UNIVERSITAS

MEDIEVAL COLLEGES OF OXFORD & CAMBRIDGE

RENAISSANCE & NEOCLASSICAL UNIVERSITIES

THE AMERICAN CAMPUS

THE POSTWAR UNIVERSITIES

Julian Arnold Elliott

UNIVERSITAS

A Study of Spatial Development of Western Universities, Exploring their Emergence as Distinctive Space, Building and Planning Types

A Thesis Submitted by **Julian Arnold Elliott** to the University of Cape Town for the Degree of Doctor of Philosophy : **August 2004**

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Scope

The thesis traces the development of universities, identifies their characteristics in terms of space, building and planning structures and explores the social background which gave rise to these features. The core chapters explore the emergence of university spatial development, first in the medieval colleges of Oxford and Cambridge, then in the renaissance and neoclassical European universities. These are followed by the exploration of the campus plans in the United States and finally, the postwar universities.

Hypothesis

The research is governed by two central, interrelated, hypotheses, namely:

- that there is a discernable evolution of university building as a series of distinctive spatial types from the 14th to the 20th centuries; and that
- this evolution can be explained by changing contextual social and technological circumstances.

Method

The methods which have been utilised are:

- secondary research by means of extensive review of the literature;
- field research including visits to a large number of universities;
- open ended interviews and discussions with various university planners throughout the world, and
- practical experience gained in professional work in the field over many years.

Findings

Each of the four periods had distinctive characteristics. Medieval colleges grew in a piecemeal manner retaining a sense of unity with a finely tuned balance of buildings to open space. This changed with the renaissance and neoclassical universities which were planned as urban 'set pieces' accommodating the increasing complexity of academic activities. The American campuses were generally planned in a suburban context with individual pavilions designed on a strong visual axis. The postwar universities explored the many planning systems which provided the compactness and connectivity required by the 'new map of learning'.

These spatial structures incorporated fragments of their heritage from the ancient world and the world of Islam. They were influenced by the English cathedral monasteries, the Italian renaissance palaces, the Ideal City paintings, city planning of the 19C, and postwar educational and urban planning theory. These influences have generally been a two-way process with iteration between city and university and university and city, but they have always resulted in the university becoming a distinct spatial variant, particularly at the finer grain of building and space structures.

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ACKNOWLEDGEMENTS

This thesis explores and synthesises events that have taken place over the last forty years. During this period it has been my good fortune to work with, meet and learn from many people all over the world. They have been fellow professionals, academics and university administrators. It is impossible to remember, let alone acknowledge all those influences which, in one way or another, have shaped my approach to the fascinating and important subject of university planning, design and architecture.

Perhaps one of the lasting influences, and one of the earliest, was Michael Brawne who coordinated a British Council course on university planning at York University in 1966. He later became a friend who, through formal lectures, conversations and writings, set up a lasting theoretical framework which I was later able to fill in with my own experience and findings. This acknowledgement comes a year too late for, alas, Michael passed away last year.

Much research into space planning and management systems took place in the early period of my work at the University of Cape Town Planning Unit. It was largely due to the understanding of Len Read, Deputy Registrar and later Registrar, who showed confidence in, and gave his support to this theoretical work which was to provide a firm foundation for our later work in opening up the Middle Campus and much of my subsequent professional work.

Special thanks must go to my supervisor, Professor Dave Dewar, who has endeavoured to discipline my non-academic background into the rigours of scholarly thinking, systematic referencing and correct grammar. The many errors, omissions and shortfalls that must surely still exist are not for want his diligent supervision.

Lastly, I must thank Helene, Paul, Steffi and Angela for their invaluable help and advice with the graphics, page layout and proofing.

Cape Town, August 2004

PROLOGUE

Introduction to the Study

P.1 Navigator Image
The Navigator Image presents an overview of the thesis.
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.

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Universitas: term originally applied to scholastic guilds, by the latter part of the 14C referred to a community of scholars whose existence had been recognised by either civil or ecclesiastical authority [Encyclopaedia Britannica, 1983].

PROLOGUE

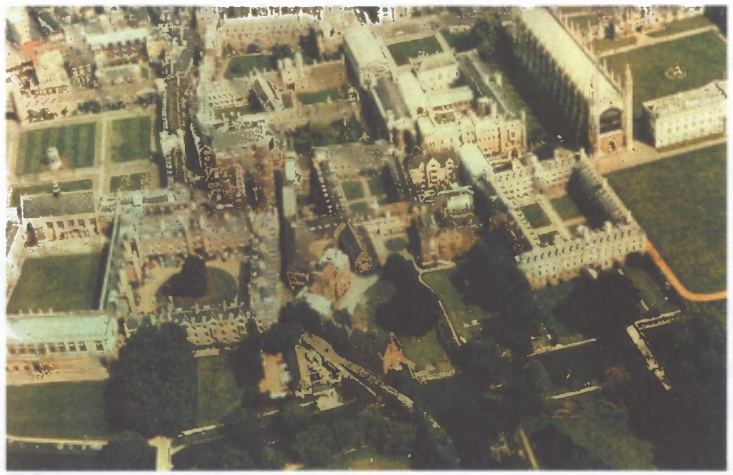
Introduction to the Study
Purpose, Scope and Method

1 Background

My involvement with university planning and building began in 1965 when I was commissioned to lead the design team for the new University of Zambia on a 'green-field' site on the edge of Lusaka, Zambia. Subsequently, I have been involved in campus planning, design and architecture at the University of Cape Town [1969-1998] and on numerous campuses throughout Southern Africa.

During this period opportunities arose to attend courses in the UK and USA, to participate in, and give papers at, conferences in South Africa and the USA, spend a study period at Cambridge University, visit many universities throughout the world and meet leading counterparts in my field [Appendix 1].

In 1977, I was engaged in a lengthy period of study travel visiting new universities in Australia, New Zealand, North America, Europe and the Middle East. After several visits to tertiary institutions in the UK, I found myself in Cambridge in a university environment which was very different from the modern, often brutal, institutions I had been visiting. At first I thought this was just a romantic reaction to my disillusionment with much postwar university development. However, the more I thought about it, the more I realised that there were lessons to be learned from the Cambridge model, particularly in its 'open' architecture, pattern language and balance of building form to open space [Fig P.2].



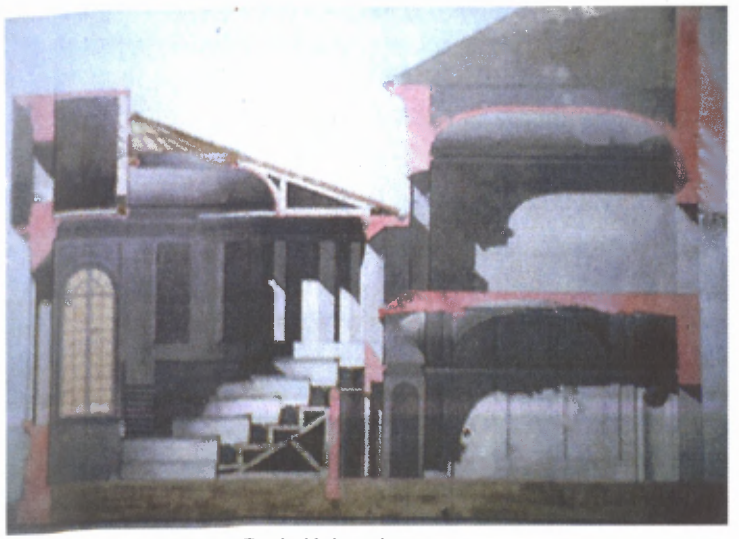
P.2 Aerial View of Cambridge
Aerial view of the Cambridge 'Backs' from Trinity to Kings College on right
[Cambridge University]

From that time onwards, I made a point of visiting old universities in Europe and the United States. There were great rewards in this, both in terms of the quality of architecture and also of their planning and design structures. While visiting Pavia University outside Milan, I was reading in the library when I came across a monograph on the university with splendid coloured drawings showing 18th century developments [Fig P.3]. These indicated how, with the demands of teaching increasingly large classes, particularly anatomy, the lecture theatres could no longer be accommodated in the traditional palazzo type buildings. This brought home to me the realisation of how much the 'grain' of university buildings had evolved from spaces which were undifferentiated from those in the general urban fabric, to the highly complex spaces which make up university buildings today. It also raised questions of whether this evolution could be explained through a connection to the changing function and nature of the university and it's context.

