex model 401 was put on the market, however, suggesting a dissatisfaction with the design, or at least its surface finish, on the part of Aalto (33). He had very strong views concerning the use of wood and believed that it should not be contorted into over complex shapes and did not approve of the Eameses' DCM chair which he considered forced
the natural qualities of the wood, arguing that 'plastic does not speak the language of wood fibres' (34).

Other plywood furniture in the 1930s

Aalto's plywood forms had a tremendous influence on the work of other furniture designers, particularly in England where many of the European émigrés settled during the mid 1930s. Aalto had a tremendous champion in P. Morton Shand who arranged an exhibition of Aalto's furniture at Fortnum and Masons store in 1933 (35). One of the first designers to be influenced by Aalto was the Russian émigré Serge Chermayeff who used the flowing forms of Aalto's chair frames but with an upholstered seat (36).

Other British designers, including Betty Joel and Gerald Summers, took up the challenge of plywood (37). Summers produced designs for his own firm, Makers of Simple Furniture Ltd, which included a bent plywood armchair of 1933-34 formed from a conically moulded piece of plywood and incorporating various pieces of hard wood which were dovetailed into the moulded plywood seat. Other pieces such as his plywood lounge chair of 1934 were far more aesthetically and technologically innovative. The 1934 chair, while aesthetically beholden to Aalto, pushed plywood technology forward in that it was formed from a single sheet of bent plywood. The plywood was cut in various positions before moulding and its lack of joints - often the first elements to weaken - meant that it was well suited to its purpose for use in the tropics where the high humidity affected the stability of furniture joints. Although it represented a technical advance on Aalto's work, this chair was never a
commercial success, largely because it had to compete with the Aalto pieces which were imported into Britain from the mid 1930s.

Unperturbed, Summers produced other designs utilising plywood, including a plywood tea trolley, 1935, the most technologically and aesthetically striking feature of which was the single moulded S-shaped piece of plywood which formed the main body of the design. Summers was intrigued by the potential of plywood to be moulded into complex forms and in his side chair of 1934 he produced a design which resembled Aalto's plywood and laminated armchair of 1931-32 in which a single piece of plywood was moulded through three planes (38).

The best known designer to work with plywood was Marcel Breuer who had made his name with bent tubular steel furniture at the Bauhaus during the 1920s. On arrival in England, Breuer became involved with Isokon, a London based furniture manufacturing company established in 1935 by Jack Pritchard who had worked for Venesta, a major plywood manufacturer and distributor (39). From the mid 1930s, Isokon was a focus for avant garde design and Walter Gropius was appointed controller of design. Breuer's 1936 armchair for Heals, which owed a great deal to Aalto, is a relatively poor attempt to come to terms with the formal vocabulary of plywood; its heavily padded upholstery and the unusual curve has none of the elegance of Aalto's work. By contrast, his Isokon long chair of laminated wood and plywood represented something new. It has been suggested by Christopher Wilk that the long chair, which incorporated a single sheet of moulded plywood suspended between a frame, was, in part, derived from a similar chair by Breuer in bent flat aluminium and flat steel of 1935 (40). Although manufactured from 1936, many of the
technological difficulties were not successfully solved until the 1950s (41). Breuer was to have a direct influence on the Eameses' designs of the 1940s; the child's desk/stool of 1943 manufactured by Evans Products Company being clearly derived from Breuer's side table of 1936 (see Figs and below).

Most plywood experimentation in Britain came to a halt after Germany invaded the Baltic States - the main suppliers of plywood - in the autumn of 1939. Coupled with this, many of the émigré designers packed their bags again and moved to the USA, thereby helping establish that country as the main centre of the Modern Movement. The use of plywood in furniture design in America was given a boost by László Moholy Nagy who, appointed with Gropius's blessing as the Director of the New Bauhaus in Chicago in 1937, encouraged his students to make chairs by moulding plywood into complex shapes, witness the work of Nathan Lerner and Kenneth Evertsen (42). Peggy Guggenheim commissioned plywood furniture for her Art of This Century gallery in New York and Frederick Kiesler produced a plywood and solid wood rocker and pedestal table in 1942 (43). Whilst bent, none of this furniture was moulded through more than one plane and complex curved furniture was not attempted until Charles Eames and Eero Saarinen's entries for the MOMA Organic Design in Home Furnishings Competition of 1940.

During the 1930s plywood furniture mainly utilised cut-out rather than moulded plywood. Although influential designers including Richard Neutra and Rudolph Schindler designed such furniture, most of the cut-out furniture was of relatively uninspired design and took plywood
furniture design into a cul-de-sac by the end of the 1930s, from whence it was rescued by the work of Eero Saarinen and the Eameses during the 1940s (44).

The bent plywood upholstered armchair of 1939-40 for the Klienhans Music Hall, Buffalo, New York, 1938-39 was Eero Saarinen and Charles Eames's earliest venture in this material. Manufactured by Vernon M. Page, Inc, Baltimore, the chair is clearly derived from the work of Aalto in its use of a single piece of plywood moulded through one plane to form the seat and back, although, as R.Craig Miller has pointed out, the influence of Gilbert Rohde, who designed a solid bent wood chair in 1931 which was manufactured by the Heywood-Wakefield Furniture Company, is also evident (45).

ORGANIC DESIGN IN HOME FURNISHINGS COMPETITION, 1940

The Eames and Saarinen moulded plywood furniture of 1940 was the outcome of a competition instigated by the Department of Industrial Design at MOMA, under the direction of Eliot Noyes and Ira Hirshma (Fig. 50). In terms of the introduction of a new aesthetic in furniture design, the exhibition was as much a landmark as the Die_Wohnung exhibition in Stuttgart of 1927 at which was first exhibited the tubular steel cantilevered chair.

Since its establishment in 1929 by Alfred Barr Jnr, MOMA in true Modernist fashion had paid as much attention to design as it had to the fine arts (46). The Organic Design in Home Furnishings Competition was
the first inter American competition held by the museum and aimed to link designers and manufacturers as well as interest potential customers. The idea of a museum concerning itself with the applied arts was not new; there was a long tradition both in Europe and in America of museums being established to improve the manufactured products of a particular country. The South Kensington Museum (now the Victoria and Albert Museum) being the first of the national museums to be so established. During the 1930s fine art museums held exhibitions of Modern industrial design, witness the Metropolitan Museum of Art's Contemporary American Industrial Art, 1934, which featured room settings and designs by well known designers including Eliel Saarinen, Donald Desky, William Lescaze, Raymond Loewy and Russel Wright (47). What was unique about the 1940 MOMA competition was that it emphasised the manufacturing aspect. Such a competition caused great excitement at Cranbrook - Benjamin Baldwin and Harry Weese submitted entries as well as Charles Eames and Eero Saarinen - as well as at countless other design institutions in the USA.

The competition emerged after the MOMA had been contacted by the managers of key department stores across the country, including Bloomingdales, New York, Baker Brothers, Los Angeles, and Marshall Fields and Co, Chicago (48), who were conscious of a lack of high quality contemporary furniture and textile design. All had, at one level or another, been involved with selling and promoting Modern design; indeed, Marshall Fields had sold Gerald Summer's bent plywood archair and in 1934 Bloomingdales displayed sixty eight pieces of Russel Wright furniture manufactured by the Heywood-Wakefield Company (49).
A set of distinguished jurors was chosen, including Alvar Aalto and Marcel Breuer, and the competition, which was open to designers from both North and South America, covered nine categories including seating and other furniture for a living room, dining room, bedroom, one room flat as well as outdoor furniture, lighting equipment and woven and printed fabrics (50). The competition privileged the utilisation of up-to-date technologies and modern methods of manufacture, whilst giving little aesthetic direction. Contrary to popular belief, the use of the word organic did not refer to a preference on the part of the museum for an organic aesthetic; Eliot Noyes argued that:

"A design may be called organic, when there is a harmonious organisation of the parts within the whole according to structure, materials, and purpose. Within this definition there can be no vain ornamentation or superfluity, but the part of beauty is none the less great - in ideal choice of materials, in visual refinement and in the rational elegance of things intended for use." (51)

While MOMA did not dictate a particular aesthetic, several designers, including Charles Eames and Eero Saarinen, adopted an organic aesthetic which had become increasingly popular in America during the 1930s for designed objects.

Eames, then Head of Industrial Design at Cranbrook, and Saarinen, who was working in his father's architectural practice, became enthused with this project not least because of the possibilities of manufacture and distribution on a large scale. As Charles Eames wrote in 1941:

"The aim...was to provide the largest group of people with good furniture within their means. The opportunity was a rare one because of the unique phase of the competition which provided contact with manufacturers and an outlet for winning designs." (52)
They gathered a small team of helpers around them, including Charles's students Don Albinson and Harry Bertoia, and students from other Cranbrook departments including Ray Kaiser whose role was to colour the presentation drawings (53).

Eames and Saarinen submitted six entries in the form of drawings and photographs of scale models for living room seating and several designs for the other living room furniture, winning first place in both categories. The former included a side chair, conversation chair, relaxation chair, easy chair, sofa unit, and lounge chair. The case furniture comprised plywood benches and cabinets which could be arranged in a number of combinations. The case goods were accompanied by a desk and the entire group was complemented by a plywood coffee table (Fig. 51). The seating designs were the most important because Eames and Saarinen proposed to produce moulded plywood shells in complex yet ergonomically satisfactory forms which eliminated the need for upholstery. They wanted to use modern methods of bonding and attempted to utilise the cycle weld technique which had been devised by the Chrysler Car Corporation to mount engines and meant they could bypass the need for bolting or piercing the seat (54).

After winning the competition, Eames and Saarinen set about producing their designs. Eames and Saarinen were young idealistic designers keen to utilise new industrial techniques in the furniture industry. Their idealism and enthusiasm were soon tested when they began to search for firms to manufacture their designs. Eames visited Grand Rapids to study
the furniture industry but found mainly the production of 'period' pieces utilising old technology (55). Eames, as always, remained optimistic and as Eliot Noyes later recollected, claimed that for each of the problems he and Saarinen needed to surmount 'there must be at least ten simple standard techniques which the furniture industry must have developed years ago, and which could be found on page 793 of some furniture makers' handbook of standard practice' (56). Eames and Saarinen did not find them in a handbook, however, and there was a long period of research before he, in collaboration with Ray, finally mass produced moulded plywood furniture.

The main problem was that the moulding required intense heat and pressure to produce such complex shapes and the plywood was apt to be marked and then needed to be upholstered, thus defeating one of the purposes of such furniture - the elimination of expensive and cumbersome upholstery. At Artex, Aalto had developed a method of successfully moulding plywood into two dimensions by using steam but the process was slow and ensured that Aalto's furniture remained priced at the top end of the market. Eames visited the Grand Rapids factory of the Haskelite Manufacturing Corporation of Chicago, a firm which had established a reputation as a maker of mass produced plywood stadia seating (57). The moulding of the complex shells proved a major challenge even for this firm and, in the end, the finished shells were not up to the required standard and were upholstered in foam rubber and a wool fabric designed by Marli Ehrman by the Heywood-wakefield Company of Gardener, Massachusetts, long famous for its wicker furniture, some of which was upholstered (58). The only exception to this was the exposed back of
the side chair which was the least complex of the designs and therefore the one least likely to be flawed.

The production process was very primitive. It began with an 'ideal body' form moulded in wire mesh and preserved in a plaster cast which was then translated into an iron mould (59). The actual moulding process involved the use of heat and pressure after which the shell needed to be trimmed and then upholstered (60). A further problem faced by Eames and Saarinen was that, by 1940, the United States was preparing for war and materials such as aluminium and techniques such as cycle-welding were reserved for military use which meant that Eames and Saarinen were forced to compromise and use maple wood legs which pierced the chair shell (61).

The sectional sofa represented a modern solution to the problem of sofa design. Eames and Saarinen wanted to get away from the ubiquitous heavily upholstered sofa which was extremely popular in the inter war years. In contrast to much other seating furniture which used helical springs, webbing and filler pads, all of which made it cumbersome, their sofa was based on a moulded plywood shell topped with flat springs which were then upholstered. Flat springs provided as much comfort as traditional springs but without their greater bulk and, to emphasise their point, they illustrated in the catalogue accompanying the exhibition a traditional sofa which was dissected in order to show the advantages of the Eames/Saarinen design (62). Other innovations included the proposed use of a zipper so that the customer could use single units as chairs or join them together as a sofa.
Although it was the technological innovations of the moulded plywood chairs shells which captured most of the publicity, the Eames/Saarinen entries for sectional storage units which rested on benches were also very inventive. Modular furniture was not new and in the exhibition catalogue Eliot Noyes outlined its origins in large scale office organisation at the end of the nineteenth century, with demands from organisation and method experts such as Frederick Taylor for more efficient offices utilising mass produced desks, chairs and cabinets. The development of the roll top desk and filing cabinets to store the ever increasing amount of paper work came in response to such demands and many designers from Frank Lloyd Wright to Gilbert Rohde designed offices and office furniture (63). In the inter-war years uniformity and standardisation were the dictating factors behind this type of furniture which was greatly admired by the early Modern Movement, particularly Le Corbusier, whose Decorative Art of Today, 1925, illustrated some examples (64). By the late 1940s designers such as the Eameses and George Nelson began exploring the application of this type of modular furniture to the home (65).

Eliot Noyes commented on an interesting new feature in Eames and Saarinen's work:

"These designs by Saarinen and Eames, probably for the first time, exploit the base for itself. The various advantages of this system are demonstrated in the detail from one of Saarinen and Eames competition drawings. Units which rest directly on the floor provide difficulties in rooms where a baseboard prevents their fitting snugly against the wall. The base system by Saarinen and Eames not only avoids such difficulties by raising the units well off the floor, but also adds many pleasant new possibilities by extending the usefulness of the bases as seats or plant stands." (66)
The whole system, which was to be manufactured by the Red Lion Furniture Company, consisted of standardised units made from plywood veneered with Honduras Mahogany which could be used in a variety of ways. The bases, which came in a variety of lengths, were designed to support a differing number of units, all of which were a standard 13 inches in height. The cabinets were available in two sizes. Eames and Saarinen added variety through a number of different infills, including cupboards and drawers. An interesting feature of the case goods was a two legged table which rested on the cabinets and Eames and Saarinen finished off the group with a moulded plywood occasional table. Once again they found the furniture industry wanting. Firms were not prepared to develop the project because retailers did not like the idea of stocking the large amount of units needed to make it a success (67).

This new plywood furniture caused considerable excitement at the exhibition but the full impact of it was lost because of the outbreak of war. Nevertheless, much attention has been give to it subsequently, albeit mainly in terms of the technical processes which Eames and Eero Saarinen wanted to use, even though at the time, the cycle-weld technique and the mass production of complex moulded plywood were not used. However, as Christopher Wilk has argued, of equal importance was the aesthetic innovation of the seat furniture (68).

Although the chairs represented an exciting new aesthetic, the two designers played down the importance of aesthetics in their work. In
true Modernist terminology Eames claimed that both he and Saarinen worked to no preconceived aesthetic criteria:

"With no preconceived idea of form we worked simultaneously with factory technicians and many experimental sitters and as the chair forms developed we, too, were surprised and as we worked with them we found them pleasing." (69)

Today this seems somewhat naive, because, in retrospect, the seating furniture designed by Eames and Saarinen fits into a pattern whereby designers were increasingly turning to organic forms. Forms derived from natural sources were increasingly used during the 1930s as an alternative to the geometric hard edged abstraction of the furniture of, Rietveld, Stam, and Breuer. Several years later Saarinen admitted this when he recalled, 'The problem then becomes a sculptural one, not the cubist, constructivist one' (70).

In terms of the Eames/Saarinen entries, the most important designs were the conversation chair, relaxation chair, easy chair and lounging shape where the sculptural aesthetic was exaggerated beyond anything that either Eames and Saarinen would subsequently produce (Fig.52). It is probable that in these designs both Eames and Saarinen were attempting to demonstrate the potential of plywood in terms of organic form. It was not until Ray Eames, with her background in sculpture, became involved that the somewhat overpowering forms of these early designs were translated into the far more satisfactory forms of the DCM chair. The sectional sofa and coffee table were also important in introducing a new aesthetic, in the use of spindly legs on both designs.
Collaboration

As with most close collaborations, it is difficult to establish exactly what aspects of the design came from each partner. Ralph Rapson, a fellow Cranbrook student claimed that Eero Saarinen was mainly interested in the look of the chair while Eames was mainly interested in the technology (71). As already shown Eames visited the furniture industry in Grand Rapids, making a close inspection of the manufacture of plywood stadia seating. Indeed, Eames argued that he and Saarinen must develop a new approach to the manufacture of furniture design:

"That approach is to ignore all materials and techniques to determine as completely and clearly as possible our needs in furniture. Then to search for the materials and techniques which can most appropriately fill this need. Because of quantities involved these are apt to be found in factories where the efficiency of mass production is essential and form submits to no compromise. Factories making electrical equipment, airplanes, tools, or any of the many useful things which never had 'art tradition'." (72)

In his later designs, most notably his Tulip Chair of 1955-57, Eero Saarinen did indeed put aesthetics before technology in the sense that he was prepared to place a plastic seat on a metal base and disguise the final product so that the viewer/user was not aware of the difference in materials but focused on the overall design. However, in this case the collaboration was decidedly more complex than Eames working on the technology while Eero Saarinen sorted out the aesthetics. Charles Eames had studied sculpture under Carl Milles while he was a student at Cranbrook and was well versed in traditional sculptural concepts. As two energetic young designers embarking on such a novel project, both designers would have discussed in detail every aspect of their designs.
The technology used in the project helped to inform the aesthetic of the furniture but, as Eames stressed, only partly. The same technology could equally have been used to obtain a differing aesthetic. Both Eames and Eero Saarinen were responding to a new mood in design which favoured organic over geometric forms. At the same time the evidence can be read as illustrating the thesis that in collaborative work, Charles Eames drew a great deal on the aesthetic preferences and abilities of, firstly Eero and then Ray. Some of the forms of the Eames/Saarinen chairs can best be described as awkward. It was not until Ray, with her background in abstract sculpture, became involved in the design process that aesthetic innovation was translated into more harmonious designs.

Other Entries

The competition attracted a wide range of submissions including designs by Latin American designers for which there was a separate category. The competition created a genuine stir at Cranbrook: Benjamin Baldwin and Harry Weese combined forces to enter and Ralph Rapson also took part. Unlike the Eames/Saarinen's entries, the other Cranbrook designers referred back to avant garde design of the 1930s. The Baldwin/Weese design for a tea wagon was influenced by one designed by Aalto in 1936 (73). While the latter was made exclusively from wood, the Baldwin/Weese piece composed a tubular steel frame (painted grey) with shelving of either pierced steel or plywood. Baldwin and Weese also made use of pneumatic tyres for the wagon wheels whilst both designs utilised a wicker basket. Aalto placed it at the rear of his design while
Benjamin/Veese placed theirs at the front. Despite the differences, however, the latter design is clearly derivative of the former.

A similar reliance on earlier designs is seen in Ralph Rapson's rocking chair. Made from a wood frame painted black, the chair was upholstered with linen webbing. Stylistically and technically the chair derived from similar chairs by Alvar Aalto and Bruno Mathsson, one of whose chairs Rapson owned (74). Aalto used webbing in several chair designs during the late 1930s, witness his Cantilevered Chaise Longue with leather webbing of 1936-37, as did Mathsson in his Pernilla Chair of 1939. Although this particular design did not win a prize in the competition, it was one of the first MOMA competition designs to be mass produced by Knoll Associates, entering the Knoll range in 1942. Apart from the Eames/Saarinen entries, the most innovatory designs were those by Martin Craig and Ann Hatfield who entered a series of natural birch chairs with foam rubber cushions and also proposed an interchangeable series of case furniture.

Although the Eames/Saarinen entries were not the first furniture designs to suggest the use of techniques developed for other industries, (Stan, Breuer and Van der Rohe had applied the technological know-how of the bicycle industry to their tubular steel furniture), their designs nevertheless stood out as being new and exciting, both technologically and aesthetically. The original brief demanded that the designs and prototypes made for the competition and exhibition should be capable of being mass produced but the onset of war meant that this became
impossible. Writing a year after the close of the exhibition, Eames commented:

"Had the Museum of Modern Art's competition been held this year instead of last, a possible program would have required the competitors to design furniture restricting themselves to materials and techniques not absorbed in national defense. That would have been quite a trick but the competition was held last year and the Museum's view was a much longer one." (75)

He realised that the importance of the competition lay, not in the way that it failed to deliver the goods, but in the implications that it held for the future:

"It will be several years before the full value of the competition can be judged, but if its influence has made it easier for new and appropriate structural systems to be accomplished by aesthetic satisfaction we have no doubts." (76)
EXPERIMENTAL PLYWOOD CHAIR

Charles Eames and Eero Saarinen's entries for the Organic Design in Home Furnishings Competition pointed the way forward for Modern mass produced and affordable furniture. At the same time it illustrated the technological problems to be solved if such furniture was to be produced. It was these problems with which Charles and Ray Eames concerned themselves from their arrival in Los Angeles in July 1941. They established a makeshift laboratory-cum-workshop in their Westwood apartment and experimented in earnest with perfecting the technology needed to mass produce moulded plywood furniture.

Aalto had successfully moulded plywood in large quantities using steam but the Eameses realised this time consuming process (it took several hours per chair) would not lead to economically viable furniture. In order to produce items affordable to a large proportion of the American public, the Eameses developed a moulding machine which they called the Kazan machine because it produced moulded plywood forms as if by magic and was a reference to the term Ala Kazan meaning 'as if by magic' (76) (Fig.53). The machine had at its centre a plaster mould in the form of the chair required. This was covered with electric wires which provided the heat needed to mould the plywood. The plies were coated with glue and then inserted into the machine. They were forced against the mould by a rubber membrane inflated by a bicycle pump. The machine was encased in a wooden frame and securely fastened to withstand the enormous pressure within. During the four to five hour moulding process the plies were formed by a combination of heat and pressure. The time...
needed to mould a single chair was not much of an improvement on the Aalto method but the end result was a high quality one-piece moulded chair piece which only needed to be trimmed around the edges and the process was later speeded up (77).

This work was essential to the Eameses' understanding of plywood technology. All their later work was a development of this pioneering period and the later larger moulding machines were based on the forms of the 1941 Kasam machine, although it must be remembered that substantial improvements were achieved after they had access to classified plywood technology developed by the British (78). Although the Eameses would have argued that the forms of the chair seat emerged from the process of the moulding, in reality it was a conscious decision on their part to mould plywood in this particular way rather than bend it in two dimensions as had Aalto. During the war years they improved this technology and increasingly gave thought to the aesthetics of their designs (79).

The Eameses' earliest experiments were conducted by them alone, without any outside help and probably represented an almost equal input from each of them. Although Ray was trained in the fine arts, her period at Cranbrook, particularly her involvement with the Organic Design in Home Furnishings competition, had stimulated her interest in designing affordable furniture. Interestingly enough, during the period of these early experiments Charles was working full-time at the Art Department of MGM, and it was Ray, alone at home in the day, who was able to devote herself more or less exclusively to the project in hand.
PLYWOOD SCULPTURE

Experimentation was not just with plywood technology but also with aesthetics. Both Charles and Ray Eames used the plywood technology to create new forms in sculpture and a sculpture by Ray Eames was used to illustrate new approaches to modern form in 1944 (80). They used their increasing technical proficiency at moulding plywood to experiment with all manner of forms, ranging from large scale free standing sculptures to complex and small scale springs and coils, all of which not only experimented with new forms but also illustrated the potential of plywood for being moulded into all manner of complex shapes (Fig. 54). It was during this period of experimentation that Gregory Ain joined the Eameses team (81). Under Ain's direction they began substituting steel for their wood and plaster moulds (82). The use of a 1/4 inch steel mould allowed for the forming of more complex shapes and had a great effect on both the manufacture and aesthetic of their later plywood furniture. Both Charles and Ray produced sculpture which they saw as vital to the whole plywood project.

WAR WORK 1941-45

After the entry of the USA into World War Two in September 1941 the Eameses considered ways of utilising their plywood experiments for the war effort (83). It was in December 1941 that Dr Wendell Scott, a friend of Charles from Saint Louis, realised the potential the Eameses work had if used for splints. The US armed forces had used metal splints for many years but these had many problems associated with them;
for example, they did not support the leg securely and impeded circulation which could lead to gangrene (84). Wendell discussed with the Eameses the ways in which they could apply their plywood work to make splints moulded on the form of an 'ideal' leg which would more accurately support injured limbs. The moulded form also allowed for easy stacking and transportation to battlefields. This project excited the Eameses because it offered the possibility of seeing their work into mass production (85).

The mould was based on the proportions of Charles's leg and two pressings were made representing a mould suitable for each leg. These were then turned into plaster moulds. The method of production of these splints used the technology of the experimental plywood chair but differed in several ways (86). The moulding process began with the layering of the plies over the mould, the number of plies varying depending on the amount of support needed at each pressure point. The wood was held in place by rubber strips and then moulded by a combination of heat and pressure. As with the experimental chair the process took about five hours, after which all that was left to do was the trimming of the design (87) (Fig. 55). The Eameses had wanted to use plywood moulded through three dimensions to produce a one piece compound form which would support the leg but, as Christopher Wilk has pointed out, the splints reveal the technical limitations of the Eameses' work at this time because, in order to prevent the tearing of the outer layers during the moulding process, cuts were inserted into the splint to relieve the pressure (88).
The prototype splint was shown in the Spring of 1942 to officials of the US Navy who, after asking the Eameses to provide more support for the heel, welcomed the design (89). It was at this point that John Entenza became involved in the project providing financial backing which allowed the Eameses to move into a larger workspace in West Los Angeles where they established the Plyformed Wood Company (90). The splint was put into mass production in November 1942 with an initial run of 5,000. The whole project was faced with a severe cash flow problem after a delay in payments from the US Navy (91). By then the Eameses were experimenting with a plywood stretcher and needed a regular source of income to carry on with their development work. The saviour of the project came in the form of Edward Evans, son of the head of the Evans Products Company, a Detroit manufacturing firm which also had considerable interests in timber (92). Edward Evans was looking for new ways to utilise the firm’s extensive timber forests in the Pacific North West. He was a great believer in plywood as a material both for architecture and design and had already commissioned Richard Neutra to build a new regional headquarters at Lebanon, Oregon, using the company’s own wood (93).

It was a shared belief in the potential of plywood which brought the Eameses and Evans together. The fruits of this collaboration were the 150,000 splints produced for the US Navy using Douglas fir veneered in mahogany (94). From July 1943 the Eameses’ operation became the Molded Plywood Division of the Evans Products Company, a move which injected sufficient capital to allow the continuation of the mass production of the splint and permit further experimental work and a move to new
premises at 901 Washington Boulevard, Venice, California, which was to remain the Eameses' base until Ray's death over forty years later.

Once they were established at the Venice workshop they began to experiment in earnest with the plywood stretcher and arm splint (95). Using the technology of the leg splint, the Eameses proposed a plywood stretcher moulded to the shape of the human form. It was hoped that they could use three dimensionally moulded plywood in this design (96). The original design had both the sides and shell of the piece moulded to form a tight cocoon around the injured soldier (Fig. 56). An ideal form was measured from Charles's body but the complicated technology needed to mould such a design through three dimensions and the fact that an 'ideal form' did not suit everybody's shape led the Eameses to alter the design. In the second design, only the base of the stretcher was ergonomically moulded to support a body and the sides of the stretcher simply acted as a barrier to stop the patient falling out and as hand holds for carrying (97). At the same time the Eameses developed an arm splint on the same principle as the leg splint. However, neither the stretcher nor the arm splint were developed, mainly because the US Navy could not be convinced that these projects would be as successful as the leg splint (98).