All of this has engendered a great passion for the past, present and future of university building, an immersion in the literature and the desire to document some of my realisations after a long career working both at practical and theoretical levels.

2 The Thesis

In attempting to synthesise these insights and realisations, I searched the literature on the subject and was surprised to find that there has been no holistic study of the relationship between the changing nature of universities and their spatial structure. Hastings Rashdall's monumental historical work on the medieval university in Europe touches on buildings in passing [Rashdall, 1895]. Turner [Turner, 1984] and Dober's work [Dober 1965] in the USA focuses on the American Campus although the latter does mention the UK on occasions. Pevsner's Architectural Review article [Pevsner, 1967] of the 1960's is an introduction to the chronological development of the European universities, while the section on Universities in 'The McMillan Encyclopaedia of Architecture & Technological Change' is a useful overview of university development [Guedes, 1979]. Pablo Campos' recent doctoral thesis on the Spanish universities [Campos, 2000] is a comprehensive document but deals essentially with Spain. For the rest, the literature is limited to a particular period,



P.3 Lecture Theatre at Pavia University
Architects drawing showing anatomy lecture theatre at Pavia University
[Pavia University Library]

region or university. Consequently, many important aspects of this historical evolution have not been brought together and have, therefore, been lost to modern university planning.

The thesis seeks to fill this gap by:

- establishing a chronology which identifies the changing structure and form of universities in response to changing contextual circumstances;
- developing a conceptual framework for understanding the western tradition of university building through a broad analysis of it's spatial types from the 14th to the latter part of the 20th centuries; and
- analysing this typology at various levels to show how university buildings have evolved to become distinctive types in terms of their array of spaces, the preferred ways in which they are assembled into building form and the ways in which they are planned in a spatial matrix according to design criteria, growth patterns, scale and context.

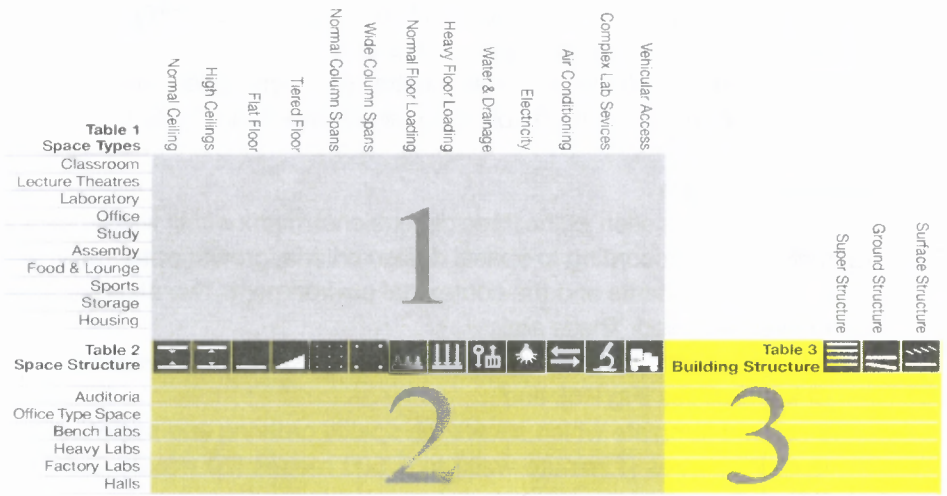
Hypothesis

The research is governed by two central, interrelated hypotheses, namely:

- that there is a discernable evolution of university building as a series of distinctive spatial types from the 14th to the 20th centuries; and that
- this evolution can be explained by changing contextual, social and technological circumstances.

Scope and Focus

The present work does not claim to be globally comprehensive. It focuses on the western traditions of Europe and North America with isolated examples from Africa. It does not attempt to draw conclusions about the relevance of these western traditions to the contemporary situation in Sub-Saharan Africa. The flow of the story starts in classical Greece and washes over the Middle East, the Mediterranean basin and Spain before taking root in Europe. In 1636, with the founding of Harvard, these traditions were exported to the new world. Later were they transferred to colonial South America, Africa and Australasia. The post-apartheid period is a watershed for universities in South Africa. It has been marked by complexity and rapid change, with academic planners grappling with ways of introducing socially, idealised and practised values of indigenous knowledge in Southern Africa and with



P.4 Space & Building Structure Tables
Table 1 shows room or **Space Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in **Table 2**. **Table 3** goes a step further & shows how these can be accommodated in 3 types of **Building Structure,** super-structure or stackable 'office' type accommodation; ground-structure for large lecture theatres with sloping floors & surface-structure with large column free spaces and often, top lighting.

Chapter 2 traces the formative influences which shaped the emergence of the university as a recognisable spatial type in the 14C. Chapters 3-6 identify four distinctive spatial types which are described in detail. These are the:

- Medieval colleges of Oxford and Cambridge;
- European Renaissance and Neoclassical universities;
- American campus; and
- Postwar universities with the emphasis on Europe and North America.

5 Conceptual Spatial Framework

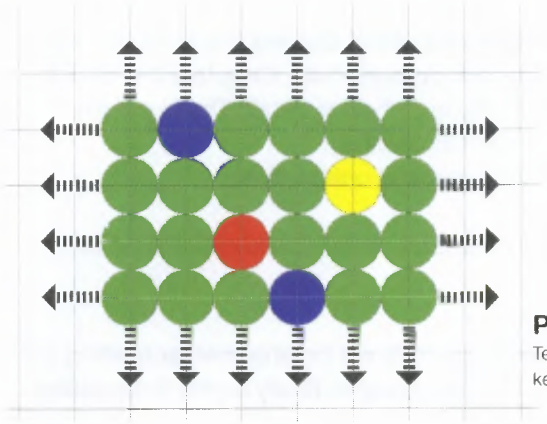
The spatial planning of each of these periods will be analysed according to consistent conceptual templates which focus specifically on the three scales of:

- space structure, describing the evolution of university room types at a micro-planning level;
- building structure, analysing how these space types are assembled into university buildings at an architectural level; and
- planning structure, dealing with campus or university spatial planning and design at the macro level.

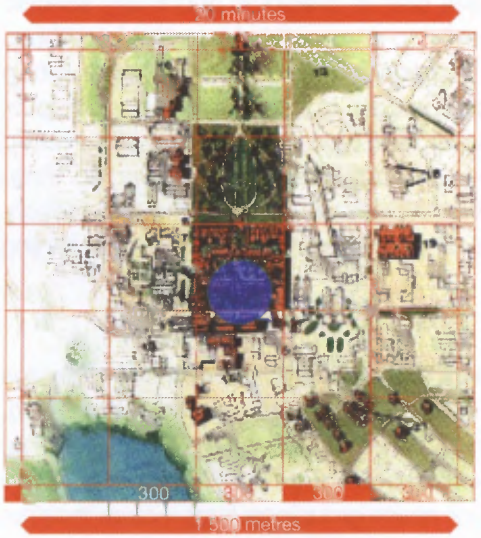
In urban planning and design it is normal to proceed through an hierarchy of planning functions from the overall plan to precincts and finally specific buildings. In my experience, it is useful to reverse this hierarchy in campus planning and design. University campuses are essentially micro-urban environments which are the result of a process of the assembly of a complex and diverse range of university space [room] types into a variety of preferred building forms which then proceed through precinctual design to three dimensional spatial development frameworks on the land. For this reason, the study deals, first with the smallest grain, space structure, then building and planning structures.

Space Structure

An analysis is made of the various space or room types, in terms of attributes such as room widths, column spacing, ceiling height, flat or tiered floors and, to a lesser extent, degree of floor loading, mechanical and electrical servicing, types of lighting and vehicular access [Table 1, Fig P.4]. This array of space types can be translated into six generic space groupings: large lecture theatres



P.5 Growth Template
Template used to illustrate growth structure & zoning of key facilities



P.6 Scale Template
Template used to show spatial ordering & scale of plans

with sloping floors; office type accommodation; bench laboratories with a high degree of service installations and special floor loading requirements; factory laboratories with heavy floor loading, high ceilings and long spans; and the large halls for assembly, exhibition, indoor sports and gymnasia, which are generally column free with roof lighting. It must be noted that the degree of detail in these analyses varies depending on access to detailed plan information, particularly with regard to older buildings [Table 2, Fig P.4].

Building Structure

The term building structure is used to describe the three-dimensional assembly of space types into patterns of built form. It is suggested that, for practical purposes, generic space groupings can be accommodated in three families of building structure:

- super-structure or stackable 'office' type accommodation which, with varying degrees of floor loading and mechanical servicing, can accommodate most space types;
- surface-structure, with large column free spaces and, possibly, top lighting for large halls and factory laboratories; and
- ground-structure for large lecture theatres with sloping floors which do not fit comfortably within stackable office accommodation [Table 3, Fig P.4].

Planning Structure

Planning structure is seen as the three dimensional matrix within which building structure locates, according to spatial design criteria, growth patterns, scale , policy, site determinants and the contextual environment. Two different types of templates are used. These are:

- a diagrammatic template which indicates growth structures and zoning of key facilities [Fig P.5]; and
- a second template which shows the spatial ordering and scales varying from 75 metres [1 minute walk] to 1 500 metres [20 minute walk] [Fig P.6].

CHAPTER ONE
Background to University Formation

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A Study of Spatial Development of Western Universities
Exploring their Emergence as Distinctive Space, Building and Planning Types

CHAPTER ONE

1 Background to University Formation from 14C to 20C

This chapter is introductory. It sets up a canvas for a broad brush stroke picture of the social, political, technological and educational influences informing the evolution of universities in the western world. It is against this background that the spatial development of universities will be examined in subsequent chapters, from their early medieval beginnings in the 14C to the postwar universities in the latter part of the 20C [Fig 1.1].

1.1 Proto-Universities

The cradle of university prehistory begins in the Greek polis [Campos, 2001-2002]. According to Louis Kahn's teaching, learning started with the man under the tree surrounded by a group of listeners. He didn't know he was a teacher neither did they know they were students. The man could have been Socrates who, in the 5C BC, was teaching that the supreme ideal of man was the disinterested search for the absolute, for virtue and for wisdom. Socrates' search for universals was followed by Plato [Fig 1.2] who, in his academy, included the education of the body, integrated dance , music and poetry with philosophy and mathematics. Aristotle, too, followed in this mould with but with less emphasis on universals and more on empirical and practical issues.

Besides the exploration of philosophical truths and mathematical theory, by 4C BC higher education was geared to produce people for political life and for administrating the affairs of the city state. Increasingly, the education of young men was directed towards social utility and practical efficacy. This

1.1 Navigator Image
The Navigator Image presents an overview of the Chapter 1 which sketches the social background to the thesis.
The illustration shows some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.

resulted in the most important requirements of classical education being the arts of persuasion or dialectic and the speaking or rhetoric. By the second half of the first century BC, the educational programme consisted of the seven liberal arts:

- the three literary arts of grammar, rhetoric and dialectic, and
- the four mathematical disciplines of arithmetic, geometry, astronomy and music.

The Romans readily assimilated Greek culture, as Horace notes; "Captive Greece captivated her rude conqueror and introduced the arts to rustic Latium" [Epistles, II, i, 156]. However, they showed a marked reserve toward Greek athleticism and the gymnasium was only an appendage to the public baths, which were monumental exaggerations of their Greek models.

The Romans considered the family as the natural milieu in which a child should grow up and be educated, with both mother and father, together with 'nurse' and 'pedagogue', playing important roles in this process. Familial education ended at age 12 in the case of girls, and at 16 in the case of males. At this age, the adolescent male assumed the toga of manhood. He then devoted one year of apprenticeship to public life, no longer at his father's side. After this he commonly embarked on military service, initially in battle but, later, as a staff officer under some distinguished commander [Veyne, 1987].

The oratorial arts were the most popular subjects in higher education in Rome for the same reasons as in Greece. Rome, however, created the schools of law which had no equivalent in Greek education. Perhaps more than rhetoric, law offered young Romans profitable careers. At first, this was entirely practical, but in Cicero's time this instruction was paralleled by systematic theoretical research and documentation. This educational system continued without great change for six or seven centuries in Roman territories, which enabled the growth of bureaucratic apparatus necessary to manage the expanding empire. Besides military expertise, this required the oratorial skills of leaders, as well as legal frameworks and management techniques of the many bureaucratic administrators, down to the secretaries and stenographers.

1.2 Mosaic showing Plato Teaching under a Tree [Pearce, 2001]

1.3 Teaching in the Mosque [Michell, Ed.1978]

The rise of Islam in 7C, some two centuries after the decline of Rome, was at the time when the Byzantine and Persian civilisations were waning. Through the teachings of Mohammed and the spread of Islam, most of the Arab and Turkish worlds were integrated. By the 11C, Islam had spread from Baghdad in the east to the Muslim universities and schools of translators in Spain in the west, into Africa in the south and through Turkey into Central Europe in the north. In order to connect these disparate lands, education became widespread, endeavouring to achieve both religious and secular aims [Fig 1.3]. These included the study of the *Qur'an* as a basis of knowledge as well as the synthesis of secular knowledge and religious belief, the practice of equal educational opportunity and establishment of teachers as guides in forms of knowledge based on revelation or intuition.

Besides Arabic language, grammar, mathematics and scientific research, Islamic education concentrated on practical aims, such as the application of technological expertise to the development of irrigation systems, architectural innovations, textiles, iron and steel products, earthenware, leather products, paper and gunpowder.

When the Caliphs felt that the major empire was secure, centres of learning were founded in all the major towns and scholars, who were capable of producing Arabic translations of the famous Greek and Roman works that were in danger of being lost to history, were assembled. However, no longer content with these translations, the Arabs branched out on their own, in that they rose above the role of pupil, and established schools and *madrasas* equipped with libraries and facilities for experimentation and observation which was not equalled in Europe until much later [Bon, 1974].