Aircraft and glider parts

The success of the leg splints and the increasing sophistication of the plywood technology led the Eames to design and produce parts for a variety of aircraft. Before the outbreak of the war, Los Angeles had
established itself as the world centre of aircraft production with firms such as the Lockheed Company of Burbank and the Douglas Aircraft Company of Santa Monica, producing all manner of military, cargo and passenger aeroplanes (99). During the war aircraft production changed exclusively to the production of military aircraft. During World War One, plywood had been used in the production of airships and aeroplanes because of its strength and lightness but during the 1930s aircraft manufacturers began switching to metal, as with the Douglas Aircraft Company who produced their DC3 aircraft from metal. During World War Two, aircraft manufacturers once again used plywood parts. The use of plywood in aircraft design had been pioneered by the British and the Eameses were given access to classified information concerning the use of bonding agents in the production of plywood as well as improvements in the moulding process (100). These improvements centred mainly on the use of improved synthetic glues which increased both the strength and flexibility of the plywood (101).

In 1942 the Eameses became involved with the Vultee Aircraft Company. Both parties realised that plywood had many advantages when used in the production of aircraft because it was both lighter and stronger than traditional wood. The Molded Plywood Division designed and manufactured parts for the Vultee BT-15 Trainer aircraft including stabilizers, wheel doors and slats (102). In this endeavour they drew on their earlier experiments with plywood and British developments and learnt a great deal in the process of moulding these large pieces of plywood. Larger versions of their original Kazam machine were needed and there was a great deal of experimentation before moulding times were established for
such large projects. The Eameses proposed developing a plywood pilot's seat which was upholstered by the parachute and also plywood fuel tanks but neither project came to fruition (103).

In 1943 they turned their attention to the development of plywood parts for gliders. By this time the Allies were ready for the invasion of France, the success of which depended on surprise and necessitated complete silence. The latter required gliders to be launched in flight at high altitudes from propeller driven aircraft and then make a silent descent to earth. The Eameses' involvement with the design of gliders began when Airborne Transport Incorporated approached the Evans Products Company about producing nose sections and other parts of the fuselage for their experimental glider, the CG-16, which was designed to transport two large jeeps (104). The plywood was to be moulded in large blister shapes some eleven feet long, seven feet wide and twenty inches deep (105). The moulding of such forms tested the resources and know-how of the Molded Plywood Division which took up the challenge with gusto. The team had to develop new moulding machines encased in steel to withstand the tremendous pressure needed to mould such large pieces of plywood. The large amounts of electricity needed to generate the heat to mould the plywood meant that a special arrangement had to be made with the local electricity company to allow the use of large amounts of electricity without affecting other consumers (106). The Eameses moulded sufficient sections for one experimental glider but, unfortunately, the pilot and accompanying passenger were killed during a test flight when the cargo moved forwards and the development of this glider was suspended (107). Nevertheless, the technical expertise
gained on these war time experiments were soon to be applied to peace
time work.

What must not be forgotten was that the war work represented a close
collaboration between Charles and Ray Eames and their team of talented
assistants. They had employed assistants from the summer of 1942 when
Charles had left MGM, taking with him fellow scenery designer Margaret
Harris. They were aided by the architects Gregory Ain and Griswald
Raetze and the following year they were joined by former Cranbrook
student Harry Bertoia. During this period Ray and Charles Eames spent
long hours in the workshop and were both very involved with the tasks at-
hand. Their war time experimentation completely changed their level of
knowledge of plywood technology and this proved influential in the field
of furniture design.

EXPERIMENTAL CHAIRS

Throughout the war years the Eameses, and Ray in particular, had
experimented with the aesthetic of plywood through their plywood
sculptures. During the mid 1940s attention refocussed on the design of
plywood furniture and the Eameses produced a number of experimental
designs which were considered suitable for adaption to mass production.
Unlike their experimentations of the early 1940s, when they needed to
develop the technology for the successful mass production of furniture,
the mid 1940s were taken up with experimentation with forms (Fig. 57).
Increasingly, the Eameses turned away from the one piece forms which had characterised the work of Eames and Saarinen in the Organic Designs in Home Furnishings competition. Many of their new experimental chairs combined tubular steel and moulded plywood, others utilised moulded plywood for all their members. The Eameses emphasised the aggregate solution to their furniture designs in that they preferred a metal or wooden frame clearly differentiated from the body of the chair which was formed from moulded plywood. The seeds of their later plywood furniture were all planted in this experimental group which was distinguished by a lightness of form where the chair and seat back were held in space by means of metal or plywood supports.

The new, light and novel forms which distinguished all the Eameses' later furniture designs can be attributed, in the main, to Ray. As with the Eames House, it was only when she became involved in the design that the forms of the plywood furniture become more delicate and, in fact, more novel. Gone were the exaggerated forms derived from Henry Moore and Barbara Hepworth and in their place were organic forms derived from more contemporary American sculptors including Alexander Calder and the Spanish Surrealist painter Joan Miro. Another source of this new lighter chair forms was Ray's training under Hans Hofmann and is discussed more fully below.

These chairs represented as much a Modern solution to seating as the tubular steel seating of Stam and Van der Rohe. The delicate legs in either tubular steel or moulded plywood, supporting the seat and back of the Eameses' experimental as well as manufactured plywood chairs of the
mid to late 1940s, were as innovative and novel as the cantilevered forms of the earlier Modernists. The technology used in the manufacture of each part of the chairs represented the application of advanced technological processes. The Eameses use of rubber shock mounts and attempts to bond these by means of radio waves testify to their aim to produce high quality, affordable Modern furniture using the best of contemporary technology.

One of the major technological problems which the Eameses faced was the joining of the seat and chair backs to the supports, either in wood or metal. As Modernists they looked to a more modern technique than piercing the plywood seat with metal legs as had occurred with the Eames/Saarinen entries in the Organic Design in Home Furnishings competition, although they had suggested utilising the cycleweld technique to join the plywood to the aluminium chair legs. In the experimental plywood furniture of the mid 1940s the Eameses redirected their attention to this technique which was based on the joining of the frame to the seat base and chair back by rubber discs which allowed a certain amount of resiliency in the design (108). The Eameses decided to use radio waves to join the discs to the chair and frames but this process proved highly problematic and the parts were joined by an extra strong synthetic resin developed during the war (109). The Eameses were not the only designers to experiment with the use of rubber shock mounts. Two Italian designers, Cristiani and Fratino, working with wartime technology, utilised rubber shock mounts in one of their chair designs in 1947 but the Eameses produced a far more harmonious design (Fig. 58) (110). Their preferred form was a separation of seat and back
held up by either metal or plywood legs. They experimented with several chairs wherein the seat and legs were formed out of a single piece of plywood, but these chairs never went into mass production.
The Eameses' first mass produced furniture included a child's chair, stool and desk made using the technological know-how gained during the war (Fig. 59). This furniture has tended to be viewed as a footnote between the Eameses' wartime technological advances and the DCM chair (111). However, the children's furniture represents more than this; it is the first example in the Eameses' work of mass produced complex moulded plywood and Christopher Wilk has argued that this was their most sophisticated furniture to date (112). A group of moulded plywood animals was also designed. Made from birch they included frogs, seals, horses, bears and elephants but the project never went into production (113) (Fig. 60).

This group represented their first attempt to humanise modern furniture. The Eameses realised that much Modern furniture had appeared cold and soulless. The use of heart motif was an attempt to make the chair more human. As such it represented a traditional way of decorating furniture, a practise which can be traced back in European folk design over many centuries. At the same time the cut-out motif filled a functional role as it formed an ideal slot to insert one's fingers and therefore lift the chair. It is this part of the design which has made this particular chair difficult for hard line Modernists to come to terms with. The Eameses' Childrens Group was never a commercial success. While it was popular with certain people, including the Girards, and was sold in a few shops specialising in Modern design, in
the main it was aimed at a market which was at that time hardly developed (114).

MASS PRODUCED PLYWOOD FURNITURE

The post war boom in Modern architecture created a large market for Modern furniture. The Eameses' plywood group, which was developed during the mid 1940s and mass produced in limited quantities from 1945 and in larger quantities by the Herman Miller Company from 1949, was one of the most original answers to the new demand. The success of the furniture was linked with its exhibition at MOMA in February 1946 and also its manufacture by the Herman Miller Furniture Company. The Eameses' relationship with MOMA can be traced back to the Organic Design in Home Furnishings Competition. Eliot Noyes, one of the organisers of the competition, remained in close contact with the Eameses during the war and was greatly impressed by their wartime and experimental work (115). After the war, as Head of Industrial Design at MOMA, he suggested that the museum should show the Eameses' new furniture. After much deliberation by the museum board (some members of which considered that such a show would be far too commercial), the exhibition went ahead and the furniture was put on display in March 1946 (116). It was not the first exhibition of Eames plywood products and furniture in New York. A smaller exhibition had been held at the Barclay Hotel and at the Architectural League but it was through the MOMA exhibition that the Eames furniture became well known (117). It was a good choice on the part of Noyes and fortuitous for the Eameses because this furniture captured the new mood that was pervading the post war world. The
exhibition made many stand up and look at the innovations of the Eameses, including George Nelson who had recently been appointed Head of Design at the Herman Miller Company (118).

The Herman Miller Furniture Company

Herman Miller was a long established furniture making firm located in Zeeland, Michigan, some twenty miles North West of Grand Rapids, once the main furniture manufacturing centre of America (119). As with other Grand Rapids firms, Herman Miller had made its name with the production of reproduction furniture (120). During the 1930s Hugh De Pree, the president of the company, had been persuaded by the young industrial designer Gilbert Rohde to produce Modern furniture (121). This change in approach was successful and when Rohde died it proved difficult to find a worthy successor. That the firm considered asking Eric Mendelsohn, the German architect and designer (122), shows how serious the conversion to Modernism had been and, in the end, George Nelson was appointed. It was due to Nelson that Herman Miller took over the distribution and manufacture of Eames furniture from the Evans Products Company.

Plywood Chairs 1945-47

It has been claimed that chair design was at the forefront of Modern Movement design from Rietveld's Red, Blue and Yellow chair of 1917-18 to Marcel Breuer's Wassily Chair (1923) and the designs of Aalto in the 1930s (123). The Eameses' chair designs were no exception and their DCM
chair came to symbolise the new optimistic spirit of the post war era (Fig. 61). The Eames chose an aggregate form for their plywood chair designs, a decision guided to a certain extent by the fact that it was more economical to produce smaller individual seats and backs which could be replaced if faulty at far less cost than a full shell form (124).

The chairs came in either lounge or dining room height with either bent plywood or tubular steel support and legs (Fig. 62). Birch and walnut were the preferred woods but other more exotic woods, including zebrawood were used (125). Five roughly cut plies were coated with a plastic binder and placed in a moulding machine based on the male/female compression principle and involving a canvas inflatable airbag and a metal mould. As the Neuhratz point out this moulding process was essentially a refinement of the earlier Kazan machines (126). However, the new compression moulds were more compact and far more efficient than those used in the moulding of the experimental plywood chair in 1941. The heating elements were placed in the airbag, the plies clamped and the airbag inflated. The heat caused the plies to fuse together as the wood was moulded and at the same time, heated oil gave the wood a melamine finish (127). Only ten minutes were required to mould the chair back and seat, after which all that was left to do was to trim down the pieces (128), but the plywood legs, which were only moulded in one direction needed twenty minutes because they were made from a larger number of plies and were far thicker than the seat and back (129). The finish was of a high enough standard to be left uncovered. In some designs, however, the Eameses used animal skins to
cover the chairs (130). As stated earlier, the Eameses had wanted to use the cycle-weld technique to join the various elements of the chair but this remained unworkable and synthetic glue bonded by heat to shock mounts was used instead. Although this method offered resiliancy, the bond tended to wear after a while with the result that many chairs had to be repaired (131).

The Molded Plywood Division mass produced some plywood chairs in the autumn of 1945, including a three-legged wood and wood and metal chair in dining and lounge heights as well as a tilting chair (132). It is possible that the Eameses saw the three-legged piece in terms of a statement about the minimum use of material and a design which broke with the convention of four legs. However, by the time Herman Miller took over the mass production of the group in 1949 all the three-legged designs had been eliminated. After the MOMA exhibition the variations were whittled down to just four, the all plywood dining and lounge chairs (DCW and LCW) and the wood and metal ones (DCM and LCM). These went into mass production in the summer of 1946 with a production run of 1,000 of each design manufactured in Venice, Los Angeles (133). A popular misconception is that the final forms of the DCM was shown at the 1946 retrospective, in fact it received its first public presentation a year later, in 1947, in the One Hundred Useful Objects of Fine Design (134).
Plywood Chair Aesthetic

The forms of the plywood chairs represented the highpoint in the Eameses' work on organic forms which proved more acceptable to consumers than the geometric forms of early Modern Movement furniture. While both Charles and Ray Eames were well acquainted with Organic Modernism at Cranbrook, the distinctive forms of their plywood chairs came via another route, namely Ray Eames' training as an abstract artist and, in particular the ideas of her tutor Hans Hofmann. Hofmann was the link between the School of Paris and the Abstract School of New York, later known as Abstract Expressionism. Although Hofmann directed his students to look at nature, he was one of the great abstractionists and himself was one of the most important factors in the development of abstract art in America after the war.

Perhaps Hofmann's greatest contribution to aesthetics was his notion of push and pull (Fig. 12). Irving Sandler has argued that Hofmann was one of the first to:

"...loosen [painting] by opening its closed planes and by using colour in itself to determine structure...[by]... pulling receding areas up to the surface and pushing back areas that protruded, in order to flatten the picture plane. The sense of the push and pull turns a picture into a dynamic field of forces." (135) [author's emphasis]

It is this push and pull conflict which appears in the seat and back of the plywood chairs. This feature has been commented on by most critics and commentators including Arthur Drexler who stated:

"Part of the elegance of this design must be attributed to the contours of the seat and, even more, the back panel.
Eames himself cites the hundred of studies discarded because the contours of these two elements somehow attracted undue attention. The back panel might be described as a rectangle about to turn into an oval, the transformation being arrested at a point midway between the two shapes. Ambiguous but not bland, the shape is instantly seen as a whole, with no part of its contour catching the eye. The curve of the seat flares more emphatically and from certain angles gives the chair a curiously animated look." (136)

Drexler's remarks about the oval and the rectangle illustrate Hofmann's ideas concerning push and pull. While these ideas were mostly manifested in Hofmann's work in the late 1940s, by which time Ray was well established in Los Angeles, Ray remained in close contact with leading Abstract Expressionists, including Jackson Pollock (137). The sophistication of the Eameses' 1946 chairs owes a great deal to Ray's training as an abstract artist. Yet she has not been given credit for the novel and distinct forms of these chairs. Because of the influence these chairs had on other furniture designers, who attempted to use the formal innovations of the Eameses with varying degrees of success they, and particularly the DCM, came to symbolise the entire plywood group although the other furniture designs in it were just as technically and aesthetically daring.

Plywood Tables 1945-47

From 1945 the Molded Plywood Division attempted to use the moulding process to manufacture table tops and legs (138). Four prototype tables were produced including a circular moulded coffee table with bent metal or moulded plywood legs (Figs. 63). Some designs had three legs, others four. An occasional tray topped table with three metal rod legs was
also produced, as was a four-legged plywood dining table in which the legs could be unscrewed for shipping and, finally, a folding table with tubular steel retracting legs. As with the plywood chairs, the aim behind the tables was to use the minimum amount of material, to mass produce low cost pieces, to exploit new methods of joining the members, to make them stackable and suitable for indoor or outdoor use (139). These tables were exhibited at the Barclay Hotel Architectural League shows and also at MOMA. Mass production of the circular moulded coffee tables began in Venice, Los Angeles, shortly after the close of the MOMA exhibition in March 1946 and continued until 1957 but the dining table remained in production for only a year (140).

The folding table was the only table design to change drastically between prototype and production stage (141). The 1946 design had an oblong plywood top and tubular steel legs which folded up whereas the top which emerged after the exhibition was based on a square with rounded edges for safety and revealed the exposed plywood layers (142). The tubular steel legs simply clipped underneath in a position which was highly decorative when compared to the straightforward arrangement of the earlier designs. It came in three sizes (dining, card and child). There were problems in finding a suitable damage-proof finish for the tops until a resin coating was added which rendered them impervious to damage (143). This problem was worked on intensively by Warren Kerkman, manager of Kerkman Manufacturing, the first outside firm to produce Eames furniture either for the Evans Products Company or Herman Miller (144). These tables remained in production until 1964 (145).
Formed from either birch or ash, the folding screen came in two heights (34 and 68 inches) with an extended length of 80 inches (Fig. 63). Screens became popular during the 1930s because they were suited to open plan interiors. Several Scandinavian designers had produced screens including Aalto (1935) and Arthur Mack (1937-39), both of which were marketed through Artex and the Eameses' screen relates to these (146). It was formed of nine half inch U shaped sections moulded from three plies (147). The Eameses considered joining the sections together using flexible tape and a synthetic bonding substance but this did not work and they were forced to use a more traditional method involving canvas hinges sandwiched into slots cut in the wood (148). This allowed the screen to be stowed away neatly, easily packed for shipping and placed in a variety of positions. The screen was developed during the mid 1940s and was exhibited at the New York shows (149). Originally manufactured by the Molded Plywood Products Division at Venice, Los Angeles, manufacturing was transferred to Grand Haven, Michigan and then to Herman Miller at Zeeland in 1949. The screen remained in production until 1955 (150).

The plywood case goods developed by Charles and Ray Eames in the mid 1940s picked up where Charles Eames and Eero Saarinen left off with their plywood modular units in the 1940 Organic Designs in Home Furnishings competition. Like the earlier designs, the later ones were
based on standard bases of differing lengths, on top of which plywood cabinets could be placed (151). The cabinets contained a variety of infills ranging from drawers, shelves, hinged front panels and radio cabinets. One of the distinctive features was the dimpled plywood which gave added strength to the design (152). Although the prototype case goods were exhibited at the New York shows they never went into mass production. But much of the technological know-how gained on this project was utilised in a series of radio cabinets of birch and ash which also made use of the dimpled plywood effect and were produced for such famous firms as the Zenith Corporation, the Federal Telephone and Radio Corporation and the Bendix Corporation (153). Some 200,000 cabinets were produced, starting at the Rose Avenue plant and later at the Grand Haven factory. Production ceased in 1952 (154).

The Eameses' plywood group was both technologically and aesthetically inventive. They were amongst the first designers to apply war-time developments to domestic production. Although they had some failures along the line, including the use of the cycleweld technique, in the main they were successful in transferring war-time practices to peace time use. At the same time their designs were aesthetically new and this explains their commercial success. While pro-Modern Movement critics admired the use of technology in the designs, the organic forms attracted the attention of consumers and this furniture sold at a level hitherto only dreamed about by Aalto and Breuer. In 1949 when Herman Miller took over production and distribution of Eames furniture, the Eameses were beginning to experiment with other materials but they remained interested in plywood and returned to it in 1956.

-172-
By the time the Eameses designed the Lounge Chair and Ottoman, they had become designers of international standing and the pieces were launched with great fanfare at the 11th Milan Trienniale (Fig. 64). This design is sometimes incorrectly referred to as the Wilder chair because the inspiration for the design was said to have come from Billy Wilder (155). The inspiration was in reality more general and centred on the idea of producing a modern chair as 'comfortable as the English Club chair' suitable for 'gracing modern homes and...watching television in' (156).

The chair design was derived from the relaxation chair submitted by Eames and Saarinen to the Organic Design in Home Furnishing competition and also referred back to an experimental lounger which formed part of Charles and Ray's post-war experiments. It comprised three sections of moulded rosewood veneered ply, whilst the base of the accompanying ottoman was formed out of a single piece of moulded plywood (157). Both the chair and stool rested on a swivel base made out of cast aluminium, as were the back braces, and the frame was joined to the shells with shock mounts. Unlike the plywood group of ten years earlier, the individual plywood pieces were only moulded through two dimensions. Also in contrast to the earlier plywood seat furniture, this chair and ottoman were upholstered to provide the comfort associated with more traditional lounge seating. They were covered in leather and originally filled with duck feathers and foam, although in later years Dacron (terylene) replaced the feathers (158). While the traditional and
'respectable' black leather was and remains the most popular covering, other colours were used (159). It became a cult object, for example the car designer Harley Earl ordered an orange upholstered version of the chair (160).

Of all the plywood designs the lounge chair and ottoman was the least avant garde. Some considered the chair too bulky and 'traditional' in design and felt let down by the Eameses whom they had hitherto regarded as aesthetic innovators (161). The design comprised the largest number of individual components of any Eames design and that inevitably added to its cost as did the expensive buttoned upholstery. The Eameses were conscious that this chair moved them away from their early aim of producing relatively cheap mass produced furniture and tried to keep the cost as low as possible whilst offering luxury and comfort (162). In the event, this chair not only proved popular at the time but has sold well ever since and remains in production today.

The Eameses' work in plywood was one of the most important manifestations of Modern furniture design. It was mass produced using the latest technologies and introduced a new aesthetic. This was what the likes of Breuer, Le Corbusier, Van der Rohe and Aalto had been trying to achieve for many years. Yet, at the same time as producing furniture which was greatly admired by Modernists, the Eameses' plywood work achieved considerable commercial success thanks to the years of experimentation, the efforts of the Herman Miller Company and also to its appealing aesthetic.
Footnotes


(3) ibid, pp.14-15.

(4) ibid, pp.17-19.

(5) ibid, pp.19-20.


(10) Alvera.A, op cit, p.50. The chair was manufactured by Gebrüder Thonet and an example is in the collection of the Technisches Museum, Vienna.

(11) ibid, p.50.


(13) The A.M Luther Co, Tallin, Estonia became a place of pilgrimage for the avant garde with visits from the likes of Mies Van der Rohe.

(14) For example; Drexler.A, Charles Eames, MOMA, 1973, p.10 argues 'All of their chairs made use of plywood shells, not bent in one direction, as had already been done by Aalto and Breuer, but moulded in two directions' and Miller.Craig.R 'Interior Design and Furniture' in Design In America: The Cranbrook Vision 1925-1950, New York, 1983, p.110 claims 'Saarinen's and Eames' achievement in 1940 was in bending laminated wood in a third dimension'.


(17) ibid, p.398.


(27) ibid, p.156.


(31) In 1938 Ray was living and studying in New York. Charles regularly visited there with Irene Rich whose mother was an actress regularly seen on the New York stage. Both therefore probably visited the Aalto show.

(32) This chair was illustrated in Domus (Finland), April 1932.
(33) Wilk.C, _op cit_, p.163. This upholstered chair was exhibited at the _Esposizione Internazionale delle Arti Decorative ed Industriali Moderne_, Milan 1933 see Felice.C.A, 'Le Sezioni straniere alla Triennale', _Domus_, May 1933, pp.282-83.


(35) _ibid_, p.156.

(36) _ibid_, p.36, this chair was illustrated in _Architectural Review_, August 1933, fig 10.

(37) Betty Joel and Gordon Summers were two important yet relatively unknown furniture designers working in the 1930s.


(42) Some of which were illustrated in Moholy Nagy.L, _Vision In Motion_, Chicago, 1947, pp.88-91.


There were entries from the United States, Argentina, Uruguay, Mexico and Brazil.

Noyes, E, *op cit*, p. 3.


Author's interview with Ray Eames, Los Angeles, May 1987.

Noyes, E, 'Charles Eames', *Arts and Architecture*, September, 1946, p. 44

Author's interview with John Neuhart, Los Angeles, May 1987.

Noyes, E, 'Charles Eames', *op cit*, p. 36.


ibid, p. 39

Noyes, E, *op cit*, p. 12.

ibid, p. 13.


Noyes, E, *op cit*, p. 17.


Eames, C, *op cit*, p. 17.


Miller, R. Craig, *op cit*, p. 307, footnote 96.

Eames, C, *op cit*, p. 17.

Miller, Craig, R, *op cit*, p. 111
Ray Eames interview 1986, and Eames. R & Neuhart. J & M, Eames Design, New York, 1989, p.27 NB Ralph Caplan claims it was so called because of the noise the machine made in the last stage of the moulding process, Caplan. R, The Design of Herman Miller Pioneered by Eames. Girard. Nelson Propst. Rohde, New York, 1976, p.44 claims it was so called because of the noise the machine made in the last stage of the moulding process.

Eames and Neuhart, op. cit, p.27.


Eames and Neuhart, op. cit, p.41.

ibid, p.28.

ibid, p.28.


Eames and Neuhart, op. cit, p.28.

ibid, p.29.

Wilk. C, op. cit, p.325.


Eames and Neuhart, op. cit, p.29.

ibid, p.33.


(94) Eames and Neuhart, op.cit, p.33.

(95) ibid, p.35.

(96) ibid, p.35.

(97) ibid, p.35.


(99) 'The Future of Aviation', Los Angeles Realtor, August, 1929.

(100) See note 79.


(102) Eames and Neuhart, op.cit, p.42.

(103) ibid, p.42.

(104) ibid, p.42.

(105) ibid, p.43. Ray Eames recalled they later learnt that Airbourne Transport Inc. had contacted other companies to mould the blisters but none were able to surpass the Eameses' work.

(106) ibid, p.43.

(107) ibid, p.43.

(108) ibid, p.61. The Eameses employed Norman Bruns specifically to work on this problem.

(109) ibid, p.61.


(111) Drexler, A, Charles Eames Furniture From The Design Collection, MOMA 1973, does not even mention this important group and other writers pay it scant attention.


(113) Eames and Neuhart, op.cit, p.57.

(114) ibid, p.55.
(115) Noyes, E, *op. cit.*
(117) *ibid.*, p.69.
(118) Caplan, R, *op. cit.*, p.30. George Nelson later recalled that he had been working along similar lines to the Eameses but on seeing their chair designs he remarked 'these are three to five years ahead of our own', *ibid.*, p.43.
(122) *ibid.*, p.30.
(123) Partly because chairs and design in general were seen as more democratic than painting and sculpture and a suitably progressive area to experiment in
(125) Fehrman, C & K, *op. cit.*, p.95, lists all the woods and finishes used in the Eameses' plywood chairs.
(126) Eames and Neuhart, *op. cit.*, p.60
(127) *ibid.*, p.60.
(128) *ibid.*, p.60.
(129) *ibid.*, p.60.
(131) Johnson, Stewart, J, *op. cit.*, recalled the problems that MOMA had with Eames plywood chairs used in the reading room because the rubber shock mounts were apt to break.
(134) This exhibition was arranged by Mies Van der Rohe.


(139) *ibid.*, p. 62.

(140) *ibid.*, p. 80.

(141) 'Dining Table, *Arts and Architecture*, February 1948, p. 33.

(142) Eames and Neuhart, *op. cit.*, p. 81.

(143) *ibid.*, p. 81.

(144) *ibid.*, p. 81.

(145) *ibid.*, p. 81.


(147) Eames and Neuhart, *op. cit.*, p. 79.

(148) *ibid.*, p. 79.

(149) *ibid.*, p. 79.

(150) *ibid.*, p. 79.

(151) *ibid.*, p. 67.

(152) *ibid.*, p. 67.

(153) *ibid.*, p. 76.

(154) *ibid.*, p. 76.


(159) For example the 1970s was the decade of white leather.


By 1948 the Eameses had, with the plywood group, fulfilled their aim to produce modern machine mass produced and affordable furniture. As dedicated Modernists they looked for other 'new' materials with which to work. They first turned to metal and proposed to stamp a series of chairs out of aluminium by drop weights (see chapter five). Metal, like plywood had been 'rediscovered' by the Modern Movement and presented as 'new' but it was a genuinely new material, glass reinforced plastic (GRP), which was to dominate the attention of the Eameses during the late 1940s and early 1950s.

The Eameses were not the only furniture designers to work with plastics; others including Eero Saarinen and Ralph Rapson, were equally excited by these new materials. But it was the Eameses who set the standard by which all other plastic furniture would be judged. The British furniture designer Robin Day refused to produce a chair in glass reinforced plastic for Hille because he considered the Eameses had produced the definitive design in that material (1). Others copied the organic aesthetics of the Eameses but few were able to achieve such harmonious designs. With their GRP seating range the Eameses were to produce their most popular and cheapest furniture to date - furniture which epitomised the material culture of the Eisenhower decade. Before looking at the Eameses work in detail, the development of plastics, and reinforced plastics in particular, will be outlined.
It was noted in 1941 that: 'plastics are pressing in upon the older materials from all sides, so much so that we are threatened with a 'plastic age' ' (2). Formed from either natural or synthetic materials, plastics are based on the ability of carbon atoms to link together in the setting process to form chains or polymers which give flexibility and strength. Thermoplastics are wax-like and retain their ability to be continually reset whilst thermosetting plastics can not be reset (3). Plastics have a much longer history than is usually supposed, and natural plastics formed out of amber, horn and bone, have been used for centuries, witness the use of bone for combs from Egyptian times (4). During the eighteenth and nineteenth centuries other plastics made from natural materials were introduced, ranging from papier mâché to gutta percha, but from the 1830s scientists began to produce semi-synthetic substances (5). Charles Goodyear produced vulcanised rubber by mixing it with sulphur in 1839 and this 'discovery' was followed by others including parkesine in 1840 and its offshoot and heir celluloid in 1869 (6). The latter achieved great popularity and by 1944 nearly 90% of toilet goods were made from it (7). Celluloid itself spawned other plastics, including cellophane and cellulose acetate and it was rivalled only by casein (8).

The second stage in the history of plastics was the manufacture of synthetic plastics. In 1907 Lee Baekeland developed the phenolic resin universally known as bakelite which, in its best known form, is synonymous with the strong dark brown material used for a variety of
objects during the inter-war years from radio cases to tea trays and from irons to inkwells (9). During the 1920s a taste developed for clearer transparent objects and manufacturers began making phenolic resin without any of the filler fibre which gave bakelite its strength and dark colour. The resultant clear but highly brittle plastic was used for countless decorative objects during the 1920s and 30s, often in Art Deco forms and in imitation of marble and onyx (10). The only problem was that this material was highly brittle and apt to break.

The third stage in the development of plastics began in 1922 when a German chemist, Hermann Staudinger, manufactured synthesised rubber (11). This not only gave the German rubber industry a boost but also changed the nature of the plastics industry because it challenged notions concerning the nature of plastics and organic chemistry held until that date (12). The 1930s saw a boom in plastics caused, in the main, by oil replacing coal as the main source for chemicals, a development which brought down the price of products and also led to the production of new plastics. New moulding processes such as that patented by the British chemist Edmund Rossiter led to the production of a multiplicity of brightly coloured egg cups, cruet sets and light fittings (13). Although produced in large quantities and reaching a wide market, plastics were mainly confined to decorative and small household objects and few professional designers involved themselves with plastics.

It was not until World War Two that plastics were applied to other areas of design, mostly of a military nature, as governments poured money into
plastics research with the result that, in the USA in particular, there was a veritable explosion in plastics after 1945. New plastics to emerge after the war included PVC, melamine, polyurethane, polystyrene, and nylon (14). One of the greatest areas of growth was in the field of reinforced plastics made from the combination of bodying agents and reinforcing fibrous materials (15). The best known of these plastics was glass reinforced plastic, known in Great Britain as GRP.

**GLASS REINFORCED PLASTIC (GRP)**

In 1942 the US Air Force became aware of the need for a self-sealing protective shield for the fuel tanks of aircraft (16). Many materials were tried including leather and plywood which the Eameses used when they worked on this very problem (17). It was the United States Rubber Company which solved the problem and produced a substance which did not rupture (18). The firm had experimented with both plywood and leather but found that a combination of the allyl carbonite resin developed by the Pittsburg Plate Glass Company and a fibrous glass fabric developed by Owens-Corning Fiberglass, which had developed glass fibres finer than human hair for the electrical industry, was more appropriate and put it into full-scale mass production (19).

Under the stimulus of the wartime economy many small firms sprang up to utilize GRP including Zenith Plastics, Gardena, California, which used fibreglass to reinforce plastic radar domes on aeroplanes (20). The cessation of military production left many GRP manufactures in deep water financially and many were unable as well as reluctant to invest
money in a material which they considered had little peace-time application. Harry Dareby, the Vice President of the Winner Manufacturing Company, Trenton, New Jersey which later manufactured Eero Saarinen's Womb and Pedestal chairs regarded 'reinforced plastic as a new material which could do damn near anything' but commented that 'too often had an inferior product been made from a superior material' (21).

There were some success stories such as the use of GRP in the construction of pleasure boats. GRP was highly suitable for boat construction because the material could be moulded relatively easily into streamlined shapes and the construction of GRP boats boomed during the 1950s (22). Other successes included the use of GRP for fishing rods, with in excess of twenty million sold in the USA between 1946 and 1958 (23). From the mid 1950s the application of GRP became far more widespread within the electronics industry with both General Electrics and Westinghouse developing the material at considerable cost because it promised an eventual huge saving over other materials and also gave products a more up-to-date image (24). At the same time Detroit began to show an interest in the application of plastics to the motor car industry. The decision of Chevrolet to style and test their new Corvette sports car in glass reinforced plastic would cost 1/10th of the cost of styling it in steel (25).

Production Methods

Although GRP was a new material, the production methods employed by the majority of the manufacturers were anything but modern and relied upon a
great deal of hand production. The material needed a long period for
curing and, because its precise behaviour under certain conditions was
unknown, a great deal of time had to be spent in experimenting. In 1956
a leading expert in the field commented:

"Up until now the small operators could not afford,
or were not inclined, to speed up their production
methods. They felt that to mechanize might require
outside capitalisation, and they were afraid that
this might mean losing personal control of their
business. So they were satisfied with their market,
their products and their volumes." (26)

There were exceptions to this rule, and one of the most notable was the
manufacturer of the Eames GRP chair shells, Zenith Plastics (now Century
Plastics) of Gardena, California, which developed a semi-mechanized
method of manufacture as did firms such as General Tire and Rubber and
Brunswick-Balke-Colender (27).

There are many ways to manufacture GRP, the simplest involving laying on
the material by hand. The original Eames side chairs produced by Zenith
in 1950 and shown at the Chicago Merchandise Mart in that year were
produced in this way but this is the most unsatisfactory method because
no two pieces are exactly the same and therefore it is usually reserved
for mock-ups (28). The bag method, which is based on a mould and an
expandable bag which forces the GRP into shape, is suitable for fairly
large pieces which require uniformity such as car and lorry bodies (29).
Another way of production was the latched dies method based on two metal
presses wherein GRP is moulded into the required shape by hydraulic
pressure (30). This was in principle the same as the male/female
presses used in the production of the plywood pieces. The machinery was

-189-
relatively expensive and mainly suitable for large quantity production and it was this method which both the Eameses and Eero Saarinen utilised in their mass produced GRP chairs (31).

PLASTIC FURNITURE IN THE USA 1940-50

The Eameses were not the only designers to see the potential of plastics for furniture design. During the early 1940s several designers produced designs for chairs to be made in plastic. The most remarkable of these was Mies Van der Rohe's Conchoidal chair designs of 1941 which were designed to be manufactured in plastic and show a change in his work away from a geometric to an organic aesthetic (32). These, the Eames/Saarinen proposed plywood furniture and the Eameses mass produced plywood pieces all had an important influence on subsequent attempts to develop an aesthetic for plastic furniture. In 1946 both Eero Saarinen and Ralph Rapson published sketches in Interiors showing prototypes for moulded plastic chairs which reflected the aesthetic innovations of Mies, Saarinen and the Eameses (33), although it is not clear if at this date they had seen his designs which were illustrated in the catalogue accompanying his Retrospective Exhibition at MOMA in 1947 (34).

Eero Saarinen beat his friends the Eameses in the production of plastic furniture with his Womb chair and sofa of 1948 (Fig.65). Eero Saarinen joined Knoll Associates in 1943 and Florence Knoll remarked to him that what 'she wanted was a modern chair which she could curl up in' (35). The resultant chair and sofa were designed in 1946 but not manufactured until 1948, with the ottoman added in 1952 (36). The chair had a single
moulded GRP shell made by the Winner Manufacturing Company of Trenton, New Jersey, but unlike the Eameses' GRP chairs, the nature of the shell was disguised with foam rubber padding and fabric covering and, furthermore, seat and back cushions were added for extra comfort.

Eero Saarinen's interest in plastics continued unabated and in 1957 his 'Pedestal' furniture (a side chair, arm chair and table) was marketed by Knoll Associates. The idea for this furniture had germinated in Saarinen's mind since 1952. As a designer he was obsessed with ridding the home of 'its slum of legs' (37) and disliked the way that most furniture designers, including the Eameses, treated legs as a separate entity divorced from the actual seat, explaining that:

"Legs become a sort of metal plumbing, modern chairs with shell shapes and cages of little sticks below mix different kinds of structures. The pedestal chair tries to bring unity of line." (38)

The chair shells were manufactured for Knoll Associates by the Winner Manufacturing Company which spent two years developing tooling and production processes (39). In contrast to his Womb seating of the late 1940s, Saarinen now exposed the GRP shell, as the Eameses did in 1950.

THE EAMESES AND GRP

It was during the war that the Eameses became interested in plastics. It is most probable that Charles's first contact with the material was at the Haskelite plant in Grand Rapids, the company which made the prototypes for the Organic Design in Home Furnishings Competition and
which, together with the Clark Aircraft Corporation, had developed a small aeroplane, the 'Clark 46', formed out of laminated phenolic plastic (40). What attracted the Eameses to plastics was the vast potential of this new material which was not being fully exploited. Charles and Ray had first used plastic materials - namely fibreglass cloth and plastic resin which they obtained from war-surplus shops, in the Japanese style internal screens in their own home. They also used melamine, for table tops and storage units (41) (see chapter five).

Plastic Armchair, 1950

The Eameses's first essay in GRP was an armchair marketed by Herman Miller from 1950, the form of which had been developed for the MOMA's International Low Cost Furniture Competition Design of 1948. The competition was established in order for designers to link up with technologists and the Eameses worked with engineers from the University of California, Los Angeles (42). Their entries proposed the stamping of sheet metal into chair form by the use of drop weights because that seemed the most appropriate method of mass producing furniture in plastic forms at that time. Charles recalled:

"We were interested in a plastic chair, but the technology at the time made that seem very difficult. We even made some drawings in aluminium, but finally chose sheet metal because of the highly advanced mass production techniques available for it, especially in stamped parts. Also Neoprene coating had come along at about that time and cut down on heat transfer. To make the Museum chair we built a drop hammer in our shop." (43)
Yet it soon became apparent that it would not be possible to economically manufacture stamped metal furniture. Even though the Eameses's stamped aluminium chairs were awarded second prize in the competition, they decided to concentrate on GRP as a more suitable material.

In this they received tremendous encouragement from Jim Eppinger of Herman Miller who wanted a new product to show at the Chicago Merchandise Mart (44). Charles Eames contacted Zenith Plastics of Gardena, California, to learn more about GRP and, after long discussions with the President, Milt Brucker, and engineers it was decided to adapt the metal armchair design to fibreglass. Only one chair was developed and, even then, it took considerable financial investment and time on the part of Herman Miller and Zenith Plastics to develop the chair (45). Sol Fingerhut, chief engineer at Zenith, decided to produce the chair with hydraulic presses using the latched die method and estimated that the development of such moulds would cost somewhere in the region of $5,000 whereas the eventual cost was four times as great (46).

The development of the chair represented a three way collaboration between Zenith Plastics, Herman Miller and the Eames Office. The project was plagued by 'really miserable problems' which exhausted them all, not least of which was the hazard to health caused by the particles of glass in the GRP (47). One of the attractions of GRP is the marble-like effect of the fibres running through the plastic and the design team spent countless months attempting to find away of letting the fibres show through the plastic without any roughness (48). The early
Yet it soon became apparent that it would not be possible to economically manufacture stamped metal furniture. Even though the Eameses's stamped aluminium chairs were awarded second prize in the competition, they decided to concentrate on GRP as a more suitable material.

In this they received tremendous encouragement from Jim Eppinger of Herman Miller who wanted a new product to show at the Chicago Merchandise Mart (44). Charles Eames contacted Zenith Plastics of Gardena, California, to learn more about GRP and, after long discussions with the President, Milt Brucker, and engineers it was decided to adapt the metal armchair design to fibreglass. Only one chair was developed and, even then, it took considerable financial investment and time on the part of Herman Miller and Zenith Plastics to develop the chair (45). Sol Fingerhut, chief engineer at Zenith, decided to produce the chair with hydraulic presses using the latched die method and estimated that the development of such moulds would cost somewhere in the region of $5,000 whereas the eventual cost was four times as great (46).

The development of the chair represented a three way collaboration between Zenith Plastics, Herman Miller and the Eames Office. The project was plagued by 'really miserable problems' which exhausted them all, not least of which was the hazard to health caused by the particles of glass in the GRP (47). One of the attractions of GRP is the marble-like effect of the fibres running through the plastic and the design team spent countless months attempting to find away of letting the fibres show through the plastic without any roughness (48). The early
chairs were formed by hand and needed rope reinforcement around the
edge of the seat, as well as many hours of rubbing down with emery paper
(49). It was planned to produce an initial run of 10,000 chairs but DJ
De Pree considered this slightly optimistic and in the end the run
numbered only 2,000 (50). Furthermore, the estimate for the chair price
proved too low at $6.25, with the chairs reaching the consumer at $32 in
1950 (51).

First mass produced in a limited quantity in 1950, the chairs were
originally available in beige, grey and parchment with more colours,
including red, yellow and green, added later on (52). The form of the
chair emerged from the natural plasticity of GRP which allowed the
formation of complex forms to support the human body in a comfortable
way without the need for upholstery. Indeed the chair represented the
first plastic chair to delight in the nature of the material because,
unlike Saarinen's 1948 Womb chair and sofa, the Eameses did not hide the
plastic (Fig. 66).

The chair shell could be placed on a variety of bases including rod
legged, cast aluminium pedestal, swivel, wire strut, wood legged, and
wood legged on wire strut, all of which were attached to the shell with
rubber shock mounts (Fig. 67) (53). The armchair could also be ordered
with tall wooden legs and a foot ring to be used as a bar or drafting
office chair (54). Once the Eameses had developed this series of
successful bases they saw no reason to change them and most of them were
used again on the bent wire chair of 1951 (see chapter five), at a time
when many design practises were striving to re-style such items in order to give their products a 'facelift'.

One of the most interesting pieces in the group was the rocker, which comprised a GRP shell placed on a wooden rocker (55) (Fig. 68). The idea for this came from a friend of the Eameses who was expecting a baby and could not find a suitable nursing chair (56). They responded to this challenge with gusto but the resultant product was never successful commercially (57). Although production was suspended in 1968, between then and 1984 the chair was produced for those Herman Miller employees who become parents (58). It is a comfortable rocking chair but its fusion of modernity and the traditional placed it between two fairly distinctive and somewhat polarised markets.

The GRP armchair entered MOMA's permanent design collection in 1950, quickly becoming a design 'classic' and much sought after by the design conscious. The chair was used in all manner of public spaces, so much so that it took on a certain 'invisibility' in that it came to be taken for granted by many who used it everyday in restaurants, schools and office buildings. Thus it was, at once, extremely 'visable' in MOMA and design circles and somewhat 'invisable' in the non-design conscious world.

*LA CHAISE*

One of the Eameses's most interesting proposals for the use of plastics in furniture was submitted for MOMA's International Competition for Low...
Cost Furniture Design in 1948 (Fig. 69). This was a moulded plastic chaise longue, more commonly referred to as 'La Chaise', because the Eameses thought that its shape would suit a Gaston Lachaise sculpture (59). The original idea was for this piece to be the prototype for a domestic chaise with a retail value of about $27 yet what the Eameses produced was their most formalistic design which drew direct inspiration from the sculpture of Barbara Hepworth and Henry Moore (60). In this case they seem to have been less successful in relating contemporary avant garde sculptural forms to furniture than with the DCM chair. The forms had more in common with Eames/Saarinen entries for the Organic Designs in Home Furnishings Competition than the more original forms of the Eameses plywood group.

The shell of the chaise was formed out of variously sized rubber and styrene foam bricks covered with a skin of resin and fibreglass cloth which was to have been available in a variety of colours. The highly sculptural piece was supported on one of the Eameses' most complex bases in which three combinations of metal legs were supported on an irregular metal star shaped base. The chaise longue was in the main an experiment, as was explained at the competition:

"The form of this chair does not pretend to clearly anticipate the variety of needs it is to fill. These needs are as yet indefinite and the solution of the form is to a large degree intuitive. The form can only suggest a freer adaption of material to need and stimulate inquiry into what these needs may be." (61)

The chaise longue project was abandoned, however, as the Eameses turned their attention to the development of the GRP armchair.
The panels which detailed information about the chaise in the competition were designed by Charles alone although it was usually Ray who worked on graphic presentations at that time (62). However, this does not mean that Charles alone was responsible for the form of the chaise longue. As with all projects, there was an input from both him and Ray of them as well as from other members of the Eames Office staff, including Frances Bishop and Robert Jacobson. Another design submitted to the Internation Competition for Modern Furniture, the Minimum Chair, was based on contemporary sculptural forms, in this case those of the Italian sculptor Giacometti. This too was abandoned and the Eameses never again produced furniture which so obviously referred to such well known fine art sources in so direct a way.

**GRP Side Chair**

Just as the aluminium armchair had been adapted to to GRP, so too was the aluminium side chair. The adaption of this design was much easier than the armchair because most of the problems had been solved in the earlier exercise. Zenaloy, a more advanced form of plastic resin reinforced with fibreglass was used for this chair (63). Originally produced in a natural fibreglass finish, a range of colours was later introduced (Fig.70).

As with all the Eames chairs there was a large number of variations available through the choice of colour or a variety of interchangable bases, all attached by rubber shock mounts. An upholstered version was quickly introduced acknowledging the fact that more comfort was required
by some people (64). Developed by Alexander Girard, the upholstery used hopsacking which was strong, relatively cheap and available in a variety of single colours as well as a 'harlequin' mixture of colours (65).

**Expanding the range**

The success of the GRP armchair lead the Eameses to consider developing the chair and expanding the range. During the early 1950s several improvements were made in the field of polyester resins and Herman Miller advertised the plastic side chair in 1953 as 'Weather resistant and easy to clean' (66). While GRP could be moulded to fit the human form, sustained periods of sitting in the chair tended to lead to slight discomfort and therefore in 1951 an upholstered version was introduced (Fig.71). Originally the fabric or vinyl covered upholstery was simply pressed on to the frame but later it was glued to the actual shell.

In 1971 the Eameses designed the Loose Cushion Armchair (Fig.72). It has been argued that during the 1960s and 1970s the Eameses did little more than modify existing designs and in actual fact produced no new designs (67) but the dimensions of this particular chair were new and the shape of the chair was completely changed to incorporate padding and a cushion (68). The back support of the chair was 6 inches higher than that of the GRP armchair and the modelling at the base of the seat provided a reverse curve, which took note of the latest ergonomical research, to give greater back support (69). In short, it was a different chair.
By the late 1960s a whole range of new plastics had been developed allowing even greater technical virtuosity and aesthetic freedom, two qualities the Eameses believed did not necessarily lead to good furniture. As Modernists, however, they were always excited by the challenge and possibilities of a new material and decided to incorporate moulded polyurethane into their chair design. Polyurethane was a rubbery plastic which, in its soft form, was suitable for upholstery being both hard wearing and flexible (70). It also freed furniture from the restrictions of traditional construction and allowed designers to treat furniture as sculpture, witness the growth of 'fun foam' furniture, a type of design of which the Eameses were highly critical (71).

By contrast, the Eameses were more concerned with the practical applications of the new material. The comfortable and hardwearing moulded polyurethane foam meant that they could dispense with the upholstery formerly applied to the plastic chairs. A new vacuum method of bonding was developed to join the polyurethane to the the chair shell which was available in a wide variety of colours (72). The edges were sealed with either a light or dark vinyl edging and the chair was finished off with a loose cushion, from whence it derived its name (73). A new base was provided for the chair which drew on that developed for the Time Life chair of 1960 (74). The Eameses also experimented with a two seater sofa variation which rested on the base developed for the Tandem Seating system but this design never went beyond the prototype stage (75). The original design for the GRP armchair had been aimed mainly at the domestic market whereas, twenty years later, the Loose
Cushion chair was aimed almost exclusively at the contract market, the importance of which grew enormously after 1945.

**CONTRACT FURNITURE**

The success of the GRP armchair and side chair led the Eameses to consider developing the group for the ever growing contract market. While some of their furniture had been aimed at offices (witness the drafting and office variant of the GRP armchair and sidechair and the ESU designed for either domestic or business use) the majority of their furniture was designed for and used in the home in the 1950s. Nevertheless, as early as 1954 using both the GRP armchair and side chair, the Eames Office attempted to develop seating suitable for either a stadium or large public spaces such as airport terminals (76). The chair shells were joined to cast aluminium spiders attached to a steel beam (77). Shock mounts were used in the hope that they would provide sufficient resiliency to withstand the wear and tear encountered in sports stadia (78). Although this seating was developed to the prototype stage (two mock-ups were made) the public seating project was set aside for several years and it was not until 1963 that Herman Miller marketed a new variation of the earlier stadia seating. Based on the GRP armchair and sidechairs, the tandem seating was made from GRP shells mounted on the bases designed for the aluminium tandem sling seating of 1962 (see chapter five) (79). The shells, which were fixed to the base in the same way as in the earlier design, could be left plain or upholstered in vinyl or fabric and the unit could be fitted with a laminated table (80).
In 1955 the GRP stacking chair caused as much excitement as had the GRP armchair, finding its way into countless universities, colleges, schools, church halls and restaurants across the USA and in other countries abroad. The stacking chair is a clear descendent of the GRP sidechair and the development work on it was carried out by Don Albinson and Dale Bauer (81). The product's saleability was increased by the design and production of a trolley which allowed large numbers to be moved around with ease (82) (Fig.73). The shells, which were produced in a number of colours including red, ochre, parchment, blue and yellow, were attached to four legs of zinc - coated steel tubes with a U-shaped hook to join the chairs in rows and lock them together securely when stacked (83). So suitable was it for academic use that in 1964 a new version was introduced with a writing table pinned to the side (84). The 'School Seating' involved an armless GRP shell, fastened in rows to steel straps which could bend around the curves of a raked lecture theatre and which rested on the floor of the lecture theatre, firmly anchoring the unit to the ground. Each chair came complete with a laminated folding table on the right hand side of the chair (85).

The success of these chairs lay not only in the use of new materials and methods of manufacture but also in the timing of their production. The post war period saw a great boom in the number of schools and colleges being built across the USA, mostly in a Modern Movement style, and thus there was a gap in the market for appropriate furniture. For twenty years institutional and educational seating needs in the USA and much of Europe had been met by tubular steel furniture with canvas covers which had a tendency to rip. Many people still perceived of tubular steel as
'cold' and 'inhuman' and, by contrast, GRP seemed warmer and the form of the stacking chair more appropriate to the human body. The choice and range of colours meant that the chairs could be used to add brightness and gaiety to large interiors. These factors, together with the fact that they were very strong and relatively cheap, account for their immense popularity in the USA, and increasingly so abroad.

LA FONDA CHAIR AND DRAFTING OFFICE CHAIR

In 1961 the Eameses designed two new chairs in GRP at the request of their old friends Alexander and Susan Girard who required seating for their La Fonda del Sol restaurant in the Time Life building in New York. Work began on this commission at the same time as work on the Time Life lobby chair and turned wooden stool (see chapter five). During the 1960s the Girards were to make a name for themselves with their interiors for several prestigious restaurants including L'Etoile in the Sherry Netherland Hotel, New York, and the Compound Restaurant, Santa Fe, both designed in 1966 (86). The starting point for La Fonda del Sol which offered New Mexican cuisine was, as John Neuhart, who worked on the project recalls, the rich cultural legacy of the American South West (87). The Girards lived in Santa Fe, and the Eameses were regular visitors to New Mexico not only to meet with their friends and discuss joint projects but also to enjoy the unique combination of Native American, Spanish, Mexican and 'Yankee' cultures which distinguishes New Mexico.
The Girards wanted to make the restaurant in New York a shrine to New Mexico and named it after the oldest inn in America, La Fonda del Sol which has stood in the Santa Fe Plaza since the 1600s. The Girards did not produce a pastiche of the desert South West but integrated elements of Mexican and New Mexican design with those of the Modern Movement to produce a very distinct interior. The graphic design, for example, combined Bauhaus style typography with New Mexican colours. The Eameses were greatly enthused with the project and Ray recalled vividly their excitement at the opportunity to produce chair designs which were modern yet fitted into the New Mexican ambiance of the restaurant (88).

The Girards stipulated that they did not want the chair designs to dominate the design of the restaurant and therefore those produced by the Eameses were similar in form to the GRP armchair and sidechair but with lower backs to meet the Girards' request (Fig. 74) (89). The texture of the chair shells were different from the gloss finish of the other plastic chairs. They were coated in gel in the moulding process and had a matt finish (90). The shell came in a grey-beige colour and bold colour was added by the upholstery fabric which came in red, orange, blue and green and added a festive touch to the chairs. Drawing on their considerable knowledge of New Mexican material culture, the Eameses chose to emphasise brightness and colour and considered that this 'integrated' their chairs into the overall restaurant design.

Although the chair was basically a refinement of the GRP armchair and sidechair, the Eameses were constantly updating their designs and always making use of improved technology for a better product. The seat was
supported on a four-sectioned cast aluminium stem and attached by shock mounts (91). A new method of applying upholstery to the seat which involved edging the chair in vinyl as opposed to wire was attempted which became the standard method on all the Eameses chairs after this date (92). Although originally made for this specific restaurant, the chair soon joined the Herman Miller general range, and with an increased range of colours, retailed at $92 ($98 in naugahyde) in 1962 (93). The shape of the La Fonda del Sol chair was repeated in the 1970 drafting office chair which was based on the GRP shell and pedestal base drafting office chair of 1950 but modified along the lines of the La Fonda chair (94). A new adjustable pedestal incorporating a foot rest was specially designed and the enormous amount of development work on this chair alone indicates that the Eameses were as keenly interested in technological improvements as they had been thirty years earlier with their first experiments in furniture making (95).