At the same time, the monastic movement swept over the Roman Empire in two arcs, one swinging east as far as Persia and Arabia, the other westward into Gaul and to the unconquered lands of Scotland and Ireland where it thrived. The importance of monasteries as bastions of civilisation and collective culture cannot be overemphasised even though they were insular communities. The emphasis the Greeks placed on mans ability to understand the world through his own powers of enquiry, was replaced by a new kind

of teaching, based on divine explanation of human experience. This, in turn, was based on a few key texts. This approach, known as scholasticism, dominated Western thinking and education for more than nine centuries.

In order to develop centres of culture and learning, and to contribute to his kingdoms intellectual revival, Charlemagne imported foreign talent from England, Ireland, Italy and Moorish Spain. The court thus became a kind of 'academy' where the Emperor, his heirs and friends, discussed topics such as existence or non-existence, the eclipse of the sun, the relationship of Father, Son and Holy Ghost and so on. Recognising the importance of manuscripts in the cultural revival, Charlemagne formed a library, had texts and books copied and instructed every school to maintain a *scriptorium*. The influence of this Carolingian renaissance spread abroad to the clergy and laity in the 9th and 10th centuries [Fig 1.4]. Contact with the East and with the highly cultivated Moors in Spain further stimulated intellectual life.

1.4 Map of Europe in 1097
Map shows Europe in the Romanesque period with location of major Monastries [Kidson, 1967]

The larger monasteries presented intricate administrative problems of a religious, social and commercial nature. In learning to deal with these issues, monasteries became administrative models for men in business and government. Meanwhile, urban schools had been set up by the church. This satisfied intellectual appetites and also offered studies in law and rhetoric, equipping scholars for the skills necessary for material advancement in the many administrative and legal jobs opening up in the cities.

By the 12th century, the monastic reformers decided to close the schools to those who did not intend to enter the cloistered life. Divine works were to be the only subject of study and meditation, with divine science moulding conscience rather than questioning knowledge. Before long, therefore, the written word of the scriptures and the Fathers of the Church was subjected to the scrutiny of human reason: a healthy scepticism which was to be the stepping stone to knowledge, aided by an understanding of critical logic.

The spatial development of these academies and schools of the ancient world, the Islamic *madrasas* and the European monasteries [the proto universities] is examined in the next chapter on the formative past.

Haskins, 1923

[University of Bolgna, Places & Museums]

1.5 & 1.6
Universitas Scolarum & Magisterum
Universities varied between the *universitas scolarum* of southern Europe, of which Bologna was the protype & the *universitas magisterum* of the north, of which Paris was the model

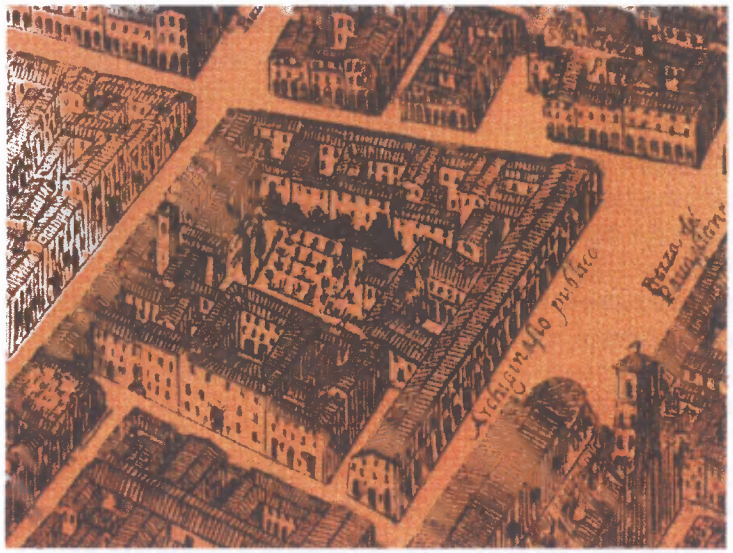
1.2 The Medieval, Renaissance and Neoclassical Universities

Meanwhile, by the 11C, universities were developing very quickly as institutional types, although they did not yet have an identifiable spatial form. These more secular institutions responded to the growing need for an educated professional class to cope with affairs that were becoming more complex and with opportunities opening up in a variety of fields. They still taught within the framework of the trivium [the three literary arts of grammar, rhetoric and logic] and quadrivium [the four mathematical disciplines of arithmetic, geometry, astronomy and music], but from now, the universities differed from all previous systems of education in that:

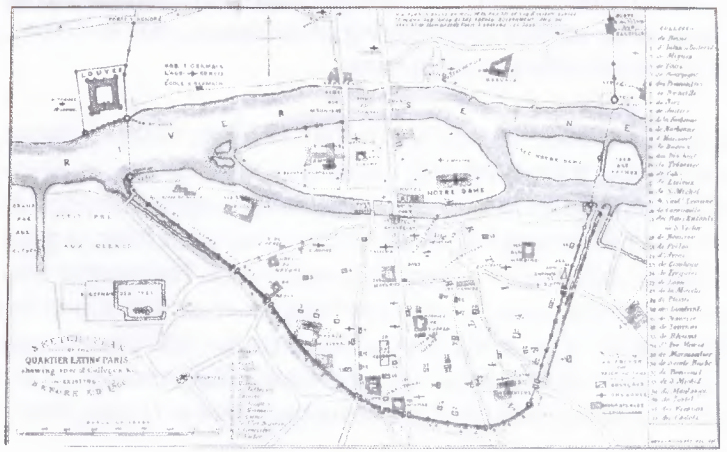
- academically, they taught at least one of the higher faculties of theology, canon law, civil law and medicine, in addition to the trivium and quadrivium in the lower faculty of arts;
- legally, they were independent corporate and self governing communities with power to examine and award licences and degrees, and
- politically, they had freedom from both religious and secular authorities as to the content of instruction and research.

The major purposes of the university were to discover knowledge through its research programmes, to communicate this discovered knowledge to its students through its instruction programmes and apply the body of knowledge to the affairs of man through its public service and extension programmes. These purposes and characteristics have not changed to this day, but they have been applied with differing emphases at different times, in different places and in different institutions.

Universities began with Bologna and Paris in the 11C. They varied between the scholars *universitas scholarum* [Fig 1.5] of southern Europe, of which Bologna was the prototype and the masters *universitas magisterum* [Fig 1.6] of the north, of which Paris was the model. At Bologna, as at Paris, a great teacher stood at the beginning of university development. The teacher who gave Bologna its reputation was Irnerius, perhaps the most famous of the many great professors of Law in the Middle Ages. By the 12C trade began to flow more freely over all of Europe. Geographically, Bologna was at the crossroads of the increasingly important trade routes between Naples, Rome



1.7 University of Bologna
Birds eye view of the Archiginnasio 1563; a building housing Medicine, Mathematics, Law, Philosophy & Natural Sciences [University of Bolgna. Places & Museums]



1.8 University of Paris
Plan of the Quartier Latin showing sites of colleges existing before 1500
[Rashdall, 1895]

and Florence in the south, Antwerp and London in the north, Venice in the east and Milan, Avignon and Marseilles in the west [Fig 1.7]. It soon attracted hundreds of students, not only from Italy, but from beyond the Alps. Far from home and undefended, the students united for their collective protection into an organisation of foreign or *transmontane* students. They organised protection against exploitation in the costs of lodgings and books. Then they turned on their other adversaries, the professors, who lived on the student fees, and required them to live up to a detailed set of regulations relating to leave, attracting classes of a certain size, the duration of a lecture, the nature of the curriculum and the systematic process for instruction and examination. This situation continued until the 14C, when masters and students united to form one university [Haskins, 1957].