Although GRP was not sufficiently strong to be moulded into a single piece chair, the Eameses could have done what Saarinen did with the 'Pedestal' chair and used metal disguised as plastic. This they chose not to do. Moreover, when stronger more 'advanced' plastics made it possible to achieve such a chair in the 1960s, they still chose not to do so. They disliked pieces such as Vernon Panton's cantilevered chair designed in 1960 but not manufactured by Herman Miller until 1967, and insisted that 'a chair must have a seat and it must have legs, in this chair you can not tell the difference' (96).
The Eameses GRP work represented their only work with a genuinely new material. While the Modern Movement propagandists claimed that plywood and bent wire were new, they had a longer history. GRP was truly a twentieth century material, the potential of which excited the Eameses and led to a remarkable seating range. The armchair and sidechair were the best sellers and made a fortune not only for the Eameses but also for Zenith Plastics and Herman Miller. The Eameses were amongst the first designers to successfully bring plastic furniture to the mass production stage. Together with their own staff, Zenith Plastics and Herman Miller, they developed all the necessary tools to mass produce this furniture. But their importance also lies in that they were the first to give GRP furniture a distinctive and popular form, namely a shell supported on separate legs, which influenced other furniture designers well into the 1960s.
Footnotes

(1) Kirkham. P, Hille, (booklet to accompany exhibition of same title, Leicester Polytechnic, 1981.)

(2) Yarsley. V.E, and Couzens. E.G, Plastics, 1941, p.11.

(3) ibid, p.13.

(4) ibid, p. 14.


(7) ibid, p.10.

(8) ibid, p.10.

(9) ibid, pp.10-11.

(10) ibid, p.11.

(11) ibid.

(12) Yarsley and Couzens, op cit, p.34. Prior to Staudinger's work, it was believed that plastics were formed from chains of linked molecules. He showed that it was possible to cross link these chains and produce plastics with chains thousands of times longer than natural molecules. It took him twenty years to convince fellow scientists. Katz. S, op cit, p.11.

(13) Katz. S, op cit, p.11.

(14) ibid, pp.12-13.

(15) Yazley and Couzens, op cit, p.86.


(18) Dunne, Gregor and Meldrum, op cit, p.39.

(19) ibid, p.39. The Pittsburg Plate Glass Company's resin was soon replaced by a more advanced resin produced by American Cyanamid Company, ibid, p.39.

(21) Dunne, Gregor and Meldrum, op.cit, p.40.

(22) ibid, p.40. The Molded Fiber Glass Company, Ashtabuck, Ohio, produced 9,000 boats per year in the mid 1950s.

(23) ibid, p.40

(24) ibid, p.40

(25) ibid, p.40

(26) ibid, p.52.

(27) ibid, p.52, Zenith Plastics along with the other firms did this by mainly adapting existing machines, ibid, p.53.

(28) ibid, p.54.

(29) ibid, p.54,

(30) ibid, p.53.

(31) ibid, p.53 and Eames and Neuhart, op.cit, p.141.


(33) 'Modern Doesn't Pay Or Does It?', Interiors, March 1946, pp.66-67.

(34) Johnson, P, op.cit, pp.172-73.


(36) 'Chemistry Builds a chair', Kohl and Haas Reporter, November/December 1951, pp.2-4.

(37) Dunne, Gregor and Meldrum, op.cit, p.75.

(38) ibid, p.75.

(39) ibid, p.75.

(40) Yarsley and Couzens, op.cit, p.127 mention the development by the Clark Aircraft Corporation and the Haskelite Corporation of Grand Rapids a small aeroplane in laminated phenolic plastic.

(41) Eames and Neuhart, op.cit, p.139 and Fehrman, C & K,

(42) Eames and Neuhart, op. cit, p. 97.


(44) ibid, p. 57.

(45) Eames and Neuhart, op. cit, p. 141.


(48) Eames and Neuhart, op. cit, p. 141 and Caplan, R, op. cit, p. 60.

(49) Caplan, R, op. cit, p. 60.

(50) Fehrman, C & K, op. cit, p. 57.

(51) Letter from Ralph Randall Jnr to Architectural Review, June 1951, pp. 398-400, regarding the price of the GRP armchair.

(52) 'Chairs by Charles Eames', Arts and Architecture, October 1951, p. 31.

(53) Eames and Neuhart, op. cit, p. 141 and Fehrman, C & K, op. cit, pp. 95-98.

(54) Eames and Neuhart, op. cit, p. 141.


(57) Correspondence with Linda Folland April 1987.

(58) Eames and Neuhart, op. cit, p. 141.

(59) ibid, p. 99.


(61) Eames and Neuhart, op. cit, p. 96.

(62) Author's interview with Linda Folland, Zeeland, Michigan, August 1986.
(63) Eames and Neuhart, op. cit., p. 142.

(64) ibid, p. 142.

(65) ibid, p. 142.

(66) Herman Miller advertisement 1951, Herman Miller Archive, Zeeland, Michigan.

(67) While it is true to say that the general tendency was to up-date existing designs the amount of worked put into these modifications was as great as that put in to the original designs. John Neuhart, interview, 1987.

(68) Eames and Neuhart, op. cit., p. 371.

(69) ibid, p. 371.

(70) Katz, S, op. cit., p. 151.

(71) For example, the upholstered and self-skinned polyurethane foam seating and hat stand by Gilardi, Ceretti, Derossi and Rosso and manufactured by Gufram, 1969-70, Katz, S, op. cit., p. 114.

(72) Eames and Neuhart, op. cit., p. 371.

(73) ibid, p. 371.

(74) ibid, p. 371.

(75) ibid, p. 371.

(76) ibid, p. 275.

(77) ibid, p. 280.

(78) ibid, p. 280.

(79) ibid, p. 280.

(80) ibid, p. 280.

(81) ibid, p. 197.

(82) ibid, p. 197.

(83) ibid, p. 197.

(84) ibid, p. 281.

(85) ibid, p. 281.

(86) 'La Fonda del Sol Ristorante a New York', Domus, July,

(87) John Neuhart interview 1987,


(91) *ibid.*, p.253.


(95) *ibid.*, p.354.

CHAPTER FIVE: METAL FURNITURE

The Eameses also designed metal furniture. Regarded as 'cold' and 'clinical', metal furniture had never been very popular but, as Modernists interested in working with 'new' materials and mass production techniques, the Eameses saw metal as a challenge and believed it was possible to produce good quality furniture which would be aesthetically appealing to a reasonably broad range of people. The Eameses devoted many years to developing metal furniture, mainly using bent metal rods (wire mesh) and cast aluminium, and attempted to apply a sculptural aesthetic to such furniture which, hitherto, had been dominated by a geometric 'Miesian' aesthetic which emphasised sharp angles and highly polished surfaces.

Shortly after arriving in Los Angeles, the Eameses furnished their Westwood apartment with home-made furniture made from 'off the shelf' piping but during the early 1940s they focused their energies on plywood design (1). Their first serious attempt to produce low cost metal furniture was in 1948 with their entries for the International Low Cost Furniture Competition at MOMA. The bulk of their manufactured furniture was designed after 1950 and falls into two main groups; firstly, their work in bent wire mesh, including the bent rod LTR (low table wire) (1950), ETR (elliptical table wire, more commonly referred to as the surfboard/elipse table 1951) and the bent wire chair (1951) and, secondly, their cast aluminium work from the mid 1950s, including the sofa compact (1954), the Aluminium Group (1958), Time Life lobby group (1960), Tandem Sling Seating (1962), table with segmented base (1964),
intermediate desk chair (1968), chaise (1968) and the Soft Pad Group (1969).

THE USE OF METAL IN FURNITURE MAKING

As with bent wood and plywood the use of metal in furniture making goes back over many centuries and this history will be briefly outlined before examining the Eameses' contribution to that history. For many centuries the use of wrought iron dominated the use of metal in furniture design (2). Wrought iron was used for structural and increasingly decorative elements in furniture design from the thirteenth century (3). Forged by heat and hammers strips for wrought iron were used to hold together such pieces of furniture as chests and armoires. During the thirteenth and fourteenth centuries the use of wrought iron on such pieces became very elaborate. There are some examples of metal being applied to other forms of furniture such as firescreens (4). From the late seventeenth century metal was mainly used for ornamentation rather than structural elements as wood became the most favoured material for furniture design (5).

During the nineteenth metal making process were greatly improved upon and metal was used in furniture design both in Europe and the USA. As with the Modern Movement most nineteenth century designers claimed to have discovered metal rather than having rediscovered it. Metal was used in furniture design in both cast and rod form. Cast iron was used mainly in the furnishings of entrance halls and public houses in the form of umbrella stands and pub seating (6). Rod metal found expression
mainly in garden furniture such as seats and flower pot stands (7). In the main there was little experimentation with new forms of seating this was to occur in the work of the Modern Movement.

**Metal and the Modern Movement**

Metal was seized upon by the Modern Movement as a suitable material for creating new forms. Initially the Modern Movement delighted in the forms of the simpler Thonet designs especially the No 14 chair. Although bentwood furniture was machine produced, affordable and had no applied ornamentation it was still regarded as old fashioned and several designers searched for a more modern material. It was the young Hungarian designer Marcel Breuer who was to introduce the language of Modernism to metal furniture. Breuer was a student at the Bauhaus in Weimar from 1920 to 1924 (8). All his early furniture was made from wood and reflected a variety of Modernist influences ranging from Expressionism to De Stijl. Breuer returned to the Bauhaus to head the carpentry work shop (he was the first Bauhaus student to be appointed to the faculty) and his club chair (1925) made from welded and bent tubular steel and named in honour of Wassily Kandinsky represented a new beginning for modern furniture design. The inspiration for this design came from Breuer's love affair with the bicycle, in particular the utilisation of bent tubular steel. Breuer came to realise the potential that tubular steel had for furniture design and approached the Adler Bycicle Company with some ideas for experimental bent metal furniture (9). The company rejected Breuer's ideas and he was forced to experiment on his own buying tubular steel and bending it with the help
of friends. Although Breuer had serious reservations concerning his chair he was encouraged to develop the design and it went into mass production with Standard-Möbel in 1926 and Thonet in 1931 (10). Although the Wassily chair was produced independently of the Bauhaus, the carpentary work shop soon became synonymous with tubular steel. Breuer also designed tubular steel furniture for the new Bauhaus building at Dessau including tip up theatre seating, side chairs and stools.

The Cantilevered Chair

While Breuer's furniture utilised a new material he did not experiment with new forms of seating. That was left to Mart Stam and Mies Van der Rohe who both applied cantilevered forms to chair design in the late 1920s. Cantilevers represented a new way of support in that, unlike traditional chair design in which the seat is supported by four legs, a cantilevered chair is only supported at one end. There has been some controversy as to who was the first designer to develop this form in furniture. The original idea is now attributed to Stam who produced a cantilevered chair from pipes and pipe fittings in 1926 (11). The preparations for the 1927 Weissenhof Siedlung exhibitions brought many of the leading Modernist designers together and Mies probably got the idea for a cantilevered chair from discussions with Stam (12). While in Germany, Stam took his design to L & C Arnold Company, Schorndorf, who began manufacturing it (13). Meanwhile Mies had produced his own cantilevered chair from steel tubing. Both designs were exhibited at Die Wohnung (The Dwelling) exhibition of 1927 to universal praise (14).
Tubular steel became the darling of the avant garde during the late 1920s and 30s (15). It was extremely popular in Germany and Holland and found expression in France in the work of Le Corbusier and Charlotte Perriand (16). Although tubular steel was used in public spaces ranging from the Daily Express Building in Fleet Street, London, 1936 to the Fascist Party Headquarters in Como, Italy 1936, its popularity with the public was never that great. As Christopher Wilk has shown it was not just the public hostility to tubular steel which led to a swing towards plywood within the avant garde but also because increasingly during the 1930s tubular steel became the material of the uninspired who either turned out countless copies of the cantilevered chair or produced novelty pieces (17). Increasingly the avant garde turned to plywood. Nevertheless metal remained a popular material for many designers and after successfully producing a range of machine produced, aesthetically innovative and affordable plywood pieces the Eameses looked for other materials first settling on aluminium.

**STAMPED ALUMINIUM FURNITURE, 1948.**

In 1948 Charles and Ray Eames responded to an international competition for low cost furniture held at MOMA with designs for shell formed chairs stamped out of steel or aluminium. The Eameses' entry shared second prize in the seating category with David J. Pratt (18). The competition aimed to bring together designers and technologists in research teams which were given $5,000 development money (19). The Eameses teamed up with the UCLA School of Engineering then under the direction of L.M.K Boelter (20). The shells were stamped out by means of a 2501b drop
hammer and a variety of prototypes were made including a side chair and armchair which used a variety of wood and metal bases (21). Also developed was the so-called 'minimum chair' which, despite its striking aesthetic, was designed to estimate the smallest amount of material needed to produce a comfortable seat (22). In the text accompanying their entry, Charles argued the case for liberating metal furniture from its poor public image:

"Metal stamping is the technique synonymous with mass production in this country, yet 'acceptable' furniture in this material is notably absent... By using forms that reflect the positive nature of the stamping technique in combination with a surface treatment that cuts down heat transfer, dampens sound, and is pleasant to the touch, we feel it is possible to free metal furniture of the negative bias from which it has suffered." (23)

However, although envisaged as selling cheaply - at between $5.80 and $11.73 - these were not the products to remove the negative bias. Technological problems plagued the undertaking, including the tendency of the moulds to smash after a few drops (24). They did not gain access to UCLA's modern hydraulic presses as they had hoped to do and, consequently, had to use fairly primitive homemade presses (25). Thus, when in glass reinforced plastic they found a material which met their aesthetic demands and also offered the public relatively cheap mass produced furniture of high quality, their work on aluminium was temporarily set aside - although not entirely forgotten.
BENT WIRE FURNITURE

During the early 1950s the Eameses continued to experiment with metal concentrating on thin rod mild steel which is better known as bent wire. This material has received little attention in histories of furniture design, yet many of the most sculptural chairs of the post-war era were produced in bent wire. Those designed by the Eameses included the LTR (low table wire) 1950, the ETR (elliptical table rod base) of 1951 and the bent wire chair of 1951 (Figs. 75-78). Bent wire was in no way the exclusive preserve of the Eames Office, the products of which look somewhat mundane when compared with the work of other designers, most notably the sculptor and one-time Eames Office assistant, Harry Bertoia, whose series of Diamond Chairs were first produced in 1952 (26). Other designers also used bent wire during this period - see Sol Bloom's woven steel mesh lounge chair and ottoman, and catch all, both of 1950 - but the Eameses were amongst the first to successfully bring bent wire furniture designs to the mass production stage (27).

Bent wire captured the imagination of the American public during the 1950s. All manner of designers and manufacturers began to use it for a wide range of items including plant stands, picture frames and coat racks as well as seat furniture. As with the GRP chairs, Charles and Ray Eames got the idea for using bent wire from seeing it applied in other fields of production:

"If you looked around you found these fantastic things being made of wire - trays, baskets, rat traps, using a wire fabricating technique perfected over a period of many years. We looked into it and found that it was a good production technique and also a good use of material." (28)
Although bent wire had been occasionally used for garden furniture throughout the nineteenth century, the Eameses used it in a new way (29). *Interiors* magazine put the position thus in 1951:

"Metal mesh is not a new chair material but Eames attains a more controlled form and lighter weight by moulding and by spacing the weave. This is not the usual uniform mesh cut like a fabric and hung on a heavy frame. The wires diverge where less strength is required and the rim is only slightly heavier wire doubled." (30)

In contrast to the heavy and cold image of stamped aluminium, bent wire appeared light and airy.

LTR table, 1950 and ETR table, 1951

The LTR table (low table wire) of 1950 and the ETR table (elliptical table rod base), more commonly referred to as the surfboard/ellipse table, of the following year, illustrate the elegance which could be achieved in bent wire. With their simple delicate forms these tables were well suited to grace Modern Movement interiors. As with much Eames, and West Coast design in general, these tables reflected an awareness of Japanese design. The base of the LTR table was made out of two U-shaped wires on the short sides of the table and attached to the table top by means of screws (31). Stability was provided by two cross braces (32). This small, low table (it is only 10 inches high) is an ideal repository for cups and glasses or for holding a plant and it can also be used as a stool. The large ETR table simply consisted of two LTR frames supporting a plastic coated plywood top (some 89 inches in
length) which was in the shape of a surf board, a well known symbol of Californian culture and one constantly seen on the beach near the Eameses' Venice workshop (33). Whilst the bent wire chair and the low table met with considerable commercial success (the former was continually in production until 1967, the later is still in production), the elliptical table, despite its aesthetic novelty, was only in production from 1951 to 1964, although 13 years is a considerable length of time compared with many items of twentieth century furniture (34).

Bent wire chair, 1950

In 1950 the Eames bent wire chair, which was produced by Banner Metals of Compton, California, and marketed through Herman Miller, retailed at $21 upwards (35). Similar to the GRP side chair in overall form and fitting the same range of bases, it was designed for the domestic interior and aimed at the consumer who wanted good modern furniture at a relatively cheap price. It also proved popular in the contract side of the market, finding its way into offices and restaurants across the USA (36). It was not the first wire chair to be produced in the USA but it was lighter and more comfortable than most. Many, including Alison and Peter Smithson, considered this the most exciting of the Eameses' designs. While they appreciated the originality of the DCM chair, it was the bent wire chair which they reserved their greatest praise for (37).

The bent wire chair led to the greatest rift between Herman Miller and Knoll Associates, both firms took out patents for the bent wire process
(38). Nevertheless Knoll challenged Herman Miller claiming that Harry Bertoia, then one of Knoll's associates, was the originator of the bent wire process, and that they should have the exclusive rights to the process (39). Bertoia had worked in the Eames Office between 1942-46 but there is no evidence to suggest that the Eameses developed ideas which originated with Bertoia who had left the Eames Office six years before his own chair was finally produced (40). Both chairs are sculptural and, because Bertoia was a sculptor by training, it has been argued that he probably developed the idea before the Eameses. It needs to be remembered, however, that Ray Eames was trained in sculpture and both Charles Eames and Harry Bertoia studied under the sculptor Carl Milles at Cranbrook, and therefore were both conversant with sculptural concepts.

Herman Miller initiated an 'interference': in legal terms this refers to an attempt to determine the originator of an invention or a process and the verdict reached was that Charles Eames had been the first to develop the process (41). However, it needs to be acknowledged that Bertoia and the Eameses had both been working towards the same goal at the same time (42). In 1956 Knoll Associates were granted a licence by Herman Miller to manufacture the Bertoia Chair using the bent wire technique patented under the name of Charles Eames (43).

Bertoia played an important part in the development of the Eames plywood group but he left the Eames Office in 1946, five years before the Eames bent wire chair. As designed, the Eames chair post-dates Bertoia's employment by several years; indeed, it could be argued that, had...
Bertoia already had the idea when he left the Eames Office, then he might have taken it to Knoll or another company earlier than he did. The look of the Eameses bent wire chair owed more to the ideas of Charles and Ray, the form of the GRP chairs, and the development work of Don Albinson, Fred Usher and Dale Bauer, than it did to the efforts of Harry Bertoia. The origins of the idea aside, there are visual and technical differences between the two chairs. The Eames design used a right angled criss crossing of the wires edged by two layers of bent wire, although in a prototype chair the Eameses utilised a diamond gridwork (44) (Fig.77). By contrast, the Bertoia chair was manufactured with a single rod edging and utilised a more adventurous triangular crossing of the wires which fill the entire space of the design (45). The Eameses chair was lighter as a result of the spacing of the wire and came in a greater variety of forms than its competitor because the seat could be attached to six bases already in production for the GRP group (46). By contrast, the Bertoia group was more sculptural. Formed of four variants on a single idea which included lounge and dining heights, high back and swivel with or without arms, the metal was either left plain, painted, or coloured in a fused plastic finish (47). Another difference lay in the fact that the Eames chair was mass produced whereas the other was not. Although the Bertoia design was originally meant for mass production, it proved easier and more economical to bend the metal by hand and, consequently, the Eames chair was the more affordable of the two (48).

One of the most problematic features of the Eames design proved to be the two upholstery pads which came in either glove leather, vinyl,
strong textured cotton or tweed hopsack (49). The first type which was made up of a single piece of foam rubber topped by a hair felt pad, covered the entire chair, while the other, a two piece pad, covered only those parts where the body came into contact with the seat (Fig. 78). The manufacture of the pads was at first put out to a tailoring firm but it proved difficult to get the pads to grip the chair frame satisfactorily (50). In the end the problem was solved in a typically Eamesian way; they went back to basics and, in conjunction with the sewing department of the Santa Monica Technical School developed new machines and new techniques until they obtained the desired result (51). Charles recalled:

"Again we were at the point where the design and production of even the machinery for making the furniture was being done in our office. Jigs and fixtures for building up the upholstered pads were made and operated in the initial production stage by fellows in our office." (52)

The problems were resolved and the chair remained in production from 1951 to 1967 (53).

STORAGE UNITS

Charles and Ray Eames had long been concerned with developing a storage unit to complement their seating designs. Charles and Eero Saarinen, had submitted a designs for a plywood storage unit in the Organic Design in Home Furnishing Competition of 1940 (see chapter three). Yet, as with the other furniture entered into this competition the storage units were never put into mass production. Charles and Ray modified the design during the 1940s and a new version was shown as part of the 1946
plywood group although this design was also never put into mass production.

The Eames Storage Unit (ESU) made its debut at the 1949 Design For Living Exhibition held at the Detroit Institute of Arts (54). They were lightweight, interchangeable, colourful and acknowledged their industrial antecedents and were amongst the most radical of the Eameses furniture designs at the time (Fig. 79). Yet, today their uniqueness is lost because such items are now fairly commonplace in offices and homes. The storage system was described as '...a frank and forthright answer to a permanent and basic furniture need: attractive, durable cabinets, cases and desks that are modestly price' (55). Designed for use either at home or in the office, the modular units came in two widths and three heights and there were a large number of options concerning the arrangements of the shelves, sliding panel doors and drawers (56). Inspired by industrial 'knock down' shelving which was easy to pack and transport, the Eames storage unit was formed out of plated steel uprights, which came in either a bright zinc or black finish, and plastic coated plywood shelves with tops of either stain-resistant plastic or wood (57). Stability was provided by crossed metal struts or lacquered masonite panels (58). Drawers came in black plastic laminate or plywood (a choice of birch or walnut) and sliding doors were available in dimpled wood, white glass cloth laminate or black hard plastics (59). A splash of colour could be added with lacquered masonite panels in red, blue, yellow, black, tan, grey and white, whilst perforated aluminium panels acted as shelf backs (60).
Aesthetically speaking the storage unit relates to the exterior construction of the Eames House which also utilised a variety of infill sections within a steel frame complete with cross rod bracing. Aestically speaking the use of colour on the ESU relates to the use of colour on the exterior of the Eames House. Both refer back to the work of the De Stijl movement and, in particular, the work of Mondrian. Although aimed at both the home and contract markets, the storage system never really caught on in either. Domestic consumers remained hostile to metal furniture in general and although metal furniture was not unknown in offices, it was usually more sobre than the brightly coloured Eameses pieces. The original version was self-assembly but the procedure was none too simple and Herman Miller later introduced a ready assembled system (61). This, however was no more successful than the original and the ESU was withdrawn from production in 1955 (62).

**Eames Contact Storage, 1961**

The ECS dormitory unit was developed in response to the growing market for furnishings suitable for student accommodation and other institutional housing (Fig.80). In 1954 the Eames Office had designed a prototype domestic storage unit in composition board, known as the Sears Compact Storage, which was formed of two units of shelves and railings. The whole unit could be closed off by an accordion door and it came with an optional extra, the 'starlight' mirror (63). Although the unit aimed at solving the problems of small post war houses, it was never produced but much of the research and development work was utilised in the ECS dormitory unit (64). The latter comprised five separate units, namely
three dressing units, a study unit, and a bed unit, each of which sold separately and could be combined in a variety of ways (65). The whole unit was exquisitely detailed with handles made of polished cast aluminium and came equipped with a reading light over the desk (66). The base of the unit did not touch the floor the whole being mounted to the wall on steel brackets (67). The complete five unit system contained most items required in a student room and allowed plenty of room for the storage of clothes and personal items. One of its most admired features was its flexibility. *Progressive Architecture* described it thus:

"Many such built-in systems available today have the disadvantage of being static; it is difficult to add or alter them. 'Eames Contract Storage' eliminates this drawback by standardizing the basic units and making them attachable and detachable thereby permitting variation in individual groups of units." (68)

The storage system was promoted as tough and easy to clean as well as being virtually impossible to dismantle without special screw drivers – features which were very attractive to those planning student accommodation (69). However, despite the claims of the Herman Miller company that the system led to significant cost reduction in dormitory provision if, from the outset, construction was planned around it, the system was never a great commercial success because it was considered to be too expensive and came on to the market at the very time that students' lifestyles were becoming more informal.

-225-
Eames and Saarinen had proposed a modern solution to sofa design in their entries for the Organic Design in Home Furnishings competition of 1940 but, like the other entries, this idea remained just that. For the 1954 Sofa Compact the Eameses looked to the built-in sofa unit in the seating alcove of their home and to a prototype wire sofa developed by Don Albinson in 1951 when the Eames Office was experimenting with this material (70). In the prototype the wire frame, which was supported by four collapsable wire struts placed on a runner, had three button tufted cushions (71). The sofa could be collapsed for transportation and, although Herman Miller was enthusiastic about the idea, the Eameses considered that it would be too time consuming and expensive to manufacture on a large scale because it required a considerable amount of hand labour (72).

The Sofa Compact, 1954

The number of parts involved in the sofa were reduced and most of the hand finishing rendered unnecessary in the adaptation of the 1951 prototype for the Sofa Compact of 1954, the black enamelled steel frame of which rests on chrome-plated steel legs (73). Designed for domestic and commercial use, it has proved a considerable success and is still manufactured today (Fig. 81). An ingenious feature of the design is the way the back can be folded down to allow for easy transportation but, perhaps because of this, it is the least sculptural of the Eameses' metal furniture, having a very two dimensional appearance. The seat and
back were formed out of three horizontal foam pads with a cord welting detail and were covered in leather, vinyl or selected other fabrics (74).

3473 Sofa, 1964 and Teak and Leather Sofa, 1984

A new version of the Sofa Compact, the 3473 Sofa, was similar to its predecessor in overall shape and in the high angled back but its back and seat, each of which was divided into three by means of upholstery piping, had none of the 'knock-down' or 'fold-up' feel of the Sofa Compact (75). Upholstered in leather it had a 'Miesian' feel to it although its newly designed cast aluminum legs and frame had none of the elegant lightness of Mies Van der Rohe's famous Barcelona Chair of 1929 (76). This overall 'Miesian' feel was not uncommon in furniture of the early 1960s, witness the work of Robin Day for Hille in Britain particularly the Gatwick airport commission of 1961 (77). The plywood frame of the 3473 sofa harked back to the Eames/Saarinen designs of 1940 and also the Time Life chair of 1960.

A more luxurious version, eventually to be called the Teak and Leather sofa, started life in 1967 but was more or less shelved until 1976 when, under Charles's direction, a great deal of time was devoted to its development, although it was not marketed until after his death, appearing in Europe in 1984 in the USA in the following year (78). It represented a rare return to furniture design in the late 1970s for the Eameses who by then had become preoccupied with film making and exhibition design.
The main difference from the Sofa Compact and the 3473 Sofa lay in the use of a teak or walnut frame, the arm rests of which were added to the design after Charles's death, and the soft upholstery, all of which gave the sofa a touch of distinction and luxury similar to the Lounge Chair and Ottoman of 1956 as well as the Soft Pad Group (1969) and Chaise (1968) which it was supposed to complement (79). This, the last of the Eames designs to appear on the market, shows how far they had moved from their original aim of producing low-cost quality modern design. It came thirty years after the Sofa compact, 1954, which was the last piece to be designed in the Eames Office with low-cost to the customer as one of the major elements of the brief. As the Neuharts have pointed out:

"In successive furniture...this objective became less important as a determining factor in the design process, but the goal of cost-effective mass-manufacturing remained an important consideration in Eames furniture development." (80)

ALUMINIUM GROUP, 1958

By 1958, when Herman Miller marketed the Eameses' first major essay in cast metal, the Aluminium Group, there had been ten years of experimentation with metal furniture in particular bent wire. After the DCM chair of 1946 and the Lounge Chair and Ottoman of 1956, the Aluminium Group is the best known of the Eameses' furniture, and is particularly admired by architects and designers especially the 'High Tech' architects of the 1970s and 1980s. As with many Eames designs, the impetus came from a problem posed by a friend. In this case it was Alexander Girard who, together with Eero Saarinen, had just designed the
Irwin Miller House, Columbus, Indiana 1953-57 (81). It was hard to find modern furniture for use both indoors and out on the terrace that led Girard to consult with the Eameses and the first aluminium chairs were specially manufactured for this house.

Charles Eames described how he and Ray became involved:

"You start on a close human scale. Here is a friend who has done something. He needs something for it and you become involved. As we were trying to analyze the reasons why there was nothing available on the market to suit him, why we were of course starting to write a programme for designing the object to fill this void. That's how it started." (82)

Outdoor furniture needed to be not only light but also durable. Aluminium was used because it was light and less likely to corrode out of doors than other metals. It also needed to stand up to high degrees of humidity, particularly in areas such as the Midwest.

Thinking about outdoor furniture for relaxing led the Eameses to the idea of a hammock and then to a sling chair. The latter was a very popular form of chair design in the 1950s, the best known being the Hardoy Sling or Butterfly Chair of 1938 marketed through Knoll Associates during the 1950s (83). The Eameses took the idea of comfort from the hammock and adopted it to more traditional forms of seating.

The profiles of the Aluminium Group chairs relate to the thin flat profile of the Sofa Compact of 1954 but the former are much sleeker and thinner (Fig. 82). The basic chair is composed of two side frames which act as both the main support and a flange into which the sling or fabric is fastened. These side bars terminate at each end in cylinders around
which the ends of the seat pads are wrapped. These side pieces are supported on the third element, namely the base, which joins on to a stem of black steel which, in turn, supports the fifth element, often referred to as an 'antler' which connects the pedestal to the base of the two side frames. A similar 'antler' acts as a brace on the rear of the seat frame as well as forming a convenient carrying handle. Arms were available as an optional extra on both the recliner and lounge versions and came in a choice of polished aluminium with clear or black nylon finish but it is generally considered that the arms reduce the overall coherence of the design.

The sling or seat came in a plastic woven cloth known as saran (specially developed for the project by Alexander Girard) which came in blue, grey, green or brown. It was made up from two layers of fabric between which was sandwiched three strips of stiff fabric at important pressure points thereby reducing the sag which resulted in other sling chairs (84). The later heat sealed koroseal (a type of leather) version had an inner filling of vinyl-coated nylon fabric and a ¼ inch thick layer of vinyl foam. This was welded under pressure using high frequency current and the welds, which were evenly placed at 1½ inch intervals, appeared as horizontal stripes on the surface of the fabric (85).

The mechanism by which this very strong fabric fitted into a groove in the frame is one of the most ingenious parts of the design. The original design for it was little more than a doodle slightly less than two inches square:
"Well having the programme in mind, you gradually begin to stew about it - while travelling in planes and so on. The actual idea, the idea for the chair - that is, the gimmick, the device that made it possible is something I [Charles] recall drawing on the back of an envelope." (86)

Originally it was envisaged to fix the fabric to stretchers which were pinned to the side frames but this was rejected on two counts, firstly, because the stretcher pins broke the smooth sharp line of the sling frame and, secondly, because it was perceived as being old-fashioned and the design team felt a new more advanced method was needed to give the chair a more up-to-date image (87). It was decided therefore to place a plastic edging on the side of the fabric. This was then inserted into the groove before the two side frames were flipped over, thus pulling the fabric into place under tension without any fasteners or adhesives; the heavier the sitter the tighter the grip. The idea of a sling support reflected Charles and Ray Eames's interest in structure and connections between two different materials and new ways of joining them together. To quote Charles again:

"... perhaps the real question that you must ultimately face is: is it a function of the necessary connections? In architecture, or furniture, or jackstraws, it is the connection that can do you in. Where two materials come together, brother watch out! The cross section was really a system of connections based on tensions which served to support the body. The chair was when we applied this system to a theory of support we had developed earlier." (88)

The original range consisted of a large reclining lounge chair (retailing at $252) a small lounge chair ($168), dining chair ($148) and ottoman ($124) as well as dining and coffee tables with tops of either slate, clear glass or Botticino marble. The latter was an unusually
luxurious material for the Eameses to work with but nevertheless proved not only attractive but extremely utilitarian. Indeed, the entire range proved extremely popular with the more 'artistic' and wealthy strata of the professional classes; as Architectural Forum remarked, the furniture was 'Engineered to withstand poolside or patio wear and weathering, yet styled to harmonize with the plushest contemporary interiors' (89).

While the idea of a sling support was very much that of Charles, much of the development work on this project was carried out by Don Albinson, Dale-Bauer and Bob Staples, with later modifications being undertaken by Peter Pearce who turned the original design into a cast metal mock up and worked on the development of the two slings (90). The success of the chair lies in the way that it combines new technology with sculptural forms. The technology came first, but, as Charles explained, the very technology allowed a considerable amount of aesthetic freedom:

"...when you've committed yourself to casting, you've committed yourself to a plastic material and the kind of freedom that can really give you the willies... in casting there are times where the definition of the problem is pretty vague. At that moment you find yourself face to face with sculpture and it can scare the pants off you." (91)

But he and Ray were well used to working through those aesthetic problems and no amount of time was considered too long if it finally brought them the desired effect. The resultant chair frame successfully balances two differing aesthetics. The more angular outline reflects the growing interest in early Modern Movement furniture, particularly the work of Van der Rohe, whilst the 'antler' features have a more
organic feel. The dynamism of this aesthetic fusion is one of the main factors which have made the Aluminium Group such a success.

The chair was an instant hit, particularly on the contract side of the market. Although the original project began as indoor/outdoor furniture, the chairs were rarely used outdoors. The Eameses tested the product by using one outside their own home and soon realised that what they had produced was very expensive for outdoor furniture. To quote Charles again:

We've been using one for a test outside our house for the past six months. But it's also an indoor chair probably a high budget outdoor chair, a low budget indoor chair." (92)

The chair was the most complex of all the Eames designs to manufacture and there is a considerable amount of hand work in the production. As they became increasingly popular in offices all over the world, the range was updated to better meet office requirements; for instance two swivel desk chairs were introduced in the mid 1960s, new materials, such as perforated metal were used, and the range of colours for the sling was increased. Furthermore, the basic structure of the Aluminium Group has been applied to other chairs such as the Soft Pad Group of 1969.
While they were working on the Aluminium Group, the Eameses, together with several other well known designers, were invited by Alcoa (Aluminium Corporation of America) to design an aluminium product which showed the diversity and potential of the material (93). The project, which was referred to as the Alcoa Forecast Program, was initiated in 1956 and, as *Industrial Design* noted,

"despite a run of new uses for Aluminium, and the firm's [Alcoa] continuing development of new textures, finishes and colors, the average consumer and many designers were still likely to picture aluminium as a light, white metal which is good for pots and airplanes. " (94)

Arthur P Hall, Vice President of public relations and advertising for the company contacted the design consultancy of Ketchum, Macleod and Grove of Pittsburg, which suggested $3,000,000 be set aside for a three year project which would finance the selected designers as well as magazine advertisements (95). The brief stipulated that what was wanted from the designers was not a product to manufacture but a concept to promote the idea of aluminium as an exciting material which could be used for a variety of purposes (96). Alcoa, as commissioners of the design, had the right to exhibit and photograph the finished object but stipulated only two conditions, namely that the piece be made out of aluminium and that it be photogenic; indeed Alcoa commissioned top photographers Irving Penn and Bert Stern as well as Charles Eames to capture the diverse objects which emerged from this project (97).
The Eameses enchanting Solar Do-Nothing Machine certainly fulfilled the brief (Fig. 83). John Neuhart recalled that the Eames Office was specifically requested to produce an aluminium toy (98), presumably because of Charles and Ray's well-known interest in toys, their use of them in their films and, last but not least, the toys they had designed for contemporary use (99). The Magazine Interiors noted:

"the ordinarily tidy Californian workshop... became cluttered with piles of mysterious, strangely decorative rubbish - flat pinwheels, stars, circles, snowflakes, and other Christmas - ornament shapes of gleaming, vivid-coloured metal, and angular bits of wire suspiciously like the broken 'works' of motor driven toys." (100)

These pieces went together to make a machine which, while apparently doing nothing, illustrated the potential of solar energy. Originally the Eameses had considered a fairly basic machine which utilised parabolic reflectors to boil water and thus to create steam which would then run an engine, but later used photovoltaic cells which were a much simpler source of power (101). The final piece consisted of an oval platform from which sprouted a number of poles topped with various cut-out pin-wheels and stars which were worked by a series of shafts, pulleys and pistons using solar energy generated by the photovoltaic cells. Aluminium was thus seen to be linked with the very latest and ecologically progressive developments in technology. The machine made a statement about the nature of aluminium in a visually exciting way (indeed, the photographs Charles Eames took of it made it look like a space probe on a distant planet Fig. 83) yet, like other Eames projects, it had an important message to communicate - in this case about the potential of both aluminium and solar power.
The next piece of Eames metal furniture was that designed for the Time & Life office building in New York. Two very different designs emerged for this commission; the comfortable chair commonly and continuingly known as the Time-Life lobby chair and a turned wooden stool which also acted as a small table. The chair was technologically and aesthetically within the parameters of the metal group as a whole whereas the turned wooden stool was based on a traditional African stool which the Eameses had in their own home. Both items were, of course, mass produced by machine. Although this combination of a 'Miesian' style 'executive' chair and an ethnic looking stool may at first seem strange, much of the Eameses work in interior design as well as in film was based on the idea of the juxtaposition of seemingly disparate objects. It also fits into the wider usage in interiors of 'ethnic' objects, particularly African, South American and Native American artifacts, which not only showed the occupant was 'cultured' and had 'good taste' but came to symbolise the up-to-date 'modern' interior. Indeed Knoll Associates offered in 1952 a similar stool designed by Isamu Noguchi made from both wood and wire rods and likewise derived from an African prototype (102).

The design is based on an African stool in the Eames House and represents a detailed thinking around the problem at hand (103). Machine produced in two halves which were screwed together, the Herman Miller stools came in four types; concave, convex, zig zag concave and zig zag convex (104). Ray Eames clearly played a considerable part not only in the conception but also in the final form of the piece. Yet she
felt that for this to be 'ascribed' as 'by' her, denied the role she played in all her other joint work with Charles. This stool is often seen as the outcome of her interest in the 'crafts' of other cultures (an interest which, of course, Charles shared) and as reflecting the whimsicality which she is supposed to have brought to their joint design work. Those design historians who emphasise the work of Charles on the 'hard' high technology side of furniture design and production and see Ray as concerning herself with 'decorative pieces' and craft inspired work such as the stool, fail to realise the important contribution of Ray as a sculptor to the forms of the plywood, plastic and metal furniture. They also miss the fact that the turned stools were an important comment on modern design, showing how designers could look for models and inspiration outside the Western industrial tradition and use them to good purpose to meet contemporary needs and humanise the modern office or home.

Technologically speaking the Time-Life chair combined ideas from both the Lounge Chair and Ottoman of 1956 and the Aluminium Group of 1958. From the former design it uses three pieces of moulded plywood to form a shell (although in this chair the plywood was hidden) and from the Aluminium Group it took the aluminium frame and base (105). The upholstery consisted of three leather cushions and armrests filled with foam padding (106). Each had two buttons, suggesting the traditional upholstery technique of 'buttoning' and reinforcing the image of the chair as suitable for executive seating. The overall form of the chair is much more 'Miesian' in its angularity than much of the preceding Eames metal furniture, although a hint of the organic forms of earlier
years can still be perceived in its somewhat rounded edges. As with the Aluminium Group, the Time-Life lobby chair was identified as a luxury item. It also achieved considerable 'cult' status when Bobby Fischer used it during the 1972 Reykjavick world chess tournament. His Soviet opponent was so impressed with the chair that Herman Miller had one specially flown to Iceland for him (107).

Although designed for the Time & Life Building, Herman Miller realised it would fill a gap for an armchair-cum-office chair suitable for executives and conferences. In 1961 Herman Miller introduced a modified version of the chair with a narrower seat and back, and a height adjusting mechanism and casters, thereby turning the chair into a desk chair (108). The intermediate desk chair of 1968 relates both technologically and stylistically to the Time-Life chair and the Executive Desk Chair (109).

**TANDEM SLING SEATING 1962**

The Tandem Sling Seating Group continued the technology of the Aluminium Group but with a form that was more harmonious en masse. The frontal view was square but the side profile reveals a characteristic Eamesian gesture in the elegant sculptural curve (Fig.84). While other furniture by the Eameses had been used in public spaces, it had been designed primarily as domestic seating whereas Tandem Sling Seating was designed specifically for Dulles Airport, Washington, D.C and Chicago's O'Hare Airport (110). Airports were to prove an increasingly important part of the contract market because during the late 1950s and early 1960s there
was a widespread increase in airport capacity throughout the United States and many new airport terminals were built, including Minoru Yamasaki's terminal at Saint Louis Lambert Field of 1954 and Eero Saarinen's Dulles airport, 1959, and his TWA terminal at JF Kennedy Airport of 1956-1962. All attempted to create a new up-to-date image for airports, many of which had been constructed during the 1930s and tended to express the ideals of the New Deal rather than the new jet age.

Domestic air travel increased rapidly in the late 1950's after the introduction of jet aircraft and by 1961 there was one take off every 85 seconds at O'Hare airport (111). This, together with an estimate for the following year of 10 million passengers through the airport, led the authorities of what had become the world's largest airport to embark upon a programme of expansion (112). In January 1962, two new terminal buildings were opened at O'Hare, both designed by C.F. Murphy Associates, a firm which concerned itself with every detail of the building (113). The designing began by addressing the fundamental question of what was an airport and went on to identify the many problems in existing airport design and how these could be improved upon. Carter H Manny, the partner in charge of the O'Hare project, began his analysis from the point of view that the airport was the main hub for several major domestic carriers. More than 25 percent of all passengers who deplaned at O'Hare were in transit and would continue their journeys to onward destinations (114). Most of these passengers had to wait between two and three hours for a connecting flight which meant that a primary consideration was facilities such as refreshment areas, wash rooms and,
above all comfortable seating areas. The old state of affairs would not do: Manny stated that:

"Having spent countless hours ourselves waiting in airline terminals, it was obvious to us that most of the public seating used in such places was inconsistent with the image of comfort and service that the airlines attempted to portray." (115)

As usual the architects had to convince the airlines and airport authorities of the need to invest in what they considered unnecessary luxuries:

"We emphasised that their responsibility of providing comfort and service to the passenger did not end with the termination of a flight. It included the furnishing of comfortable seating for the traveller who might have to wait several hours in a terminal between flights. Too often the advantages of jet travel end as soon as the plane touches down on the runway." (116)

Both Manny and Harvey Stubbsen, the interior designer for the terminal, realised that the furniture needed to be durable, resistant to wear, easy to replace, relatively cheap, aesthetically pleasing, and comfortable - but not so comfortable that people might sleep on it and take away trade from the airport hotels (117). They also realised that to obtain their ideal airport seating furniture, they would have to start from scratch and design it (118). But they did not have the experience to undertake such a project and, having decided to involve professional furniture designers, they contacted several furniture companies including Knoll International and Herman Miller (119). These firms, however, could only offer existing models which they were prepared to modify. Neither Manny nor Stubbsen were happy with what was
offered and it was at this point that the Eames Office became involved (120). The meticulous manner in which both Manny and Stubsjen had thought through the problems of airport design and the detailed way in which they communicated their ideas about airport seating impressed the Eameses who, in turn, became enthused with the project.

Herman Miller's original presentation to Manny and Stubsjen was based on the 1958 Aluminium Group which, it was argued, could be modified into multiple seating while keeping the general form of the sling. Besides their high cost, the Aluminium Group chairs visually demanded their own space in the way that sculpture does with the consequence that they look somewhat clumsy and awkward when used in a large or uniform mass groupings. It is true that Dubai and certain other Saudi Arabian airports use the Aluminium Group Seating but they have far fewer people passing through them and the pieces are mainly used as status symbols, signifying the wealth of the Arab world.

Although they came to this project through the Herman Miller connection, the Eameses had been deeply involved in the whole question of airport design from the making of their film Expanding Airport in 1957 for Eero Saarinen (121). Tandem Sling Seating was installed in Dulles airport at the same time as O'Hare, but it was the Chicago connections which made the Eameses tackle the problem in earnest. Globe trotters themselves, they had come to similar conclusions about airport design as Manny and Stubsjen, commenting 'our response could not, however, be completely impersonal. Not with the amount of air travel we do these days' (122). As designers interested in urban and interior design they had often
thought about producing mass seating for public spaces. Furthermore, they had already considered adapting the suspended upholstery principle of the Aluminium Group to cheaper office seating before they heard of the O'Hare project (123).

Although the basic ideas behind the project had been successfully worked through in the Aluminium Group, this project involved more than simple alterations to an existing design. So demanding were the specifics of the brief that the modifications involved as much work as many other projects started from scratch. There were very strict deadlines to meet and much more intensive tests relating to product durability were undertaken because of the particular needs of the contract market and this commission in particular. The design went from paper to plywood mock-up and then to the metal prototype built by Dale Bauer, Peter Pearce, Richard Donges and Robert Staples, which was tested on the most up-to-date technology then available in the furniture industry at the Herman Miller Technical Centre at Zeeland. The tests included dropping a 1001b weight on to a seat pad from a height of 5 inches 15000 times over; subjecting the arms, seat and back pad materials to 69,000 cycles on an abrasive machine; chilling the seat and back pad material to -15F for half an hour, putting it through a wringer and then exposing it to 80 hours of ultra violet light, 65-70% relative humidity and 105 F ambient temperature (124). This level of testing was very different to anything the Eameses had been involved with hitherto and was a far cry from the early days of testing plywood prototypes on a home and hand-built machine in their own apartment. The Eames Office and Herman Miller Technical Centre developed the tools and equipment necessary to
mass produce the airport furniture to a high quality finish (125). The final version of the Tandem Sling Seating had cast polished aluminium seat frames with heat sealed pads of black naugahyde reinforced with nylon fiber and vulcanised fibrestrip (126). The black painted steel support beams came in differing sizes, allowing between two to ten individual seats with the maximum number of seats between legs being three (127).

Many consider that as airport seating it has few rivals and it is still used in airports. When the new Tampa International Airport, which introduced new passenger processing concepts, opened in 1972, for instance, the architects chose Tandem Sling Seating as did the architects of the Post Modern Sky Harbour airport at Phoenix, Arizona, in 1984 (128), by which date the original design was over twenty years old (129). The success of the group ultimately lies in its aesthetic appeal and its ability to stand up to wear and tear which, with its easy replacement potential, makes it amongst the Eameses' most commercially and aesthetically successful designs.

**CHAISE. 1968**

Although the aluminium and leather chaise of 1968 was developed and marketed with a view to the domestic as well as the contract market, its high price (it originally retailed at $636) meant that it was mainly found in the offices of the larger corporations. 'Miserably expensive' was Ray's feeling about the price (130) (Fig.85). This was another project developed in response to the needs of a close friend: Billy
Wilder, the film director, who spent a lot of time in his office and often felt like taking a siesta, told the Eameses about his desire for an office couch. Wilder had definite views concerning the form of the chaise. Conscious of his image, Wilder stated that 'A man of my reputation simply can't afford to have something that looks like a casting couch. Its too obvious a symbol of lechery' (131). Yet the traditional wood and leather casting couch, as found in both real and Hollywood representations of film directors' offices, was one source of inspiration. Indeed, the challenge was to update this particular piece of furniture. In profile the chaise is similar to some of the experimental plywood recliners of the 1940s (132). The sand-cast aluminium frame carries a stretched and plasticized fabric on which are placed six leather foam-filled cushions which are joined to the frame only at the top and bottom, the rest being kept in place by zippers. Extra comfort comes with two additional small cushions for head or limb support (133).

One visually striking feature of the piece is the narrownesss of the 17 ¼ inch wide top which adds greatly to the overall form of the piece. Since a concern for formalism in itself was never a major concern of the Eameses, it seems likely that its narrowness differentiated it from a day bed or lounger which might encourage longer sleeps than Wilder desired. The inspiration for this narrowness came in part from the fact that while Charles Eames and Billy Wilder were on location for the Spirit Of Saint Louis in 1955 the latter took his naps on a thin wooden plank (134). As it was, Wilder loved the final aesthetic, commenting
'I adore the originality of the shape, it isn't the old fashioned Rubens couch, its more like Giacometti' (135).

As with most of the metal furniture, the chaise became a standard item in top level executive offices around the world. Although one suspects that in this case it was as much a status symbol as a functional object - unless the leaders of the business and commercial world took more naps than they would generally have their clients believe. It became something of a cult object, as had other Eames pieces before it, going on display at MOMA and promoted in countless interior design magazines in the late 1960s and throughout the 1970s.

**LATER METAL FURNITURE**

The chaise was considered striking in 'a severe, neo-Bauhaus way' (136) and during the 1960s the Eames Office produced other designs which utilized metal and fitted into a more pure Modern Movement aesthetic than had the earlier shell furniture in plywood, GRP or bent metal pieces. For instance, the intermediate desk chair 1968, was designed in a more 'Miesian' style with an emphasis on angularity of form. The intermediate desk chair was a combination of several different Eames designs, most particularly the *Time-Life* Lobby chair, 1960 and the Eames executive seating of 1961. Even though it was hoped that this chair would prove less expensive than other contract pieces, in the end it too proved expensive and was only in production from 1968 to 1973 (137). Other designs include the Segmented Base Tables of 1964 which had tops in veneered hardwood, plastic laminates or white Italian marble.
and a pedestal base similar in form to that of the la Fonda chair and
table (138). The novelty of the new design lay in the way that the base
could support different sized table tops by simply increasing the number
of bases (139).

From about 1971 the Eames Office moved away from producing furniture in
the 'Miesian Revival' mode yet continued to use metal, as in the two-
piece secretary chair of 1971 which is not easy to categorise
stylistically within the metal group as a whole (Fig. 86). It is clearly
derived from two sources; the shape of the seat and back rest are based
on the DCM Chair of 25 years earlier whilst in overall form it resembles
the standard secretary chair of the 1970s, a form derived from the
organic 'New Look' of the 1940s. It is one of several pieces in the
1970s which were up-dates or combinations of existing designs. The
Eameses had less time for furniture design than ever before because they
were so involved with other work including film making and exhibitions.
Charles had reached his sixties and spent a little less time than before
in the office. By that date, however, they had done perhaps more than
any other furniture makers of the western post-war era to change the
public perception of metal furniture, something which in itself, was no
mean task.
Footnotes


(4) ibid, p.10.

(5) ibid, p.10.


(7) ibid, pp.46-47.


(10) ibid, p.149.


(12) ibid, p.130.

(13) ibid, p.130.

(14) ibid, p.130.


(17) ibid, pp.143-44.


(19) ibid, p.97.

(20) The Eames team consisted of Don Albinson, Frances Bishop, Frederick Bishop, James Connor, Robert Jakobsen and
Charles Kratka.


(22) Author's interview with Ray Eames, Los Angeles, May 1987.


(33) *ibid.*, p.149.

(34) *ibid.*, p.149.

(35) *ibid.*, p.150.


(37) Dr P.A.Kirkham unpublished interview with Alison and Peter Smithson, January 1991.

(38) The details of the dispute are outlined in a letter from Peter Price of Price and Heneveld, Patent Counsel, Grand Rapids, Michigan, to Vernom Poest, Herman Miller, Zeeland, Michigan, dated February 1 1961, Herman Miller Archive, Zeeland, Michigan.
(39) ibid.

(40) Cherie and Kenneth Fehrman argue that Bertoia left the Eames Office because of 'artistic differences', Fehrman. C & K, op. cit., p.35. NB during the mid 1940s, the time of Bertoia's employment, the Eameses were totally involved with plywood whereas Bertoia was more interested in metal, ibid., p.34.

(41) Price to Poest, op. cit., see footnote 38.


(43) Price to Poest, op. cit., see footnote 38.

(44) These two designs can be compared in Eames and Neuhart, op. cit., pp.150-51.

(45) 'Bertoia: His Sculpture, His Kind of Wire Chair', Interiors, October 1952, pp.118-21.


(47) ibid., p.109.


(49) Eames and Neuhart, op. cit., p.151.


(51) ibid., p.109.


(53) Eames and Neuhart, op. cit., p.151.

(54) ibid., p.125.


(56) Eames and Neuhart, op. cit., p.127.

(57) ibid., p.127.

(58) ibid., p.127.

(59) ibid., p.127.

(60) ibid., p.127.

(61) ibid., p.127.

(62) ibid., p.127.
(63) ibid, p.188.

(64) ibid, p.188.


(66) Eames and Neuhart, op.cit, p.265


(68) ibid, p.73.

(69) 'Dormitory in a Nutshell: ECS', p.44.


(71) Eames and Neuhart, op.cit, p.154.

(72) ibid, p.154.

(73) ibid, p.154.

(74) ibid, p.154.

(75) ibid, p.283.

(76) ibid, p.283.


(80) Eames and Neuhart, op.cit, p.191.


(82) 'Three Chairs: Three Records of The Design Process', p.120.

(83) Based on an anonymous Argentinian design of the 1930s which was derived in the main from a British officer's chair of World War One. See Greenberg. C, op.cit, p.76 and Fehrman. C & K, op.cit, pp.148-49.
Author's interview with John Neuhart, May 1987.


'Three Chairs: Three Records of The Design Process', p.120

Ibid, p.119.


'Three Chairs: Three Records of The Design Process', p.120.

Ibid, p.120.


Ibid, p.74.

Ibid, p.74.

Including an aluminium crepe ball gown by Jean Desses, an aluminium rug by Marianne Strengell and aluminium shelving by Alexander Girard.

'Alcoa Ventures A Forecast', p.74.


They had made a name for themselves by designing educational toys for Tigrett Enterprises, a progressive toy manufacturer.