This was different in the case of Paris and the northern universities. They were under the control of the masters who, not only gained the right to control the curriculum and examining, but also controlled the students who enrolled under them in their houses.

Paris, the mother university, served as the prototype for nearly all the universities of northern Europe. Perhaps more than any other institution, it reflected the special qualities of medieval culture. It grew from the schools of Notre Dame, Sainte Geneviéve, Saint Victor and Saint Germaine des Pres. The beginning of this growth can be dated from the arrival in the Cité of one of the most famous teachers of his age. It was the presence of Abelard in Paris in the middle of the 12C who, from the disputations he encouraged and the crowds of students he attracted, that the university of Paris has its origin, in spirit, if not in form.

The neighbourhood of Notre Dame swarmed with a tumultuous, often disrespectful, student body and eventually Abelard's conflicts with ecclesiastical authorities led him and his followers to seek greater independence from the officials of the cathedral. Accordingly, Abelard and his followers migrated from the Cité and established themselves on the left bank of the Seine in what has been known as the Latin Quarter ever since. Latin being the lingua franca of scholars [Haskins, 1957] [Fig 1.8].

1.9 Oxford
Contemporary view of Oxford skyline [www.ox.ac.uk]

1.10 Plan of Cambridge 1688
David Loggan's Plan of Cambridge 1688, showing two main roads; Regent, Andrew's, Sidney & Bridge Street; & Trumpington Street, King's Parade, Trinity and St. John's Streets forming triangular pattern. Most colleges are between Trumpinton/St. John's Streets & the river Cam with the Backs beyond [Parker, 1983]

This organisation worked well, providing a free interchange of thought among an independent and qualified professoriate. It also carried with it drawbacks, such as exploitation of students by local landlords, unruly behaviour of students and a lack of contact between masters and students. It was largely to prevent this exploitation that the college system came into existence in medieval Paris. In 1256 the College de la Sorbonne was founded by Robert de Sorbonne, chaplain to Louis IX, and it is this humble building which was eventually to give its name to the University of Paris.

While Paris and Bologna were the great archetypal universities of Europe, another university of almost equal importance was evolving in England. In theology, it proved a worthy rival to Paris and in the natural and mathematical sciences it surpassed all others. Growth at Oxford was spontaneous and free. No Pope or King had a hand in its foundation, although both were interested in its activities.

Oxford is an unique and historic institution [Fig 1.9]. As the oldest English speaking university, it lays claim to eight centuries of continuous existence. There is no clear date of foundation, but teaching existed at Oxford in some form in 1096 and it developed rapidly from 1167, when, as a result of a royal quarrel, Henry II banned English students from attending the University of Paris. By 1201, the University was headed by a magister scolarum Oxonie, on whom the title of Chancellor was conferred in 1214, and in 1231 it was recognized as a universitas or corporation.

During the 14C and 15C Oxford became one of the intellectual centres of Europe and took a leading part in the development of scholastic philosophy, the revived study of Aristotle and the beginnings of experimental methods of enquiry.

Oxford began through a migration of students from Paris. In a similar manner, Cambridge began in 1209 with scholars taking refuge from hostile townspeople in Oxford, migrating to Cambridge and settling there. They were numerous enough by 1226 to have set up an organisation, represented by an official called a Chancellor and to have arranged regular courses of

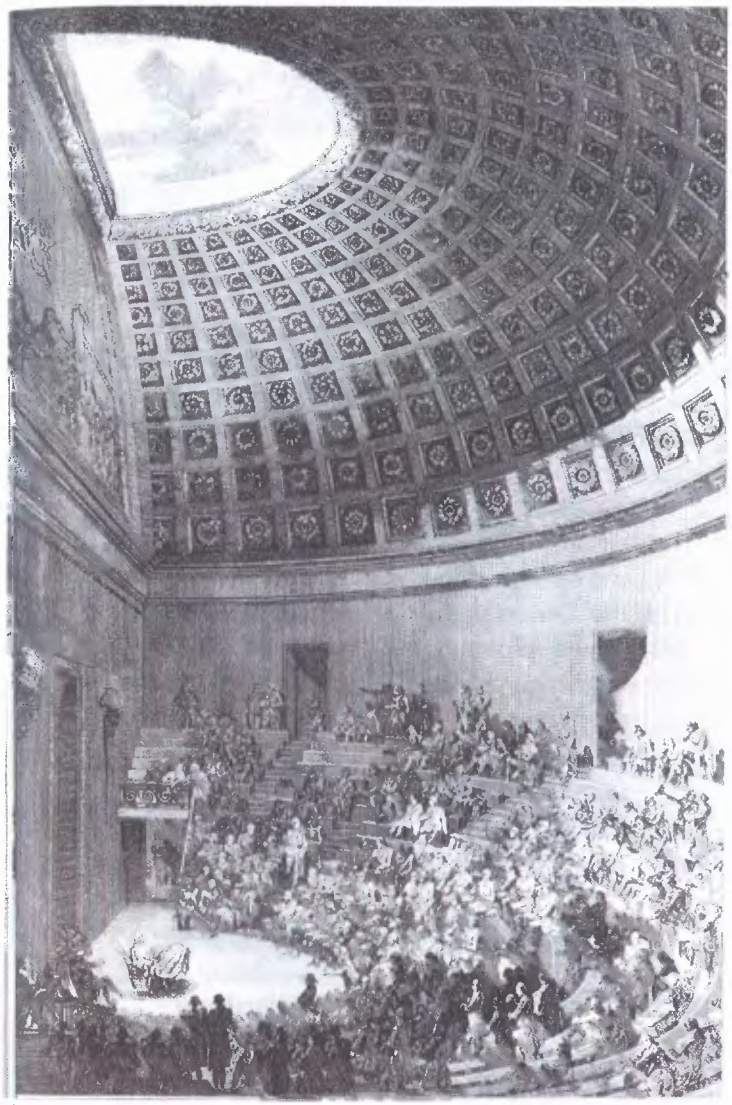
study. It should be noted that Medieval Cambridge had enjoyed remarkable links with Europe from Roman times with canals cut to link the river Cam to the Wash and from there, to the Low Countries and France [Fig 1.10].

By the beginning of the 15C, almost 100 universities had been founded in Europe. With Latin the universal language of tertiary education, scholars and masters could move easily from one country to the other. Like the Athenian academies, the major universities tended to locate outside the centres of religious and secular power. Oxford and Cambridge located outside London, Pavia outside Milan, Padua outside Venice, Pisa outside Florence and Uppsala outside Stockholm. Even in Paris, the University moved across the river, away from centres of religious power [the mitre] on Ile de Cité and secular power [the sword] on the right bank.

The forces which shaped the early universities reflect tensions between the institutions and the seats of secular or religious power, between working in the fields of traditional knowledge or exploring those new dimensions often considered radical or even heretical, balancing the favours of royal largess with religious patronage as well as the ever present tensions between university scholars and town's folk. There was also the impact of the social and religious distinction between Catholic, Protestant and Jew, as well as the issue of celibate or married dons and the admission of women to universities. Puritanism was a major issue in the Scottish universities and, to lesser extent, in some of the Cambridge colleges.

There was an upsurge of university building in the 18C and 19C with the development of science, the advent of the industrial revolution and the needs of commerce. Much of this growth was absorbed by existing institutions but many specialised institutions were established, such as the Ecole Polytechnique in Paris in 1794. These were the precursors to the great neoclassical universities which were important components of the great European cities of the 19C.

1.11 University of Virginia
University of Virginia from the Lawn with Rotunda [Hegemann, 1988]



1.12 Ecole Polytechnique
Teaching in a 19C anatomy lecture theatre [Middleton, 1980]

1.3 The American Campus

This was the background that shaped the medieval Oxbridge colleges and European universities from the 15C to the 19C, as described in Chapters 3 and 4. It was also the university culture which was exported to the new world in the early 17C by the Pilgrim Fathers.

By 1636 Harvard was founded in the Colony of Massachusetts. During its early years, the College offered a classic academic programme, consistent with the prevailing Puritanic philosophy of the first colonists. Universities proliferated rapidly in the following century but this conservative attitude changed very slowly remaining an elementary form of education with strict religious emphases, a narrowly classical curriculum and an emphasis on producing people with practical skills, suited to the opening up of the vast hinterland.

However, the nature of university planning was to change in the early 19C, with the development of the quintessential American campus for the University of Virginia [Fig 1.11]. It was the utopian vision by Thomas Jefferson to create a campus modelled on the ideal city of the Italian Renaissance, set in the spacious Elysian fields of suburban Charlottesville. It was charged with connotations of democracy, purity, wisdom and independence and it fortified the noble ideal of the classical curriculum. In short the classical environment created at Virginia became the hidden curriculum which influenced university architecture in the United States and elsewhere for over 150 years.

1.4 Social and Technological Revolutions

This was all to change in both the old and new worlds in the 18C and 19C, with the changing pace of social, intellectual and economic forces. Increasing trade had added to national wealth and this, together with technological developments of the industrial revolution, such as the steam engine and factory systems resulted in industrialisation, urbanisation and the beginnings of mass labour. At the same time, intellectuals and philosophers were rallying against outworn economic abuses, unjust privileges and intolerance. This was a revolutionary time at a political, industrial and educational level, which was reflected in increasing growth and complexity in universities.

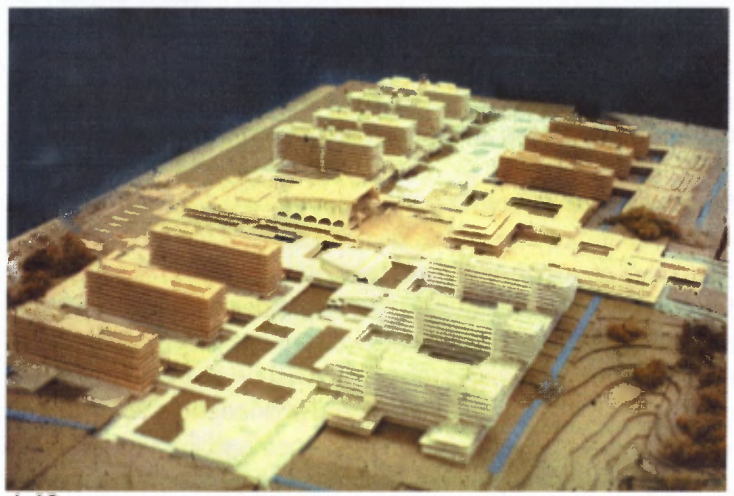
It was a period in which spatial complexity started to emerge [Fig 1.12]. The 'grain' of university buildings now became much finer and richer, with specialised spaces, particularly the large lecture theatres and laboratories which, although of a rudimentary nature, foreshadowed the highly serviced laboratories which were to become a feature of university buildings in the 20C.

These social and economic changes required the broadening of the curriculum and emphasis on commercial and scientific subjects. These trends continued into the 20C, with rapidly spreading prosperity, immense increases in population and the explosion of knowledge. This led to the establishment of new professions, growth of large scale science-based industry, the influence of mass media, increasing power of organised labour and widespread scepticism about accepted values. It also resulted in the development of the automobile, which had such a devastating impact on the built environment, as described in the chapter on the American campus.

1.5 The Postwar Universities

Chapter 6 examines universities in the postwar period [Figs 1.13-14]. The baby boom of the mid 1960's led to the establishment of an unprecedented number of new universities throughout the world. This, together with the importance placed by society on higher education and research, has meant that, just as the cathedrals embodied the collective social values of the middle ages, so the universities now embodied those of the latter half of the 20C.

The postwar universities were built during an heroic period; a period of optimism and great social and technological change. It was the beginning of the computer age, space travel and religious, cultural and economic globalisation with social change triggered by a rejection of authoritarianism and a sense of a 'brave new world'. It was also the time of a sexual revolution with the advent of the birth control pill, experimentation with drugs and exploration of what Aldous Huxley called, 'the doors of perception' [Huxley, 1953].



1.13 University of Bochum
Model of University of Bochum. Typica largel German Postwar university

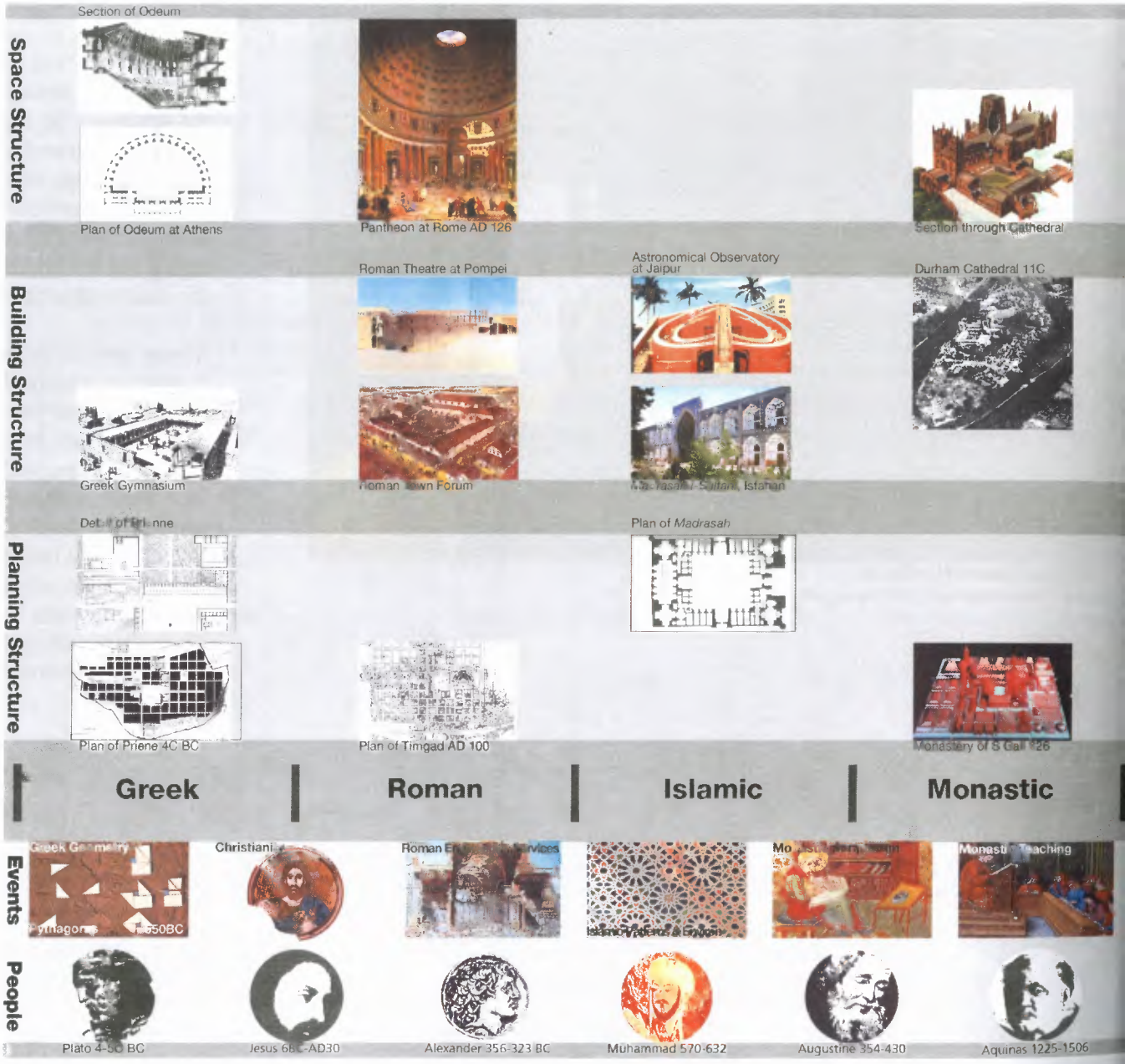
1.14 Free University of Berlin
Postwar lecture theatre with 180° viewing arc