They were introduced to these cells by the engineer Eddie Lipps who became their neighbour upon buying the Entenza House in 1955. Eames and Neuhart, op cit, p.220


Ray Eames interview May 1987.

Eames and Neuhart, op cit, p.249.
(105) ibid, p. 249.

(106) ibid, p. 249.

(107) ibid, p. 249.

(108) ibid, p. 249, Eames Executive Seating comprises two chairs, namely a swivel lounge and a tilt swivel lounge.

(109) ibid, p. 327.


(112) ibid, p. 140

(113) ibid, p. 140

(114) ibid, p. 140.

(115) ibid, p. 140.

(116) ibid, p. 140-41.

(117) ibid, p. 141.

(118) ibid, p. 141.

(119) ibid, p. 141.

(120) ibid, p. 141.

(121) Eero Saarinen had suggested to the Eameses that they design the seating for his terminal at Dulles Airport, Eames and Neuhart, op cit, p. 275.

(122) 'Evolution of a Design', p. 142.


(124) 'Evolution of a Design', p. 142.

(125) Eames and Neuhart, op cit, p. 275.

(126) ibid, p. 275.

(127) ibid, p. 275.

(128) 'Phoenix Airport Rises Again', Commercial Renovation, June 1985, pp. 40-42. Norman Foster considered using the group for his new terminal at Stanstead airport, London
(129) Interview with Norman Foster, BBC.2 Late Show, November, 1990.


(132) Drexler, A, op cit, p.48.

(133) Eames and Neuhart, op cit, p.339.

(134) ibid, p.339.

(135) 'The Anti Casting Couch', p.48.

(136) ibid, p.48

(137) Eames and Neuhart, op cit, p327.

(138) ibid, p.293.

(139) ibid, p.293.
CHAPTER SIX: THE EAMESES AS COMMUNICATORS

Of equal importance to their work as architects and furniture designers was the Eameses' work as communicators, as seen in their award winning films, multi-media presentations, multi-screen shows, exhibitions, books, timelines and proposed information centres. It was work which increasingly came to dominate the output of the Eames Office from the mid 1950s. Both Charles and Ray Eames had a strong interest in a wide range of ideas, from history to computers and from mathematics to fine art. They believed that knowledge, or what they referred to as 'information' and 'ideas', was going to increasingly occupy the leisure time of the population, as automation led to people having longer periods of free time and they were concerned with filling this time in a socially worthwhile way by feeding people all manner of ideas.

That the Eameses' work as communicators was as important as their other work was recognised by writers such as Patricia Degener in 1977 who argued that:

"It might seem that the chair designs-$500,000,000 worth have been sold throughout the world-represent the pinnacle of their success. But their major contribution has been in the revolutionary use of the visual image to communicate to the general public with amazing clarity complex scientific concepts and massive amounts of information" (1).

This work deserves reappraisal not least because their use of multi-media, multi-screen and film was a means of communication rather than a medium of personal expression. It was this aspect of their work which
endeared them to the (now film critic and director) Paul Schrader when he was at UCLA film school (2). In 1971 Schrader claimed:

"In film, the Eames aesthetic introduces a new way of perceiving ideas into a medium which has been surprisingly anti-intellectual. Cinema threw every other art into the twentieth century, Wylie Sypher contends in Rococo to Cubism, and remained woefully in the nineteenth itself" (3).

An analysis of their work in these areas is also important because it was work which brought them considerable contemporary fame.

The Eameses' approach to the exchange and distribution of information was greatly affected by the development of information theory after World War Two, particularly the work of Claude Shannon (b1916) and Warren Weaver (b1894) (see below). They realised that to convey information to a wide spectrum of people, it had to be intelligible and appealing. The ways they achieved this were, firstly, by clarifying rather than simplifying information so that it could be understood by a professor in a particular field as well as by a lay person, and secondly by adding 'personal' notes to whatever mode of communication they were using.

DEVELOPMENT OF COMMUNICATIONS THEORY

How people communicate has concerned scholars since the time of the Ancient Greeks (4). Although the discussion of such ideas took place within a wide variety of disciplines, there was no such thing as communication studies per se until the twentieth century. Interest in
communications theory was stimulated by advances in communications technology during the late nineteenth and early twentieth centuries when innovations such as the telegraph, telephone, cinema, wireless and mass circulation newspapers and magazines led to rapid and direct communications between people over large distances and the ability of a few to have considerable power over ‘the masses’ by controlling the main channels of communication. Much of the early work in the area of communications theory took place in the USSR during and after the 1917 Revolution as the Communists realised that in order to gain and stay in power, against great odds, they both had to control and invest in communications (5). Increasingly during the 1920s and 30s communications theory was crystallized, not only in the semiotic sense but also in the technical sense. The most important developments in the latter field came in the late 1940s with the work of two American mathematicians who had been involved in code breaking during the war.

**Claude Shannon and Warren Weaver**

Working with fellow mathematician Warren Weaver, Shannon produced a definition of communications centred around the transmission of messages. They worked in the Bell Technical Laboratories where they were concerned with maximising the effectiveness of communication by radio waves and telegraph/telephone lines (6). Their theory was first published in *The Bell System Technical Journal* in July 1948 and was expanded and published in book form in 1949 as *The Mathematical Theory of Communications* (7). Shannon and Weaver’s theory was developed under the influence of Norbert Wiener (1894-1964) the ‘father’ of cybernetics.
- a branch of science concerned with making parallels between electronic and biological control systems (8).

Shannon and Weaver developed a linear theory of communications which concentrated on methods of communication and divided the process into several distinct acts. They defined six elements of the communication process, beginning with a source and including an encoder, a message, a channel, a decoder and a receiver. To illustrate their argument they gave the example of a person making a telephone call with the source represented by the caller, the encoder the mouthpiece, the message the words spoken, the channel the telephone wires, the decoder the earpiece of the receiving telephone and the destination the mind of the other person on the line.

It was a very simple formula which helped many, including the Eameses, to come to terms with the question of communications. Weaver claimed their theory, 'has so penetratingly cleared the air that one is now, perhaps for the first time, ready for a real theory of meaning' (9). The most important feature of their work was the presentation of their ideas in diagramatic form, something which had many imitators, including the Eameses who used it one more than one occasion (Fig.87) (10). But the main purpose of their research was to improve the accuracy and efficiency of the communications process and their tendency to concentrate on the technical aspects of communications rather than the messages that were sent has been criticised (11).
Shannon and Weaver's theory also included the problem of a noise source, this being outside interference which diminished the clarity of the message. Two ideas closely associated with the problems of interference were the idea of redundancy, ie those parts of a message that were not vital to the comprehension of the message and its opposite, entropy, ie those parts of a message which were crucial to the basic understanding of a message (12). Shannon and Weaver suggested that to counteract entropy the message should be continually repeated until understood. A concept related to Shannon and Weaver's work was the idea of feedback (13). Feedback also developed under the direct influence of cybernetics and the application of feedback in the technical sense centred around the idea that electronic circuits should audit their own performance to compensate for any loss in message or meaning.

The Eameses made a film on the subject of feedback for IBM in 1961. Introduction to Feedback (10 minutes 40 seconds colour) compared the use of feedback in the modern electronic computer with its use in everyday situations. Feedback also affected their use of film and exhibition designs in that they believed that one did not have to register all the images in their entirety in order to understand the basic message. Their exhibitions featured history walls covered with numerous popular and less well known images relating to the period under discussion. On viewing the images the person's memory was meant to be triggered off, thus allowing the person to draw on their prior knowledge of the subject or period.
The Eameses first became interested in communications theory in the early 1950s and contacted Bell Technical Laboratories to find out more about this new subject. They were initially appalled with how Bell approached corporate communication, as Charles later told Paul Schrader:

"We went to Bell Labs and they showed us a picture of a man with a beard and somebody says 'you will invent the telephone', or something. And this is about all you get." (14)

Nevertheless, this contact introduced them to the innovative ideas of Shannon and Weaver and they went on to make a film version of them. A Communications Primer (1953, 22 minutes 30 seconds colour), attempted to illustrate communications theory to architects and planners and, as Charles recalled:

"I had the feeling that in the world of architecture they were going to get nowhere unless the process of information was going to come and enter city planning in general. You could not really anticipate a strategy that would solve the increase in population or the social changes which were going on unless you had some way of handling this information. And so help me, this was the reason for making the first film, because we looked for some materials on communications." (15)

Shannon was delighted with the result and regularly used it in his classes and IBM used the film to introduce people to Shannon and Weaver's ideas (16). Increasingly during the 1950s communications theory became a topic of much debate with much of this discussion centred around Marshall McLuhan (1911-81).
Marshall McLuhan's Global Village

One of McLuhan's most famous concepts was that of the 'Global Village' was the result of the increase in media communications in the post World War Two period (17). To a certain extent this notion influenced the Eameses' work, particularly the idea that modern communications could help to break down boundaries between peoples, as evidenced in their multi-media presentation Glimpses of the USA, 1959, presented as part of the USA/USSR exchange of that year. However, to a large extent they stood in contra-distinction to McLuhan's other concept that the medium was the message, which emphasised the importance of the medium in contrast to the Eameses who always emphasised the importance of content. As Charles explained:

"you must be committed to the subject, to the discipline of the concept involved, not to the medium." (18)

The Eameses always viewed the message as the most important aspect of their work and would have utilised any new available media in their obsssession to communicate ideas.

PHOTOGRAPHY, SLIDES AND PRESENTATIONS

In one of their first formal attempts to communicate ideas in 1945, the Eameses used a slide presentation known as 'Lecture 1' (19). First shown at the Californian Institute of Technology, Pasadena, it combined slide projection with a formal lecture by Charles. In this lecture they used a single slide projector to show between thirty and forty slides
The presentation attempted to communicate the similarities between the man-made and the natural worlds. A wide variety of subjects were photographed including toys, details of paintings, buildings, rocks, trees and flowers. 'Lecture 1' was presented on many occasions at the Eames Office and at each presentation the Eameses modified it to suit the particular group to which it was being shown by the substitution of different and more appropriate images.

Most of the images for the lecture presentation were taken in Southern California by Charles using a 35mm Leica camera. Charles, who had learnt photography with nineteenth century photographic technology, never ceased to be amazed at the accuracy, mobility and freedom permitted when using a modern 35mm camera which allowed him to shoot close-ups more easily. Charles's style of close-up photography was greatly influenced by the graphic designer Herbert Matter who worked in the Eames Office from 1943 to 1946. Matter's influence on Ray has already been detailed (see chapter one). His influence on Charles was mainly in terms of photographic techniques and, as John and Marilyn Neuhart emphasise, it was Matter who showed Charles what a 35mm camera was capable of doing. The Eameses presented their slide shows using the 'fast cut' technique of showing individual images in quick succession. This was an effective way of passing on a great deal of information because it followed the way that the human eye and brain registered images in real life. The presentations became increasingly sophisticated, with more and more images used. Sound was an equally important part of the presentations whether recorded music, appropriate noises or speech.
One of the most impressive demonstrations of the slide technique occurred in 1953 when Charles and Ray Eames assembled a course for architectural students at the University of California at Berkeley. Invited by fellow Case Study Architect, William Wurster, Head of Architecture at Berkeley, San Francisco, to teach a graduate course, the Eameses preferred to teach new undergraduates and devised a course which ran from December 1953 to April 1954 (28). They disliked the emphasis within the American education system on specialisation and considered graduates too directed in their outlook (29). The most memorable part of this course was the slide presentations, which drew on their vast collection, and involved four separate presentations (Townscape, Seascape, Railroad and Road Race) each utilising either two of three screens.

Townscape was a two screen presentation comprised of close-ups of the architecture of a supposedly typical American town, although many of the photographs were taken in Venice, California. One of the most visually interesting features of this presentation were the close-up shots of road markings (30). Seascape was a two screen presentation of images of the sea and shoreline in and around Los Angeles accompanied by recorded sounds of wind and sea (31). As the Neuharts have shown, this was the forerunner of one of the Eameses most artistically inventive films Blacktop, 1952 (32). Railroad was another two screen presentation combining all manner of close-up images of trains, railway tracks, sleepers, railway workers and railways signs. This presentation was accompanied by typical railway noises (33). Roadrace detailed through slides the last car race to take place in San Francisco's Golden Gate Park and was accompanied by the actual sounds of the race recorded by
Charles (34). Some of these images were used ten years later in the Think presentation in the IBM Pavilion at the New York World's Fair of 1964 (35). All four presentations addressed the Eameses belief that a careful selection of details were able to give a feeling of the whole (36).

From the mid 1950s the Eameses increasingly turned to moving images, multi-screen shows and exhibition designs. They still retained their interest in slide presentations and produced further work in this field including Konditorei, 1955, a three screen 96 slide presentation using slides taken on the Eameses' visit to Germany as part of a cultural exchange programme which detailed the making, baking, decorating and serving of cakes in a Munich coffee shop (37). The slides focused on details such as the icing on the cakes, the decoration on the coffee shop's china and the waitresses' uniforms (38). Tivoli, 1961, was a single screen presentation of 92 images taken by Charles on a visit to the famous Tivoli Gardens in Copenhagen, Denmark in the spring of 1959 (39). Both Charles and Ray fell in love with this park which they considered less gimmicky than many American theme parks with its Commedia dell'Arte Theatre and its musical concerts (40). Their slide presentation, which was only shown to close friends, aimed to capture the simple pleasures of the park (41). The layout and ambience of the park greatly influenced the Eameses in their designs for the IBM pavilion at the New York World's Fair of 1964-65 (see below) (42).

In 1967 the Eameses produced three slide presentations Government, Education and Management (G.E.M.), Herman Miller International and
Picasso. G.E.M was a three screen presentation of 345 images presented in Miami, Florida, at an IBM regional conference (43). Most of the slides were taken from earlier slide presentations and were meant to illustrate familiar objects looked at afresh, ranging from a freeway junction to a sea shell and from the layering of snow on garden furnishings to the workings of a clock (44). This presentation was also shown at the 1967 Photographer's Convention in Los Angeles and with several alterations at the Smithsonian Institution, Washington DC, in December 1967 where it was known as Smithsonian Gems (45). This illustrated the flexibility of slide presentations which, unlike moving film, could be made more appropriate for eaching showing by the simple substitution of different images. This flexibility of slide presentations perhaps goes some way to explaining the popularity of this medium of communication with the Eameses even after they had mastered the techniques of film production.

The Herman Miller International slide show of the same year also illustrated the spontaneity of the slide presentation process. In 1967 Herman Miller had arranged a coast to coast trip for its overseas licensees. After visiting New York, Chicago and Zeeland they headed West, stopping briefly at Santa Fe to visit Alexander and Susan Girard before heading for Los Angeles (46). Their Westward progress had been secretly recorded on film by Eames Office staff and whilst on a visit to the Eames Office, the group of seventy five people was shown a three screen slide show of 156 images recording the trip and including a meeting at the Herman Miller headquarters in Zeeland, an afternoon in the Girard's adobe house in Santa Fe, and an outing to Disneyland. The
show had no narration or commentary but was accompanied by Sousa's *Stars and Stripes Forever* (47). 1967 also saw the slide show *Picasso* which recorded a one-hour visit by Charles to a Picasso exhibition at MOMA. Charles took all manner of close-ups of Picasso's paintings, sculptures, pottery and collages and produced a three screen 96 slide presentation which was accompanied by a recording of Gertrude Stein reading from her art criticism of the work of Picasso (48).

The most important use of slide presentations occurred in 1970-71 when Charles was appointed Charles Eliot Norton Professor of Poetry at Harvard University. The Professorship was open to any person who had made a significant contribution to the arts (49) and each incumbent had to present a series of lectures open to the entire university. Charles's six lectures, entitled *Problems Relating to visual communication and the Visual Environment*, combined narration, film clips and slide presentations (50). The equipment needed to present these shows was specially manufactured in the Eames Office because nothing suitable was found on the market (51). *Lecture 1* (October 10 1970) was concerned with illustrating beauty in working out problems and combined the showing of moving films such as *Powers of Ten* and *Tops* with images taken from the original 'Lecture 1' of 1945 (52). The highlight of this lecture was the three screen 180 slide presentation *Circus* which marked the first public presentation of the circus photographs taken by Charles from 1948 onwards (53). The slides were accompanied by a variety of circus noises recorded in a big top and recorded music including Fucik's *Entry of the Gladiators* (54). Charles hoped that this first presentation would illustrate that the very freedom and spontaneity
which characterises circus performances were in actual fact the result of rigid discipline (55).

Lecture 2 (November 2 1970) was more autobiographical in content and Charles detailed what he considered the most important influences on his life including his mastery of the wet plate technique prior to his using film (56). This presentation combined films such as Images of the City, 1967, and The Day of the Dead, 1955, with slide shows including a three screen 144 slide presentation entitled Cemeteries which was made up from photographs of gravestones and cemetery statuary from all over the world (57). This presentation was accompanied by the music originally composed by Elmer Bernstein for Dead of the Fifties (58). Lecture 3 (January 14 1971) discussed the positive aspects of dealing with constraints and several short films and extracts were used to illustrate this (59). These film sequences were combined with two slide shows, one of which was Sets which featured objects and concepts which shared a common concept (60). Timgrad was a three screen 66 image slide show which illustrated the ruined city of Timgrad in North Africa, recounted the problems concerning the upkeep of public services during the Roman Empire and aimed to show that little had changed in the administration of cities between 100 AD and 1970 AD (61).

Lecture 4 (March 15 1971) stressed the importance of learning from primary visual sources and included animated sequences from existing Eames films (62). It included two slide presentations; Goods a three screen 33 image of what Charles called 'good old fashioned goods' such as bundles of wood and balls of string and Baptistery a three screen 57
image show of views and details of Florence Cathedral's Baptistery (63). Lecture 5 (March 29 1971) was on the subject of work and was informed by Charles's strong belief in the Protestant work ethic (64). National Fisheries Centre and Aquarium was the film shown and the three slide shows included Tanks, a three screen 117 image record of the marine life kept in the Eames Office during the making of the film (65). Also included in this presentation was a three screen 87 image slide show on the nature of work in India and a three screen 48 image survey of the architectural work of Eero Saarinen (66). The last lecture, given in April 1971, was a resumé of the preceding lectures together with four films and one of the most ambitious slide shows (a three screen 240 image entitled Movie Sets) (67). All the images for the latter were taken by Charles on visits to Billy Wilder's film sets including Irma La Douce, The Spirit of Saint Louis and The Private Life of Sherlock Holmes (68).

MULTI-MEDIA/MULTI-SCREEN PRESENTATIONS

The Eameses' interest in multi-media and multi-screen presentations was influenced by developments in film making and their ideas on education. The increased threat from televisions in the 1950s led many film makers, distributors and cinema owners to experiment with new processes and methods of exhibition, the most famous being 3D and Cinerama, both of which received their first public presentation in 1952 (69). However, the cost of such innovations was prohibitive and the greatest expression of these techniques was in the countless multi-media and multi-screen shows at the numerous World's Fair's held during the 1950s and 60s in
specialy constructed pavilions sponsored by large corporations and the US Federal Government. Associated with this was a movement in the 1950s to free cinema from the dominance of a single rectangular screen. Abel Gance working in the 1920s had been well in advance of the Eameses in this area, incorporating triple-screen effects in his film *Napoleon* of 1922 (70). As already mentioned, the Eameses held strong ideas on education. They disliked the over specialisation inbuilt into the American education system and argued for teachers to make links between subjects. They were also concerned with introducing modern methods of teaching to make lectures more interesting.

The Eameses, in collaboration with George Nelson and Alexander Girard, were the first communicators to present a multi-media presentation combining moving film, slides, music and narration. This took place at the University of Georgia in Athens, Georgia, in 1953 and was entitled *A Rough Sketch For a Sample Lesson for a Hypothetical Course* (71) (Fig. 88). Originally George Nelson had been approached by Lamar Dodd to develop a new approach to teaching within the Department of Art (72). Nelson contacted the Eameses whom he knew to be interested in the communication of ideas and Alexander Girard was also invited to join the group (73). The project, which was eventually funded by the Rockefeller Foundation, involved a multi-media presentation incorporating sound, film, graphic panels, narration and smells - one of the most unusual features of the presentation was the piping of smells such as that of baking bread through the air conditioning vents to accompany the appropriate images (74). The aim was to present new, more effective and
ultimately more economical ways of presenting information to students.

Nelson explained that they were involved in:

"the breaking down of barriers between fields of learning...making people a little more intuitive...increasing communication between people and things." (75)

While the initial costs of the projects were high in terms of making film and buying projectors and screens, the efficiency in the presentation of the information would, the developers argued, make it economically viable in the long run (76). However, the presentation was given only one other showing - at UCLA in May 1953 (77).

The Eameses were amongst the first to develop the idea of multi-screen presentations in the late 1950s. Their first large scale multi-screen presentation was *Glimpses of the USA*, 1959, shown in Moscow at the American National Exhibition in Solanski Park in a geodesic dome built by Buckminster Fuller (78). The exhibition was organised by the United States Information Agency who appointed George Nelson as the overall designer (79). It was Nelson, again, who approached the Eameses; on this occasion to make a film on a typical day in America (80). The show was a technological extravaganza and made use of 2,200 slide and moving images projected on up to seven screens measuring some 20 feet by 30 feet. The complete show lasted thirteen minutes and was shown sixteen times per day during the period of the exhibition (81).

The show was composed of images representing various aspects of American life from meal-times to a clip from Billy Wilder's film *Some Like It*
Hot. The most memorable aspect of the presentation for the ordinary Russian was the ending formed by a single shot of a bunch of forget-me-nots. While some officials had thought it more appropriate to end with the taking off of a jet aeroplane, Ray suggested the show end with a simple touch (82). It was a good choice, because the significance of forget-me-nots as a symbol of friendship and loyalty is the same in both cultures (83).

In 1962 the Eameses produced The House of Science for the Seattle Century 21 World's Fair in a pavilion designed by Minoru Yamasaki (84). For this presentation, which combined animation and live action, projection was directly on to the pavilion wall rather than on to screens, with anything from one to six images being shown at once (85). This presentation acted as an introduction to the US Government's five science pavilions and was divided into two parts. The first, an animated film by Glenn Fleck, illustrated the development of science in terms of an architectural allegory, each field of science being represented by an appropriate contemporary architectural style (86). The film began with the beginings of science in the ancient world and as science advanced and new branches of sciences developed so the buildings divided and changed in architectural style. A collage of buildings representing the entire breadth of modern science ended the first section which was followed by a combination of still and moving images which detailed contemporary scientific thought (87). A film version of The House of Science (14 minutes, colour) was made in 1964.
Their most ambitious multi-screen presentation was Think, shown in the ovoid theatre at the New York World’s Fair of 1964-65 (Fig. 89). The 400 spectators at each showing were lifted into the theatre on the so-called ‘people’s wall’ to see and hear a narrator present animation, still images and film projected on to 14 large and eight small screens, all of different sizes and shapes, the combination of which was arrived at only after much experimentation. The narrator of the show, referred to by the Eameses as ‘the host’ (88), told the audience before the show began:

"Ladies and gentlemen, welcome to the IBM information machine. And the information machine is just that—a machine designed to help me give you a lot of information in a very short time." (author’s emphasis) (89)

The presentation did just that.

Sponsored by IBM, whose motto was Think, the show indicated the main ways the electronic computer could be used in contemporary life. The aim was to show the computer not as a mystery machine but as something which affected everyone. This was communicated by showing the computer in operation and drawing analogies between the computer and ordinary everyday situations. This was a favoured trick of the Eameses in their attempts to demystify this particular machine (see computer films below). This was the last multi-media presentation by the Eameses Office. The Eameses believed that one of the most effectual ways of getting information over was by information overload. This meant the bombardment of the viewer with large numbers of visual detail conveying a single idea or piece of information. The aim had been to convey an
enormous amount of information but, nevertheless, Think was criticised as being overpowering. Mina Hamilton wrote 'the kaleidoscope-like result is overwhelming...but too fragmented to be entirely successful' (90).

Increasingly Charles and Ray came to the conclusion that information could be more successfully disseminated by other means, particularly by using a single screen. Even so, the show had its admirers and there was no denying that the Eameses had achieved a high degree of technological perfection. Their nearest rival at this time was Jordon Belson, who used the multi-media technique in a far freer manner, projecting abstract images through a kaleidoscope on the Morrison Planetarium in San Francisco in the 1960s, and continued to experiment with multi-media work whilst the Eameses turned to other things (91).

FILM

Although the Eameses turned to film making primarily as a way of communicating ideas, their work as film makers was as technologically and aesthetically inventive as any other aspect of their work. They achieved considerable fame and won a wide range of awards both at home and abroad (92). Ray had been interested in films since her student days (93). By the time they arrived in Los Angeles, they both had an interest in still and moving photography. Their move West put them on the edge of the movie world, a world they came to know well, with Charles working in the art department of MGM (headed by Cedric Gibbons) from 1941 to 1942 on films such as Johnny Eager, I Married an Angel, Random Harvest and Mrs Miniver (94). They knew many people associated...
with the film industry, including the movie director Billy Wilder and his wife Audrey, the screen writer Philip Dunne and the film actor and director Charlie Chaplin. Some of Hollywood's best known actors were used by the Eameses as narrators, including Laurence Harvey in House of Science (1964, 14 minutes colour) and Orson Welles The World of Franklin and Jefferson (1976, 28 minutes 20 seconds colour), and Charles's expertise behind the camera was relied upon by Wilder for sequences in his biopic of Charles Lindburg, The Spirit of St. Louis, (Warner Brothers) 1957.

Although they were on the fringe of Hollywood, their moving films were more closely related to, and influenced by, West Coast avant garde film making and also to the expansion of business and sponsored films in the immediate post-war period. The film maker and critic Paul Schrader has categorised the Eameses films into two main types, these being toy films and ideas films (96). These categories are not that rigid because even in the early toy films the Eameses used film to communicate ideas about the toys. At the same time the later ideas films were equally concerned with aesthetics and objects. The Eameses had a variety of direct contacts with the world of experimental film. John Entenza was a central figure in the Los Angeles avant garde and avant garde film making was regularly promoted in the pages of Arts and Architecture (97). In 1957 the Eameses joined up with several other independant film makers to form an exhibition and distribution service exclusively for independent film makers (98).
John Whitney, an avant garde film maker of note, who had a great interest in combining moving forms derived from mathematics with music (99), worked on film production in the Eames Office from 1956-60, contributing to; Toccata For Toy Train (1957, 14 minutes colour), The Information Machine: Creative Man and The Data Processor (1957, 10 minutes colour) and Glimpses of The USA (1959) in particular. After he left the Eames Office he made computer films of his own including Catalog (1961), and Permutations (1968). These form an interesting comparison with the Eames films of a slightly earlier date in that Whitney used computer imagery to create artistic expression rather than to convey ideas about computers. The Eameses in the 1950s, and they and Whitney in the 1960s, were to give computers their distinctive screen expression which held sway for many years. As early as 1953, in A Communications Primer, the Eameses took shots of various parts of computers in close-up, so that the forms of the punch card, keyboards, or the magnetic tape dominated the whole screen, a technique which was used throughout the 1950s and 60s in representations of computers in both film and television.