A 'knowledge society' was born and a 'new map of learning' drawn up, with many hybrid disciplines emerging in the gaps between traditional subject fields. Research was taking place across traditional boundaries with the emphasis on inter-disciplinary curricula. The astonishing advances in the fields of computer, nuclear and space sciences, health sciences and biotechnologies, robotics and nanotechnologies as well as communications and media services, created new challenges for the university and its facilities. These educational forces, together with the social and economic forces of a transnational global society, were to have a profound impact on the spatial development of universities

It was also an heroic period for architects and planners, physical and academic, charged with bringing an unprecedented number of new universities into being. Many of the problems faced were similar to those of city planners, but on a smaller scale. Consequently, there were parallels between the two fields with a common emphasis on separating wheeled and foot traffic, with concerns about structures facilitating growth and change and with the development of compact plans with high levels of connectivity. The university, however, was always a distinct variant of the city. One form of this was the way it was structured at the pedestrian scale rather than the scale of the motor car. Another was the way in which it was an outcome of the understanding of the attributes of a vast range of space types and ways in which these could be assembled into significant building forms.

Chapter Two

Academies, *Madrasahs* and Monasteries



CHAPTER TWO

Academies, *Madrasas* and Monasteries

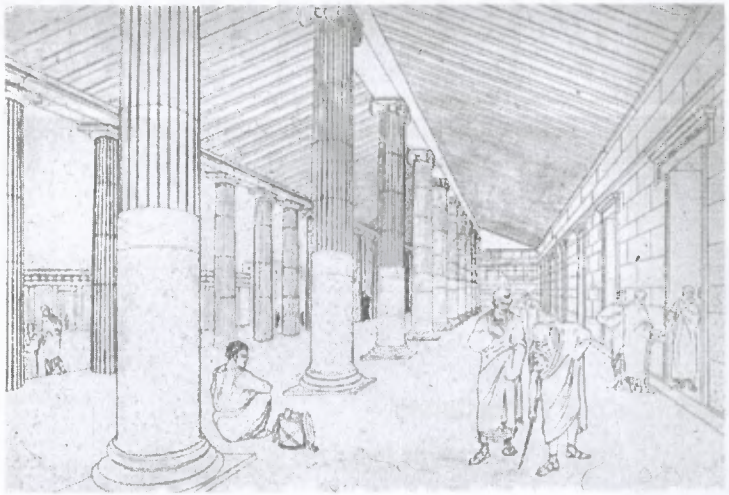
2 The Formative Past : Proto Universities from 5C BC-14C AD

The emergence of university building as a distinctive type can be traced to the 14th century. However, formative influences emerged much earlier. This chapter is a summary of the major historical influences which gave rise to early university buildings. These include the Greek academies, Roman schools, Islamic *madrasas* and Christian monasteries. Sometimes these influences were fairly direct, as in the case of the English cathedral monasteries and the Oxbridge colleges. In other cases the influence was more conceptual and fragmentary. Examples include the secluded and secure internal open space, archetypal architectonic elements such as the use of the colonnade and arcade as well as the philosophers, scholars and poets walks. There are also some parallels between the Greek and Roman city plans and the pedestrian generated web structures of the postwar universities.

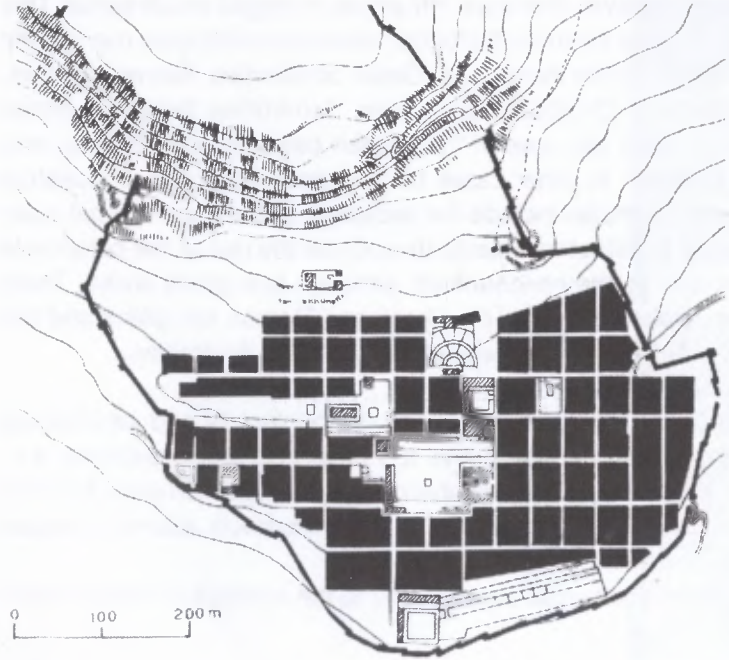
The chapter builds on the social, political, technological and educational background described in Chapter One. It is organised in two sections: the

- first discusses the formal and spatial developments which arose from the social context of the Greek academies, Roman schools, Islamic *madrasas* and the monastic movement; and the
- second relates this spatial development to the conceptual framework of the thesis.

2.1 Navigator Image
The Navigator Image presents an overview of Chapter 2.
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.