The Eameses work was decidedly less 'avant garde' in style than their fellow independents and owed as much if not more, to that other burgeoning strand of film, the sponsored business film which flourished in the 1950s and 60s (100). These films were not only an economic success, but were in many cases an aesthetic triumph, particularly the work of the Eameses and Saul Bass. As a type of film making it had a noble history which can be traced back to the sponsored documentary films of Robert Flaherty of the late 1920s (101). During the war, many
Americans had increased their familiarity with film which gave out information and facts rather than told a story and which covered a wide range of war-time subjects, from how to avoid venereal disease to how to keep fit (102). To communicate this information film makers used a variety of new features developed before the war including split screens, diagrams, the combination of animation with live action, and dials and clocks on screen to show the passing of time. These became standard techniques and were used regularly by the Eameses and other film makers in the post-war period. The war-time short films were particularly successful in getting across information and showed a new type of film to vast numbers of people.

After the war a whole range of organisations, from the Federal Government to large corporations such as the Boeing Aircraft Company, Bell System, General Motors, International Business Machine Corporation (IBM), used film as part of their promotion and advertising as well as to convey specific messages. The Eameses made films for the Boeing Aircraft Company, Westinghouse Electric Corporation, the Corporation for Public Broadcasting, Polaroid Corporation, Herman Miller as well as the Federal Government, but the main client for their films, as well as their exhibitions, was IBM. While most sponsored business films were little more than product promotion, the Eameses produced films and exhibitions of a high technological and aesthetic standard on a wide variety of scientific ideas which never referred to specific IBM products. IBM saw this type of 'up-market' company promotion as very important and gave the Eameses a free hand in their film making.
The toy films from Traveling Boy (1950, 11 minutes 45 seconds colour) through Toccata For Toy Train (14 minutes, colour), 1957 to Tops (1969, 7 minutes 15 seconds colour) focus on simple objects in an attempt to communicate to the viewer the visual pleasures found in such objects. All the toys and objects were chosen with extreme care and were all well made objects and reflected values which went back to the Arts and Crafts movement. The Eameses believed in such concepts as truth to materials and honesty of construction and in the opening narration to Toccata For Toy Trains Charles claimed:

"...a moment of object-integrity: all the complexity and variation of tops have resolved into the basic form of two planes, one of them suspended by the balanced forces of gravity and gyroscopic momentum. The unaware viewer realizes that he has never really understood even an insignificant creation like a top, never accepted it on its own terms never enjoyed it." (105)
In the second half of the film, which Schrader referred to as the 'fall of the tops', the tops begin to slow down. Once again the focus is on more elaborate tops, which the Eameses hoped would now be seen afresh.

Many of their ideas films were made to get across an idea or concept to potential customers as with S-73 (1954, 10 minutes 40 seconds colour) which aimed to illustrate the flexibility of the Sofa Compact which was shown being assembled in various situations. Two years later Lounge Chair (1956, 2 minutes 15 seconds colour) elaborated this idea when the Eameses made a short 'fast cut' film of the construction of their Lounge Chair and Ottoman to introduce it on the Today television show. Charles considered this a far better way of publicising the chair than by talking about the design on the air (106). So successful were these films in getting across their messages that Herman Miller went on to commission the Eameses to produce films to promote other furniture designs, from ECS (1961, 10 minutes 30 seconds colour) which illustrated the Eames Contract Storage Units through to Soft Pad (1970, 4 minutes colour).

The Eameses made other films communicating ideas on a wide variety of subjects and for a wide variety of organisations. In 1958, when Eero Saarinen was attempting to sell his idea for the new airport at Washington DC, he turned to the Eameses to produce a short film which would show his proposed design and its advantages over earlier airport buildings (107). The Eameses did this in a short animated film The Expanding Airport (1958, 9 minutes 30 seconds colour). In 1966 the
Boeing Aircraft Corporation commissioned the Eameses to produce a film to sell to the Federal Government their idea for a supersonic transport plane (SST) designed to compete with the Anglo/French supersonic Concorde and the result was The Leading Edge (11 minutes 15 seconds colour) (108). Other corporations which employed the Eameses included Westinghouse (Westinghouse In Alphabetical Order, 1965, 12 minutes colour) and the Polaroid Corporation (SX-70, 1972, 11 minutes colour which documented the development and use of the new polaroid instant camera).

The Eameses most important attempts at communicating ideas by film were both made in the late 1960s, A National Fisheries and Aquarium (1967, 10 minutes 30 seconds) and a Powers Of Ten: A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of the Universe (1968, 8 minutes black and white, later remade in colour in 1977, 9 minutes). The latter was made for the Commission on College Physics and the Eameses always referred to it as a 'sketch film' (109). Influenced by Kees Boeke's Cosmic View: The Universe In Forty Jumps, first published in 1957, they decided to make a film version of it. The film details a journey away from earth to the furthest known point in the universe and back, passing through a human hand to the level of a carbon atom. The camera pulls back at the rate of the power of ten and therefore the viewer travels ten times the distance s/he has travelled in the preceding ten seconds, the journey being measured on a series of dials on the left hand side of the screen. Schrader saw the film as popularizing:

"Post-Einsteninian thought the way the telescope popularised
Copernicus; and the effect is almost upsetting. The spectator is in perspectiveless space; there is no one place where he can objectively judge another place. Just as the vacationing hayseed begins to think of himself as a citizen of the country rather than of the Sioux Centre, and the jet-setter begins to think of himself as a citizen of the world rather than of just the United States, so the time-space traveller of Powers of Ten thinks of himself as a citizen of the universe, an unbounded territory." (110)

In the same manner Schrader was impressed with the film National Aquarium, admitting that:

"To extrapolate an environmental aesthetic from a ten-minute sponsored film like National Aquarium may seem like the height of critical mannerism for some."

(111)

The film was made for the Federal Government, or more precisely the Department of the Interior to put across the idea of an Aquarium in Washington DC and part of a larger campaign which also included models and booklets. As Charles explained:

"Aquarium wasn't a selling job, it was a report. Mike Kerwin, a venerable member of Congress, was interested in this and this was to be Mike Kerwin's monument. But Mike Kerwin didn't have any idea really of what an aquarium should be. As he or someone else said, 'Anything to keep those little children from peeing in the Capitol.' This is about the level these projects get started." (112)

The Eameses threw themselves and the Office into the project with great enthusiasm, studying all aspects and building a model of an aquarium in their office complete with actual specimens (113). The short ten minute film combined stills, moving film and animation. Schrader saw this film as one of the Eameses' greatest at conveying ideas claiming that:

"Even though Congress has yet [1971] to give final approval, the National Aquarium exists. It exists not only to the architects, to whom it always exists, but also
to those who have seen Eames's film." (114)

**Computer films**

The Eameses' films about computers form a distinct group and were part of a wider interest in promoting these new machines (see exhibitions below). In their feature *A Communications Primer* (1953), they were amongst the first to film a functioning computer at a time when the term computer had not even come into common usage. The Eameses went on to make many films on the new computer age, many of which were made for Information Business Machine Corporation (IBM). Eliot Noyes, one of the main champions of the Eameses' work, was head of design at IBM and commissioned the Eameses to make films on a wide variety of computer related topics. The Eames/IBM relationship was very similar to the Eames/Herman Miller relationship in that both were liberal minded and paternalistic firms. The Eameses' view of the computer as a tool for good equated with that of IBM, and therefore IBM could afford to let these creative artists have a free hand.

Their first film for IBM was *The Information Machine: Creative Man and the Data Processor* (1957). This animated film illustrated how the computer had emerged out of centuries of innovation and was an advance on all that had gone before. To show this advance, the Eameses contrasted the ease of problem solving in the present with the solving of problems prior to the computer. *Introduction to Feedback* (1960), originally planned as a sequel to *A Communications Primer*, explained the theory of feedback in the computer by drawing analogies between its use...
in electronic circuits and its use in everyday situations, from a person threading a needle to a young girl in nineteenth century dress playing a game of jacks through to a modern computer (114). Both films illustrated the Eameses' view of the computer as a tremendous technological advance but both attempted to humanise the machines by showing their roots in the past, and the way they corresponded to problem solving in everyday life. Both films won them major awards for their efforts (115).

The Eameses went on to make other films for IBM which promoted this view of the computer, including A Computer Glossary Or: Coming to Terms With the Data Processing Machine (1968, 11 minutes colour) which combined live action and animation. The film was described by Charles thus:

"With a live-action prologue that gives an intimate view of a computer data path, this animated film presents, through computer terminology, some revealing and characteristic aspects of the electronic problem-solving art." (116)

In the same year Babbage's Calculating Machine or Difference Engine (1968, 3 minutes 50 seconds black and white) showed in close-up the only existing Babbage Difference Engine, an early nineteenth century calculator and forerunner of the modern computer (117). The Scheutz Machine (4 minutes 40 colour) of one year earlier showed a variation on Babbage's Difference Engine constructed by two Swedish scientists in 1853 and emphasised the long heritage of the modern computer (118). A Computer Landscape (1971, 10 minutes colour) which complemented their IBM exhibition A Computer Perspective saw the Eameses use the term
landscape in its artistic sense when they showed a wide variety of functioning computers, the people who operated them and the rooms they were installed in (119). Other films were made on the subject of computers for IBM also referred to exhibitions, including A Computer Perspective (1972, 8 minutes colour) and Copernicus (1973, 9 minutes colour) (120).

**FILM MAKING: TECHNIQUE**

As in all areas of their work the Eameses spent a great deal of time perfecting their film technique. The Eameses favoured format for moving film was 16mm (121). The Eameses only turned to moving images in 1950 when their friend, the screen writer Philip Dunne, lent them a 16mm movie projector, while away on location in Argentina, and they rented a camera to make something to show on it (122). 16mm was less expensive than 35mm and easier to work with. It suited the Eameses' needs well, they wanted to produce high quality films without the costs incurred in feature film making. Most of their early films were made in the studio at the Eames House on a large table top. Their rented 16mm camera had no extension lenses and in order to film close-ups Charles made cardboard extension rings and also made editing equipment using plywood reels (123). Their second film Blacktop (1952) was shot by Charles using a hand held 16mm cine special (124). As with Traveling Boy, Blacktop was edited on their home made equipment. Charles used dissolves for transitions between shots and was helped in this instance by Ted Fogelman at Consolidated Film Industries (125).
In 1955 the fast cutting technique developed for the slide shows was utilised in the films *House: After Five Years of Living* (10 minutes 40 seconds colour), *Textile and Ornamental Arts of India* (11 minutes colour) and *Two Baroque Churches* (10 minutes 30 seconds colour). The Eameses were not the only film makers to use this technique (Arthur Lipset *Very Nice Very Nice*, 1950, for the National Film Board of Canada and Chris Marker's short Science Fiction film *La Jetée*, 1962, also used this technique (126)) but they were amongst the first to do so, Michael Brawne has noted that:

"The interesting point about this method of film making is not only that it is relatively simple to produce and that rather more information can be conveyed than when there is movement on the screen, but that it corresponds surprisingly closely with the way the brain normally records the images it receives." (127)

It was because of these very reasons that the Eameses embraced this technique of film making which suited their budget and their desire to communicate the maximum amount of information.

Five years after moving into their house they decided to make a film recording those years. They wanted the viewer to experience their home, as they did and they chose a selection from the vast number of 35mm slide transparencies of their house which were transposed onto film by Parke Meek, a member of their staff (128). The slides were recorded sequentially onto 35mm motion picture film by an animation stop-motion camera which allowed Charles to make fades, dissolves and colour corrections (129). This technique was also used in other films from *Lounge Chair*, (1956), to *The Black Ships*, (1970, 7 minutes 15 seconds)
colour). As in the case of slide shows, its use in film represented an economical yet effective method of film making. This is clearly illustrated by De Gaulle Sketch (1958, 2 minutes black and white) which was made in one week as a demonstration for CBS about the effectiveness of the fast cut technique (130). The film comprises a compilation of images from contemporary French and American newspapers at the height of the Algerian uprising and was later shown on CBS as part of the Fabulous Fifties, a compilation of short Eames films summing up the decade (131).

A Communications Primer (1953) was the first Eames film to combine live action, animation and still photography. This juxtaposition of differing techniques became a standard feature of later Eames films. In the main it was felt that a change in technique, i.e. from still to live action, concentrated the viewers attention. S_73 (1954) combined live action and fast cut, Expanding Airport (1958) combined animation and fast cutting and their Emmy award winning The Fabulous Fifties (1960) combined live action, still photography, fast cutting and animation (132).

During the 1950s the Eameses became increasingly interested in animation and in 1957 produced their first fully animated film, The Information Machine: Creative Man and the Data Processor, with animation by Dolores Cannata and camera work by Parke Meek and John Whitney (133). The drawing talents of Glenn Fleck were also called upon for The Expanding Airport, 1958 and five animated films were made for the Mathematica Peep Shows which formed part of the Mathematica: A World of Numbers and Beyond exhibition of 1961 (134). These were presented in a novel way,
being shown in individual viewing boxes on continuous 8mm loop film.
These proved so popular that the film tended to wear out and they had to
be withdrawn from the exhibition (135). This represented a rare failure
on the Eameses part in the exploration of technology and they solved it
by showing the films in a theatre setting (136).

Other technical innovations included the use of a kaleidoscopic lens, as
in Kaleidoscope Shop (1959, 4 minutes colour) and Kaleidoscope Jazz
Chair (1960, 6 minutes 30 seconds colour). During the 1960s and 70s
they developed very sophisticated equipment including a computer managed
motion control system, devised by staff member Bill Tondreau, which
allowed a camera to move more smoothly and zoom in and out of the image
on a slide transparency (137). This was used in Cezanne: The Late
Work With Quotations From His Letters and Reminiscences (10 minutes
colour) and Degas in the Metropolitan (10 minutes colour), both of 1978.

FILM MAKING: AESTHETIC

Although Charles shot the films the aesthetic of all their films derived
from Ray's talents as visualiser. Not only could Ray mix and match
objects creating wonderful juxtapositionings but she had a wonderful eye
for detail. It was Ray's eye for detail which makes the look of the
Eameses film so striking, even in films about computers and science,
subjects not normally considered to be of great aesthetic appeal.

The toy films are marked by wonderful combinations of objects and the
focus of the films was the nature of the objects themselves. Most of
their toy films represented the Eameses concern with 'object integrity'; indeed, it was here, that the Smithsons felt it was most manifestly expressed. Writing about the Eameses aesthetic, Peter Smithson claimed:

"It is a special way of looking at things, a special sort of composition. It communicates a love of the objects photographed, a kind of reverence for the object's integrity" (138)

This quality was firmly established in their very first toy film, *Traveling Boy*, 1950. In this the Eameses used a wide variety of toys which they had collected, including Polish toys bought in Chicago and Oriental dolls acquired in Los Angeles's Chinatown (139), and set them against a background of drawings by Saul Steinburg and a set made up of a collection of sea shells, rocks and tumbleweed (140). The colours harmonised with reds, oranges and black dominating, and a similar colour scheme and look was achieved two years later in *Parade:or Here They Come Down Our Street*, which used a wide variety of toys acting out a parade against a townscape drawn by Sansí Girard (141) (Fig.91). Two later films continued the use of mechanical toys, namely *Toccata For Toy Train*, 1957 and *Tops*, 1969, the first being a film about toy trains and the second a film about all manner of tops.

The circus in which both Charles and Ray had long been interested, and a visit by the Sumo wrestler Jesse Takamiyama, also proved source material for the Eameses; *Clown Face* (1971, 16 minutes colour) illustrates the art of clown makeup while *Sumo Wrestler* (1972, unfinished), illustrates the preparation of the hairstyle of a Sumo wrestler (142). The Eameses interest in folk art was expressed in their film *Textile and Ornamental*. 

-286-
Arts of India (1955, 11 minutes colour) a record of Alexander and Susan Girards' exhibition at MOMA of the same year (143). A similar delight in another culture is seen in Day of the Dead (1957, 15 minutes colour), made in association with the Museum of International Folk Art, Santa Fe. The film focused on the images of the 'El Dia de Los Muertos' celebration and was a suitable subject for the Eameses who delighted in the colourful richness of the craft based nature of the folk art used in this traditional Mexican day of celebration.

Not all the Eameses films dealt with subjects so obviously aesthetically rich. Many of their films focused on subjects such as early American history, computers and scientific personalities and concept. In terms of the computer films, which showed machines which threatened to transform peoples day-to-day lives, these machines were photographed with images of hearts and flowers in order to humanise them, as in A Communications Primer, 1953, and The Information Machine, 1957 (Fig.92). Even in Powers of Ten, 1968 and 1977, the attention to detail is supreme with the arrangement of the picnic which appears at the start of the film and reappears midway through the film, suggesting the hand of Ray in the careful arrangement of a basket of fruit (Fig.93). This added a vital human small scale touch to a film dealing with reaching out as far into 'infinity' as one could at the time. In films like Copernicus, 1973, which was a short overview of the astronomer's life and work based on an exhibition of the previous year, the Eameses went to great lengths to film actual objects used by Copernicus as well as the places he lived (144). Nevertheless in the final analysis it was their love of
communicating ideas which made and continues to make their work in film so interesting.

EXHIBITIONS

The Eameses also used exhibitions in order to communicate ideas and information. Their early exhibitions were concerned with promoting Modern design, particularly their own furniture. For instance, the New Furniture Designed by Charles Eames exhibition (1946) at MOMA attempted to communicate not only the technological advantages of Eames furniture in a series of information panels designed by Herbert Matter, but show the items in domestic and office settings. This approach characterised all their early exhibition designs whether held in a department store or museums (145).

In all their exhibitions they used the latest technology and modern materials including plywood for exhibition stands and perspex for display cases. They also introduced several innovations into exhibition design including the timeline, image wall and displays the visitor could use. The timeline was one of the Eameses' most important contributions to the communication of ideas and exhibition design. It mapped out a narrative, such as the history of modern India or the history of mathematics, and provided essential background information to particular exhibitions (Figs. 94-95). It also acted as a visual representation of the passing of time and each decade was usually marked at the top of the timeline to indicate this and a collage of images, including buildings, art works, personalities and events were used to trigger off in the
viewer's mind a series of connections related to the main narrative of
the timeline. The Eameses used these timelines in many of their
exhibitions, where they were often referred to as the history wall, but
their most innovatory use was in the Computer Perspective exhibition of
1971 which included a 3-dimensional timeline with actual objects pinned
to it (146) (Fig. 96). The image wall was a similar device which allowed
the display of a large number of images.

The Eameses were amongst the first to emphasise a hands-on approach and
many of their exhibitions included areas where visitors could use the
latest IBM machines and specially constructed machines which explained
complex scientific theories. The 1961 exhibition Mathematica: A World
of Numbers and Beyond, which occupied some 3,000 square feet, for
instance, combined traditional exhibition items such as cases containing
artifacts as well as more up-to-date 'interactive displays' designed by
Charles with the help of Gordon Ashby (147). The latter were placed in
the centre of the exhibition and quotations were written on boards
suspended from the ceiling whilst the two side walls formed the history
wall and image wall.

The Eames Office combined forces with that of Eero Saarinen on the IBM
exhibit at the 1964 World's Fair in New York where the Eames exhibition
was located in the pavilion designed by Saarinen (148). The Eameses had
visited Copenhagen in 1959 and had greatly admired the Tivoli Garden ('a
magical enchanting atmosphere of play and relaxation for all ages') and
the starting point for their IBM pavilion was the atmosphere at this
pleasure garden (149). The exhibition contained elements of the
Mathematica exhibition, a typewritter bar where visitors could try out the latest IBM machines and a scholars' walk containing additional information about computers, but the whole exhibition was dominated by the multi-media presentation *Think* (discussed above). Other innovations included in this exhibition were two computer controlled puppet shows one of which, The Singular Case of the Plural Green Mustache, featured Sherlock Holmes attempting to solve a mystery by his usual process of deduction and then by Boolean logic (a method used in the programming of digital computers) (150). The show was designed to illustrate the supremacy of the computer in this matter, as was Computer Day at Midvale which showed the installation of the first computer at the mythical middle American town of Midvale (151).

The premise was that the solving of problems by computer was no different to the solving of problems by humans doing everyday tasks. This was a simple but effective way of presenting the computer yet, in a way, it was a dangerous analogy, because it suggested that humans had nothing to fear from these machines. In their book based on the Computer Perspectiva, exhibition of 1972, the Eameses had a section entitled 'Dark Visions of Machines' which illustrated scenes from Fritz Lange's film Metropolis, 1927 and a copy of E. M Forster's short story *The Machine Stops*, which presented a terrifying world dominated by machines but this stood in contrast to the progressive aspects of the machines emphasised by the Eameses (151). The other striking feature in this particular exhibition was the use of decoration. What is commonly referred to as 'Americana' was used to decorate the exhibition.
as a veritable State Fair of stars and stripes and red white and blue bunting which echoed the St. Louis World's Fair of 1904. Even the famous IBM logo was given a nostalgic treatment. The Eameses exhibition aesthetic closely followed their interior design aesthetic and film aesthetic in that they humanised the exhibition spaces by the addition of plants, flowers and folk art. With their later exhibitions some felt the Eameses had gone too far, particularly in their series of exhibition on scientific themes and personalities of the early 1970s. For example *Issac Newton*, 1973 saw IBM's New York headquarters turned into an 'olde English Christmas fayre', with the gallery decked out with holly and mistletoe and plum puddings (152).

**Later Exhibitions**

*Nehru: His Life and His India*, 1965, was, as were most of the later exhibitions, designed to travel - in this case to Europe and India where it is still touring today (153). Once again, the Eameses combined original artifacts, photographs and text. Although reflecting the latest concerns about exhibition design with its notable absence of showcases and its use of modern materials, the exhibition used stands made from indigenous Indian woods and constructed using traditional Indian methods of manufacture (154). In this, as in all the later exhibitions, the 'modern' aspects were tempered not only by the non-modern nature of many or all of the artifacts on display, but by flowers and plants and other novelty items. All the later exhibitions were characterised by the use of the open plan, and utilised knock-down
frame which not only included the display panels but also the track lighting and often the floor covering (155).

The Eameses' most ambitious exhibition was *The World of Franklin and Jefferson* which toured both Europe and America, and was designed to commemorate the two hundredth anniversary of the American Revolution. Commissioned by the United States Information Agency (USIA) in 1972 to design an exhibition on Thomas Jefferson for the bicentennial celebrations in 1976, the Eameses widened the brief to include Benjamin Franklin, another of the Eameses' most favoured historical personalities (156). The exhibition reflected the liberal rational view of the world that Jefferson, in particular, believed in and was criticised for ignoring the darker side of American history, particularly the question of Westward expansion and its consequences for Native Americans, and promoting a white liberal view of history (157).

The exhibition made use of modern exhibition technology such as blown-up photographs and text, laminated plywood display columns and perspex cases for rare artifacts. The exhibition also used original artifacts including some of Paul Revere's silver, Franklin's scientific instruments and a stuffed bison (158). The exhibition was divided into four main sections, firstly 'Friends and Aquaintances' which looked at the circle of friends around Franklin and Jefferson, secondly 'Contrast and Continuities' which described the lives of Franklin and Jefferson, thirdly 'Three Documents' which examined the two men's role in creating the declaration of independence, the constitution, and the bill of rights and finally a section which looked at the role of Jefferson in Westward
expansion. The exhibition included a timeline and also reflected the Eames's taste for Americana in the form of red white and blue bunting proclaiming some of Jefferson and Franklin's most famous speeches and quotes.

BOOKS, CATALOGUES AND TIMELINES.

To promote new ideas and reinforce those ideas already expressed in film and exhibition design, the Eameses also made extensive use of books, catalogues and timelines. Individual timelines were produced including Men of Modern Mathematics, 1966 and A Pictorial History of Herman Miller, 1967 (159). Important ideas were also communicated in books, mostly produced to accompany exhibitions such as A Computer Perspective, 1973 or, in the case of Powers of Ten, as a development from a film (160). The books approached their subject matter in the same way as did the films and exhibitions with each page divided into several sections. The main part of each page was taken up by the main feature, either text or images, while the top and bottom sections contained anecdotes and additional information which, while not bearing directly on the main narrative, increased the reader's knowledge of the subject. In a way these were like footnotes but, by being placed at the top and bottom of the page, they allowed the reader easy access to them. This method of presentation was used by the Neuharts and Ray Eames in their Eames Design (1989).

-293-
INFORMATION CENTRES

Another outlet for their interest in communications was centres for the distribution of information, the germ of which can be traced back to Charles Eames and John Entenza's entry for Architectural Forum's City Plan competition of 1943 (161). The Eameses' earliest expression of this idea was their entry for the Jefferson National Expansion Memorial Competition, 1947 (162). The jurors wanted a memorial that simply commemorated a historical figure but the Eameses wanted it to be more than that and proposed a centre in which the values and ideas of Jefferson lived on. Charles referred to their proposed amalgam of library, museum and printing plant as an 'information centre, to stimulate, to inform and to involve the people in activities that, springing from them, create the social environment' (163).

The Eameses idea of information centres worked on two levels. Firstly it provided information to visitors in large institutions such as the Metropolitan Museum of Art (their 1975 film Metropolitan Overview suggested the need for an 'information hall' to help visitors come to terms with the large scale of the institution). Secondly, it was concerned with helping institutions get information about their products or exhibits over to the visitors.

Their concern with such information centres developed during the 1960s when the Office worked on a variety of proposals for several institutions which both stored and passed on information. The National Aquarium Proposal 1966-69, involved graphic panels, a film and a booklet
explaining how the Aquarium would process information to the public (164). At the same time, they were concerned with developing a museum and exhibition space at IBM's new headquarters at Armonk, New York, to give:

"a fresh look at those historic objects and events that helped place the computer in terms of our changing culture... Ideally it would be housed in a beautifully equipped loft space with the mood of a working laboratory, where visitors could feel that they were being let in on the experience." (165)

Nine years later they developed this idea in the IBM 590 Corporate Exhibition Centre in IBM's Manhattan premises. Built on three levels, the proposal included aspects of all the Eameses' previous projects for IBM, including updated *Mathematica* and *Computer Perspective* exhibitions. There was also an 'Information Access' area where visitors could try the latest IBM machines. Other rooms were designated as library, seminar room, and theatre for films and plays, all geared to promoting the computer. Most of the information centres remained no more than ideas but they remain important examples of how the Eameses attempted to combine the many aspects of their interest in communications to produce centres concerned with the handling of information and the promoting of ideas.
Footnotes

(1) Degener, P. 'Masks and Marvels From The Eames Team', Saint Louis Post Dispatch, 8th September, 1977, p.11B.


(5) ibid.

(6) See Fiske, J. Introduction to Communication Studies, 1982, p.2. Shannon and Weaver were the founders of the process school of communication which was concerned with the transmission of messages (the other strand, referred to as the semiotic branch, deals with how messages interact with people in order to produce meanings).


(8) Wiener's theories were published in Cybernetics or Control of Communication in the Animal and the Machine, Cambridge, Massachusetts, 1949.


(10) Other models included those by George Gerbner (1956) Laswell (1948) and Newcomb (1952).

(11) Fiske, J, op.cit, p.10.

(12) Shannon, C and Weaver, W, op.cit, p.9.

(13) Fiske, J, op.cit and Hinde, R, op.cit.

(14) Schrader, P, op.cit, p.9.

(15) ibid, p.9.


(19) Eames and Neuhart, op.cit, p.51.
(20) ibid, p.51.
(21) ibid, p.51.
(22) ibid, p.51.
(23) ibid, p.51.
(28) Eames and Neuhart, op. cit., p.185.
(29) Author's interview with Ray Eames, Los Angeles, July 1986.
(30) Eames and Neuhart, op. cit., p.186.
(31) ibid, p.186.
(32) ibid, p.186.
(33) ibid, p.186.
(34) ibid, p.186.
(35) ibid, p.186.
(36) ibid, p.186.
(38) ibid, p.202.
(39) ibid, p.267.
(40) Ray Eames interview July 1986.
(41) Eames and Neuhart, op. cit., p.257.
(42) Author's interview with John Neuhart, Los Angeles, July 1986.
(43) Eames and Neuhart, op. cit., p.319.
(44) ibid, p. 319.
(45) ibid, p. 319.
(46) ibid, p. 321.
(47) ibid, p. 321.
(48) ibid, p. 329.
(49) Correspondance with Z. Maynard, Reference Librarian, Harvard College Library, April 1986.
(50) Eames and Neuhart, op.cit, p. 355.
(51) ibid, p. 355.
(52) ibid, p. 356.
(53) ibid, p. 91. Charles was made an honorary member of the faculty of the clown college run by Ringling Brothers and Barnum and Bailey's Circuses, in 1971 they made a film on the subject of clown makeup, Clownface, (16 minutes, colour).
(54) ibid, p. 356.
(56) Eames and Neuhart, op.cit, p. 357.
(57) ibid, p. 357.
(58) ibid, p. 357.
(59) ibid, p. 358. The extracts were from De Gaulle Sketch, Symmetry from Mathematica PeepShows, Music of the Fifties from The Fabulous fifties, 'The Dinner party Sequence' from Think as well as Introduction to Feedback.
(60) ibid, p. 358.
(61) ibid, p. 358.
(62) ibid, p. 359 the extracts included; House of Science, The Lick Observatory and A Small Hydromedusan: Polyorchis Happlus
(63) ibid, p. 359.
(64) ibid, p. 360.
(65) ibid, p. 360.
(66) ibid, p.360.


(68) ibid, p.362.


(70) Gance also experimented with colour and 3D effects in this film, Mast. G, op.cit, p.196

(71) The presentation was entitled Art X by Nelson, although the Eameses never referred to it as such. Eames and Neuhart, op.cit, p.177.

(72) ibid, p.177.

(73) ibid, p.177.

(74) ibid, p.177.

(75) cited in Eames and Neuhart, op.cit, p.177.


(77) Eames and Neuhart, op.cit, p.171.

(78) ibid, p.239.


(80) Eames and Neuhart, op.cit, p.239.

(81) ibid, p.239.

(82) ibid, p.241.

(83) ibid, p.241.

(84) ibid, p.273.

(85) ibid, p.271.

(86) ibid, p.271.

(87) ibid, p.273.

(88) ibid, p.287.

-299-


(92) See chapter 1. footnote 2.

(93) Ray Eames interview 1986.

(94) Eames and Neuhart, op. cit, pp. 27-28.

(95) Charles was in charge of the second unit and produced a montage to link the various sequences of the film together, ibid, p. 210.


(102) During the war there was a veritable explosion in documentary film making.

(103) Opening narration for Toccatta For Toy Trains, 1967.

(104) Ray Eames interview 1986.


(108) Eames and Neuhart, op. cit, p. 309.


(110) Schrader. P, op. cit, p. 11.

(111) ibid, p. 13.

(112) ibid, p. 12.
(113) Eames and Neuhart, op. cit, p.326.

(114) Scharder, P, op. cit, p.12.


(116) Schrader, P, op. cit, p.12.

(117) Eames and Neuhart, op. cit, p.326.

(118) ibid, p.320.

(119) ibid, p.370.

(120) Both were based on exhibitions see below.


(123) Eames and Neuhart, op. cit, p.135.

(124) ibid, p.163.

(125) ibid, p.167.


(127) Brawne, M, op. cit, p.452.

(128) Eames and Neuhart, op. cit, p.199.

(129) ibid, p.199.

(130) ibid, p.234.

(131) Eames and Neuhart, op. cit, p.244.

(132) Including Gifts From The Sea, Music of The Fifties, De Gaulle Sketch, Dead of The Fifties, Comics of The Fifties and 'Where Did You Go?', 'Out', 'What Did You Do?', 'Nothing'.

(133) Eames and Neuhart, op. cit, p.223.


(135) Eames and Neuhart, op. cit, p.261.
(136) ibid, p.261.
(137) ibid, p.448.


(139) Eames and Neuhart, op.cit, p.135.
(140) ibid, p.135.

(141) The five year old daughter of Alexander and Susan Girard.

(142) Eames and Neuhart, op.cit, p.357.
(143) ibid, p.201.

(144) Based on a 3 screen slide presentation shown at an international symposium celebrating the 500th anniversary of Copernicus's birth.

(145) Including displays for Carson Pirie Scott (1950), Macy's (1951), Detroit Institute of Arts (1949) and MOMA (1950).

(146) Eames and Neuhart, op.cit, pp.361-69.
(147) ibid, pp.255-59.
(148) ibid, p.285.
(149) ibid, p.267.
(150) ibid, p.287.
(151) ibid, p.287.

(152) Eames C & R, A Computer Perspective: Background to the Computer Age, op.cit, pp.100-01.
(153) Eames and Neuhart, op.cit, p.407.

(154) Author's interview with J.A. Panshall, Leicester, March 1986.


(159) Eames and Neuhart, op.cit, p.418.
(160) The Neuharts used a timeline to contextualise the Eameses work in their Connections exhibition catalogue, 1976.

(161) A Computer Perspective Background To The Computer Age
Powers of Ten About The Relative Size of Things In The Universe

(162) Eames and Neuhart, op.cit, p.37.

(163) ibid, p.85.

(164) ibid, p.85.

(165) ibid, pp.315-17.

(166) ibid, p.329.
Conclusion

The work of Charles and Ray Eames represented a very close collaboration of two extremely talented designers over a thirty eight year period. This chapter examines the findings of each of the preceding chapters in relation to that collaboration, the extent to which their work was original in aesthetic and technological terms and whether or not there were any common threads or themes to the wide range of work undertaken by them.

Both Charles and Ray came from different creative backgrounds and brought their own expertise to bear on their joint works. As shown in chapter 1 Ray was a well rounded Modernist by the time she enrolled at Cranbrook whereas Charles's work was more eclectic in form and style at that date. By 1940 Ray had been associated with the New York avant garde art scene for several years and was right at the forefront of Modernism. She was a member of both the American Abstract Artists and Hans Hoffmann's school, had also taken part in several group showings of Modern art and had involved herself in protests against the New York artistic establishment which did little to promote Modernism. By contrast, as also shown in chapter 1, Charles's work was more eclectic in nature ranging from the Colonial Revival through work influenced by Eliel Saarinen to the production of topographical watercolours. By the time they met, Charles was increasingly coming under the spell of the Modern Movement. Nevertheless, as detailed in chapter 1, Ray was by 1940 the most 'advanced' of the two, a position which does not sit
comfortably with the usual notion of Ray as the wifely advisor on colour and form in contrast to Charles the Modernist architect.

Ray's considerable input into their joint works was detailed in chapters 2, 3, 4 and 5. Her particular contribution lay in the area of aesthetics, particularly form, structure, colour and interior arrangements. Ray had a wonderful 'eye' and was in the main responsible for giving the Eameses' work its distinctive look. Her vital contribution in these areas is seen in their distinctive use of organic forms in furniture design, the bold use of colour on the facade of their own home, and their distinctive interior and exhibition schemes. But Ray's contribution was not simply confined to aesthetics; she also played a part in the utilisation of new materials and technologies in the early years of the partnership. As demonstrated in chapter 3, Ray was equally involved in the development of the plywood undertaking, if not more so than Charles who in the early days, worked full time for MGM. Similarly as shown in chapter 2, her architectural drawings for the Eames and Wilder Houses indicate a considerable input on these two designs.

However by and large, the technological innovations seem most often to have originated with Charles, with their development in the main being undertaken by him or Eames Office staff. Charles was also mainly responsible for ideas and concepts and the choice of subjects for films and exhibitions in the main, as detailed in chapter 6 seem to have come from him. Charles was also in charge of the day to day running and administration of the Eames Office, a task which Ray had little interest.
in. Yet, after Charles's death in 1978, Ray kept the Office going in a limited manner until her death exactly ten years later.

The Eameses' work was as inventive in aesthetic terms as it was in the application of new technologies. The Eameses did not have a single mode of aesthetic expression but utilised a number of aesthetic forms. The architecture of the Eames House was at the time seen as aesthetically novel but as shown in chapter 2 their architectural work was strongly influenced by the forms of the early Modern Movement in general and the work of Mies Van der Rohe in particular. The most innovative aspect of their architectural aesthetics was their use of a De Stijl inspired colour scheme on the facade of their own home and to a lesser extent on the Entenza House. In contrast the Eameses' interior design aesthetic was more original and saw the reintroduction of decorative objects into interior design. Their distinctive interior design aesthetic was not only found in their own home but in their interior schemes for the Herman Miller Furniture Company executed during the 1950s and 60s which were greatly admired by a large number of people and helped to popularise this style. These interiors stood in opposition to the minimalist spaces so beloved by the International Style Modernists, the Eameses work in this field was one of addition as opposed to reduction.

In terms of furniture design their work was characterised by two diverse aesthetics, namely Organic Modernism and Miesian 'hard edged' Modernism. The former was given expression in their plywood, glass reinforced plastic and bent wire seating. Although their forms were seen in some quarters as new and exciting, the use of organic forms was in itself not
that original, although the Eameses particular expressions were. As shown in Chapter 1, 3 and 4, their preference for this style was part of a wider taste for organic forms which had developed during the late 1930s under the influence of Alvar Aalto and Surrealism and flourished in post World War Two America. As shown in chapter 5 the Eameses Miesian 'hard edged' aesthetic for metal furniture relied heavily for aesthetic direction on the precedent set by the early Modern Movement. In the final analysis the Eameses utilised what were the two standard aesthetic forms of mid-century Modernism ie. Organic Modernism and the Miesian 'hard edged' Machine Aesthetic. Nevertheless, as shown in chapter 3, the utilisation of organic forms as represented by the DCM Chair (1946) was highly original and differed from the somewhat exaggerated and awkward forms given to furniture by other designers including Charles Eames himself when he worked in collaboration with Eero Saarinen in 1940.

In the area of communications their distinctive aesthetic was manifest in the juxtapositioning of a variety of contrasting images, and was perhaps given its greatest expression in their computer films and exhibitions in which they illustrated these machines side by side with hearts, flowers and stars in an attempt to humanise and make these machines appear less frightening. They also used different media to create aesthetic contrasts including combining animation and live action. The also made a distinctive feature of visual excess, as clearly expressed in their later exhibition designs which were significantly different from the white walls and uncluttered displays so beloved by MOMA and other institutions promoting Modernism.
The Eameses were equally inventive in their use of new materials and technologies. At the time critics praised this aspect of the Eameses' work, even though as shown in chapter 3 the technological innovations did not always work in a mass production context. In architecture they were amongst the first to utilise pre-fabricated steel frames designed for light factory units in a domestic context. While Neutra's Lovell Health House, Los Angeles, 1929, had preceded the Eameses' work by twenty years, the frame for the earlier house was specially manufactured for the job and not obtained 'off the peg' like that of the Eames House.

With regard to furniture, they were amongst the first to successfully machine mass produced compound moulded plywood furniture and fibreglass pieces. They introduced a host of new ideas into furniture production ranging from new wood colouring techniques to the application of shock mounting to furniture mass production. As shown in chapter 3 they were not the first to mould plywood through 3 dimensions but they were the first to bring this technique to the mass production stage. As shown in chapter 4 they were not the first to produce a chair in glass reinforced plastic, but they were the first to produce a plastic chair which honestly expressed the nature of the material. Nevertheless they had some technological failures and perhaps the most dramatic of these was the problems associated with the cycle weld technique. It was hoped this process could be utilised to secure the rubber shock mounts to their furniture. Yet even after many years of experimentation the process was never successfully mastered and in the main the Eameses relied on the utilisation of strong synthetic glues.
Their work as communicators was also characterised by the mastery of new techniques and the development of new technologies. They were amongst the first to use fast cutting in their slide and film shows. Together with George Nelson and Alexander Girard, they were the first to present a multi-media show in 1953 at the University of Georgia, Athens, Georgia. They were also amongst a group of film makers pioneering multi-screen shows in the late 1950s and 1960s. In the early days Charles was particularly inventive in his adaption of their limited facilities to the production of film, yet, in the main they used standard film making equipment. The major contribution to film technology by the Eames Office, was the development of the computer managed motion control system developed in the mid 1970s by Bill Tondreau.

Given the length of time that the Eames worked together, it seemed likely that there would be some recurrent themes in their work but this is not always immediately discernable because of the variety of media in which they worked. The main area of common concern was their love affair with technology. The Eameses always utilised new technologies and materials and they always spoke and wrote as 'functionalists'. Their interest in new technologies and materials has been detailed earlier in this conclusion but it was felt in all areas of their work.

The second concern which is central to their work is the humanising of what was regarded as the cold and inhuman aspects of Modernism. In architecture, however, apart from the addition of De Stijl-type facades to certain buildings, there was little or no 'softening' of the machine
aesthetic. It was mainly in furniture design that the influence of Alvar Aalto and Organic Modernism was felt. In interiors and exhibitions the machine aesthetic aspects of 'Modernism' were 'softened' and humanised by the addition of objects - including toys and ceramics. Colour, 'cultural surprise' and visual pleasure were the results in design schemes whose influence on subsequent design has not been sufficiently appreciated. In films, the humanising of the 'cold' and 'inhuman' is best seen in the computer films where hearts and flowers proclaimed a 'non-rational' emotional and human dimension to the ways in which the new world of the computer should be approached. Over the years their involvement with communications increased, as illustrated by their work in film, multi-media, multi-screen and exhibition design. The Eameses had always been interested in getting over ideas and information and from the 1950s this was a common thread running through film, multi-media, multi-screen, exhibition design, books and information centres.

Over forty years their partnership made a considerable impact on design, not only in USA and Europe but also in other parts of the world. Charles and Ray Eames influenced many young designers, particularly in the fields of furniture design and exhibition design and continue to do so today when once again Organic Modernism is in vogue and 'Post Modernism' applauds the plethora of materials and images offered by the Eameses.
Fig. 1. Photographs of Charles and Ray Eames c1941-76.
Fig. 2. 335 Bristol Place, Webster Grove, Missouri, 1933, Gray, Eames and Pauley.

Fig. 3. 101 Mason Avenue, Webster Grove, Missouri, 1933, Gray, Eames and Pauley.
Fig. 5. Skyscraper, Saint Louis. Lithograph, c1927, Charles Eames.
Fig. 6. Town Gate Amberg, pen and ink, 1929, Charles Eames.

Fig. 7. Nude, pen and ink, c1935, Ray Kaiser.
Fig. 8. St Mary’s R.C. Church, Helena, Arkansas, 1935, Eames and Walsh.

Fig. 9. St Mary’s R.C. Church, Helena, Arkansas, 1935, West Front, Eames and Walsh.
Fig. 10. Meyer House, Huntleigh Village, Missouri, 1936-38.

Fig. 11. Table for Meyer House, 1936-38, designed by Charles Eames, manufactured by John Rausch.
Fig. 12. *Pompeii*, oil on canvas, 1959, Hans Hofmann. (Tate Gallery, London).

Fig. 13. *Composition with Yellow*, oil on canvas, c1944, Ray Eames. (Exhibited Los Angeles Museum 1944).
Fig. 14. Cover design for *Californian Arts and Architecture*, December, 1942, Ray Eames.
Fig. 15. Collage, *Arts and Architecture*, September 1943, Ray Eames.

Fig. 16. *Dot Pattern*, c1950, with Ray Eames.
Fig. 17. Sea Thing, (also called Brown and Black Free Shapes on a White Ground), textile design 1945, Ray Eames.

Fig. 18. Carl Milles, Meeting of the Rivers, Aloa Plaza, Saint Louis, 1933-40. The basin was designed by Charles Eames.
Fig. 19. Case Study House 11, 1946, J. R. Davidson.

Fig. 20. Case Study House 20, Bailey House, 1947, Richard Neutra. Built on the same site as the Eames and Entenza Houses.
Fig. 21. Case Study House 14, Greenbelt House, 1945, Ralph Rapson.

Fig. 22. Case Study House 22, 1959-60, Pierre Koenig.
Fig. 23. Case Study House 14, Greenbelt House, 1945, Ralph Rapson.

Fig. 24. Eames House, model of original bridge plan, 1945, Charles Eames and Eero Saarinen.
Fig. 26. Plan of the site of the Eames and Entenza Houses showing the relative positions of the two houses.
Fig. 27. Eames House designs Arts and Architecture, December 1945.
Fig. 28. Eames House, interior arrangement. *Arts and Architecture*, December 1945.

Fig. 29. Eames House, view from facade.
Fig. 30. Eames House living block looking from meadow.

Fig. 31. Eames House living block looking from studio block.
Fig. 32. Eames House studio block from living block.

Fig. 33. Eames House front facade of living block.
Fig. 34. Eames House corner of living block.

Fig. 35. Eames House living room looking towards the seating alcove.
Fig. 36. Eames House staircase, note the cherub.

Fig. 37. Eames House window showing reflection of eucalyptus trees.
Fig. 38. Eames House doorbell.
Fig. 39. Entenza House, model, 1945, Charles Eames and Eero Saarinen.
Fig. 40. Entenza House, original designs published in *Arts and Architecture*, December 1945.
Fig. 41. Entenza House, plan of interior arrangement.
Fig. 42. Entenza House, design for front facade, Charles Eames and Eero Saarinen, 1945.
Fig. 43. Entenza House facade shortly after completion.

Fig. 44. Entenza House, interior view looking towards the fireplace.
Fig. 45. Entenza House, interior.

Fig. 46. Entenza House, interior.
Fig. 47. Herman Miller Showroom, Los Angeles, facade, Charles and Ray Eames, 1948.

Fig. 48. Herman Miller Showroom, side view.

Fig. 49. Herman Miller Showroom, entrance.
Fig. 50. Poster for the Organic Design in Home Furnishings Competition, 1940, E. McKnight Kauffer.
Fig. 51. Furniture for the *Organic Design in Home Furnishings* Exhibition, MOMA, 1941, designed by Charles Eames and Eero Saarinen.
Fig. 52. Relaxation Chair entered for the Organic Design in Home Furnishings Competition, MOMA, 1941, designed by Charles Eames and Eero Saarinen.
Fig. 53. 'Ala Kazam', moulding machine developed c1941 by Charles and Ray Eames.
Fig. 55. Moulded plywood splint c1942, developed by Charles and Ray Eames and other members of the Plyformed Wood Company.

Fig. 54. Moulded plywood sculpture c1943, Ray Eames.

Moulded plywood stretcher c1943, designed by Charles and Ray Eames and other members of the Molded Plywood Division.

Fig. 57. Experimental plywood chairs c1944, designed by Charles and Ray Eames and other members of the Molded Plywood Division.
Fig. 58. Armchair utilising shock mounting developed c1952 by Cristiani and Fratino.

Fig. 59. Child's chair, 1945, designed by Charles and Ray Eames.

Fig. 60. Plywood elephant, 1945, designed by Charles and Ray Eames.
Fig. 61. DCM/LCM chairs, 1947, Charles and Ray Eames.

Fig. 62. DCW/LCW chairs, 1945, Charles and Ray Eames.
Fig. 63. DCM chair, circular moulded plywood coffee table, plywood folding screen, photographed by Charles Eames c1950.
Fig. 65. Womb chair, 1948, Eero Saarinen.
Fig. 66. GRP armchair shells designed by Charles and Ray Eames, developed by the Eames Office, manufactured by Zenith Plastics, Gardena, California.

Fig. 67. GRP armchair, arranged by Ray Eames and photographed by Charles Eames.
Fig. 68. GRP rocker, 1950, Charles and Ray Eames.

Fig. 69. La Chaise, 1948, Charles and Ray Eames.
Fig. 70. GRP side chair, 1950, Charles and Ray Eames.

Fig. 71. Upholstered GRP armchair and rocker, 1951, Charles and Ray Eames.

Fig. 72. Loose cushion armchair, 1971, Charles and Ray Eames.
Fig. 73. GRP stacking chair and trolley, 1955, Charles and Ray Eames.
Fig. 74. La Fonda del Sol side chair, 1961, Charles and Ray Eames.

Fig. 75. ETR (elliptical table rod base), 1951, Charles and Ray Eames.
Fig. 77. Bent wire chair showing angular spacing of the wire.

Fig. 78. Bent wire chair with attached upholstery pads.
Fig. 79. ESU (Eames storage units), 1950, Charles and Ray Eames.

Fig. 80. ECS (Eames contract storage), 1954, Charles and Ray Eames.
Fig. 81. Sofa Compact, 1954, Charles and Ray Eames.
Fig. 82. Aluminium chair and ottoman, 1958, Charles and Ray Eames.
Fig. 85. Chaise, 1968, Charles and Ray Eames.

Fig. 86. Two piece secretarial chair, 1971, Charles and Ray Eames.

Fig. 87. Shannon and Weaver's theory of communication illustrated by Charles and Ray Eames in A Communications Primer, 1953.
Fig 89. Interior of the IBM Pavilion at the New York World's Fair. 1964, showing the layout of the screens for the Think multi-screen show.
Fig. 91. Still taken from *Parade: or Here They Come Down Our Street*, Charles and Ray Eames, 1952.

Fig. 92. Still taken from *A Communications Primer*, Charles and Ray Eames, 1953.
Fig. 93. Still taken from *Powers of Ten*, Charles and Ray Eames, 1968.
Fig. 94. Timeline used in *Mathematica: A World of Numbers and Beyond*, 1961.

Fig. 95. Timeline used in *Nehru: His Life His India*, 1965.
SELECT BIBLIOGRAPHY

N.B. Place of publication is London unless stated otherwise.

PRIMARY SOURCES
Books/Catalogues


Kaufmann. E. Jnr, Prize Designs For Modern Furniture, New York, 1950.


MOMA, Machine Art, New York, 1934.


Los Angeles Regional Planning Commission, Annual Report, 1940, 1941 & 1942.


Periodicals


'Alcoa Ventures A Forecast', Industrial Design, August 1957, pp. 73-79.

'Among The Tree Tops', Interiors, September 1948, p.100.

'Another Eames Innovation', Interiors, July 1972, p.28.


'Applied To Chairs', Art Digest, April 1946, p.12.


'Case Study House', Arts and Architecture, July 1950, pp.26-39

'Case Study Houses 8 & 9', Arts and Architecture, January 1945, pp.43-51.

'Case Study Houses 8 & 9', Arts and Architecture, March 1948, pp.40-41


'Case Study House for 1949', Arts and Architecture, April 1949, p.40

'Case Study House For 1949: The Interiors', Arts and Architecture, September 1949, p.33.


'Case Study House Number 9 Under Construction', Arts and Architecture, January 1949, pp.31-32.

'Chairs by Charles Eames', Arts and Architecture, October 1950, p.31.


'Competition Winners Named', Architectural Record, March 1949, p.4.


Degener.Patricia, 'Masks And Marvels From The Eames Team', Saint Louis Post Dispatch, September 8 1977, p.11B.


'Design Today', California Arts and Architecture, September 1941, pp.18-19.

'Designs For Post War Living', Arts and Architecture, August 1943, pp.23-37

'Dining Table', Arts and Architecture, February 1948, p33.


373


'Eames Esthetic', *Canadian Architecture*, June 1973, pp. 56-59

'Eames Exhibit At MOMA', *Interiors*, June 1973, p. 76.


'Eames Furniture Show', *Architectural Forum*, May 1973, p. 73


Eames, Charles, 'City Hall', *Arts and Architecture*, June 1943, pp. 22-23.


Eames, Charles, 'Mies Van Der Rohe', *Arts and Architecture*, December 1947, pp. 24-27.

Eames, Charles, 'Organic Design', California Arts and Architecture, December 1941, pp.16-17.


'Eames World', Architectural Association Journal, July/August 1956, pp.54-55.

'Exhibitions: Eames At Home', Architectural Forum, April 1973, pp.71-72


'Furniture of Charles Eames', Design Incorporating The Indian Building, June 1973, pp.32-35

'Furniture Showroom', Arts and Architecture, October 1949, pp.26-29.


'Herman Miller Showroom, Los Angeles', Architectural Review, March 1953, p200


Holroyd, Geoffrey, 'The Wit of Technology', Architectural Design, September 1966, pp.464-


'Latest Version Of Eames Chair From Herman Miller', Interiors, October 1970, p.150.

'Life In a Chinese Kite', Architectural Forum, September 1950, pp.90-96.

'Lounge Chair By Eames', Architectural Review, September 1956, p.197.


McCoy, Esther, 'Arts and Architecture Case Study Houses', Perspecta, No.15 1975, pp.54-73.


McQuade, Walter, 'Charles Eames Isn't Resting on His Chairs', Fortune, February 1975, pp.96-100 & 144-145.

MacCarron, Patricia, 'School Class looks Back On 50 Years', Saint Louis Post Dispatch, June 16 1975


'Material As Both a Structural and a Tactile Medium', Interiors, July 1949, pp.98-99.


'Modern Doesn't Pay, Or Does It?', Interiors, March 1946, pp.


'MOMA To Show Eames Furniture', Progressive Architecture, March 1973, p.44

Munchnic, Suzanne, 'A Tribute To Charles And Ray Eames', Art Week, 15th January 1977, p.5.


'Nelson, Eames, Girard and Probst: The Design Process at Herman Miller', Architecture Minnesota, January/February 1976, pp.19-31


'New Eames Lounge Chair Uses Feathers And Down', Progressive Architecture, April 1956, p.92.

'New Series of Storage Units Designed By Charles Eames', Arts and architecture, April 1950, pp.34-35.
'Now In Production', Architectural Review, April 1960, p.270.


'Office Furniture', Interiors, April 1956, pp.154-155.


'Ou'Est-Que Le Design?', L'Oeil, October 1969, p.62

'Personalities', Progressive Architecture, August 1960, p.59


'Prologue', Progressive Architecture, July 1971, pp.56-59

Rice.Patricia, 'Franklin And Jefferson Visit The Enemy Camp', Saint Louis Post Dispatch, 20th October 1975, p.2D.


'Science Film by Charles Eames', Arts and Architecture, July 1962, pp.22-23.


Sherman, Thomas B, 'Ex-St. Louisan Who Made Eames Chair', Saint Louis Post Dispatch, 22nd October 1951.


'Sieges Edites Par Herman Miller', L'Architecture Aujourd'hui, June 1960, pp.92-93.


Silvy, Maurice, 'Maison de Charles et Ray Eames a Los Angeles', L'Architecture d'Aujourd'hui, September 1962, pp.31-32.

Smith, Jean, 'Modern Classic Comes To The Market', The Scotsman, 11th March 1983.

Smithson, Alison, 'And Now Dhamas are dying out in Japan', Architectural Design, September 1966, pp.447-448.


'St.Louis Art For Arkansas', Saint Louis Post Dispatch, April 1936.


'Stimulus Fabric Collection', American Fabrics, Vol.20, pp.68-72


SECONDARY SOURCES


Roth, A., Die Neue Architektur, Zurich, 1946.


Pritchard, J, View From a Long Chair, 1984.