2.2 Greek Stoa Adjacent to Agora
[Wycherley, 1962]



2.3 Priene : City Plan
City is built on four broad terraces. It is planned with seven east-west streets on contour connected by some 15 north-south stepped paths. The main streets are 7.5 metres wide and the remainder are 4 metres. Besides typical residential blocks, elements of the city are Acropolis, Temple, Agora, *Ecclesiasterion*, *Prytaneum*, Market, Theatre, Gymnasia and Stadium
[Benevolo, 1980]

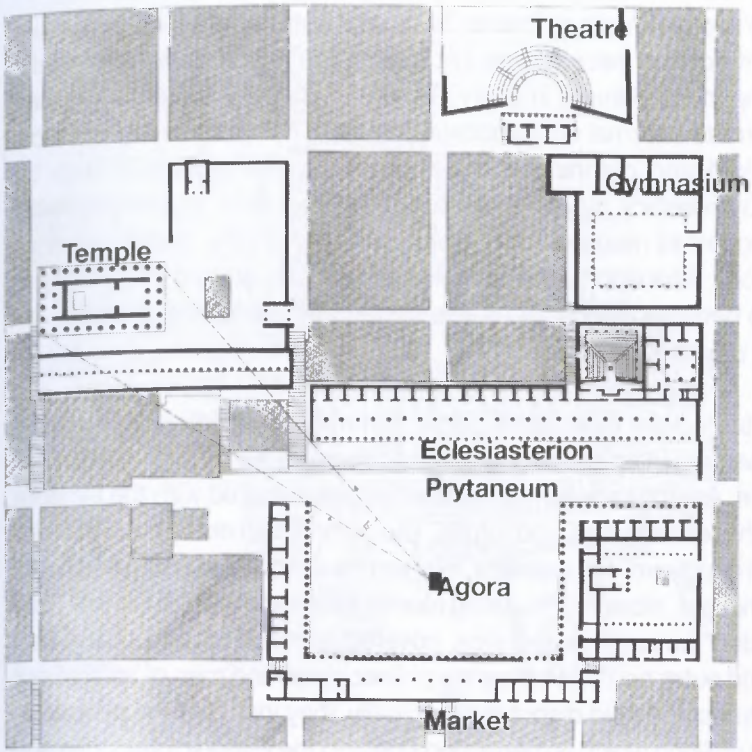
2.1 Formal and Spatial Developments

2.1.1 Greek and Roman Cities

The classical world of Greece and Rome was the cradle of university prehistory. Here intellectual, athletic, social and religious life blossomed freely, within a layout formed by trees, open spaces, shrines, running tracks, shady colonnades and surrounding walls. Later, these were complemented by more elaborate facilities with many elements becoming archetypes for subsequent academic developments. These included the agora [public open space], peristyles [columns surrounding a building], stoas [detached colonnades], arcades, meeting houses, theatres and gymnasia [Figs 2.1-2].

The spatial framework for these architectonic elements was the Greek and Roman city, the urban nucleus of the city state. With its clearly defined limits, geometrically ordered structure, compact form and integrated social life and organisation, it was a remarkable achievement which has seldom been equalled. Places for citizens to gather were a major element in Greek urban settlements which were seldom larger than 5,000 people. These gatherings for all adult males with the right to vote were essential to the 'democratic' process. They took place in the many outdoor urban spaces, encouraged by the mild climate. These places included the agora, theatre, the many public 'squares' and stadia.

Greek and Roman cities were planned on the flexible concept of a geometric grid which could be adapted to any particular setting. The urban grid, which was later to influence many university plans, makes its first appearance in the Middle East, but it was in China and Greece that the grid was first established as a coordinated system. A major contribution to the development of the grid was made by Hippodamus of Miletus who, as Aristotle states, "discovered the divisioning of cities" combining it with a social theory of urbanism whereby the city was divided into zones for religious, civic, commercial and residential zones for farmers, craftsmen and soldiers. Hippodamus' work was noteworthy not only for his division of land uses but for planning procedures which anticipated future growth and change in the city. Thus the city was



2.4 Priene : Plan of Centre
Temple, Agora, *Ecclesiasterion*, *Prytaneum*, market, gymnasium & theatre. Gymnasium is located between the *Ecclesiasterion* & Theatre
[Doxiadis, 1972]

not only a reflection of a democratic society organised in spatial terms, but also conceptualised in the time dimension [Moholy-Nagy, 1969].

By the 4th century BC, the popularity of the grid was at its peak and, with Alexander's conquests, it spread to Asia Minor. Priene, in Iona, [Figs. 2.3-5] was typical of Hellenistic cities, in that it demonstrated a unifying concept, a classical completeness, in its constituent elements. It was built on four broad terraces, stepping down nearly 100 metres from acropolis to gymnasium on its southern edge and planned with seven east-west streets on contour connected by some 15 north-south stepped paths. The main streets were 7.5 metres wide and the remainder were 4 metres in width.

By this time, therefore, the city was no longer just an aggregate of buildings, but an expression of organisation at the level of city planning. Besides typical residential blocks, the primary public elements of the city were acropolis [citadel], temple, agora [75x48m.], *Ecclesiasterion* [House of Assembly], *Prytaneum* [Town Hall], market, theatre, gymnasium and stadium. Priene was planned with buildings as compositional groups rather than individual works. The colonnaded agora, represented the emphasis placed civic responsibility, the cloistered court with its symbolic altar and the sober geometry of senate house, emphasised the importance of the public domain against the anonymity of the merchant and residential city [Moholy-Nagy, 1969].

Similar geometric city plans were adopted by the Romans, who used them more rigidly in places where colonisation was closely linked with military organisation. Very often, as at Timgad, AD 100 [Fig 2.6], a square plan [*quadrata*] was used with a chequer-board grid plan, almost symmetrical in both directions. The edges were about 350 metres apart, enclosing an area of 12,000 hectares. The rigid gridiron pattern had eleven streets in each direction which intersected to form square *insulae* [city blocks] with sides of 21 metres. The grid changed in the centre to accommodate the forum, theatre and other civic buildings such as the educational facilities which influenced or adapted to these spatial elements

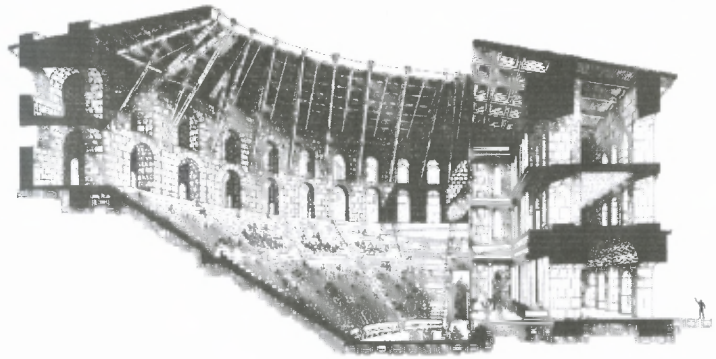
2.5 Priene : Perspective of City
Lower Gymnasium & Stadium at bottom of illustration. A: Agora, B: *Temple*, C: *Prytaneum*, D: *Eclesiasterion*, E: Upper Gymnasium, F: Theatre
[Benevolo, 1980]

There were two gymnasia at Priene. The upper gymnasium was located in a prominent position between the *Ecclesiasterion* and Theatre. Gymnasia were an important element in every Greek city and they were the closest building form to a formal educational institution. The Greek word *gymnos* means naked and *gymnasion* means a place where people strip to exercise. Gymnastics played a great part in Greek life: *gymnastike* was complementary to *mousike* [music and literature] in the normal scheme of education. Philosophers assembled to talk and lecture in gymnasia, which also became places for all less systematic intellectual pursuits, as well as for physical exercises.

In Athens there were three great public gymnasia, the Academy, Lyceum and Cynosarges. Plato's teaching in the Academy gave great status to that gymnasium. Aristotle's teaching was similarly associated with the Lyceum and Antisthenes with the Cynosarges. The *gymnasium* complex consisted of an open courtyard, the *palaistra*, a wrestling school, a running track and an assortment of cloak rooms, oiling rooms, baths and lecture rooms. They also included the colonnaded stoa, covered porticos for practice in bad weather and outer porticos where the philosophers and men of letters read public lectures and held disputations. Finally, they included the *peripatos*, an area for walking which is mentioned briefly in the Platonic dialogues and the groves or plots of arable land leased to individuals for the cultivation of olives and other plant material.

The gymnasium was a state run centre for training where men and boys met and practiced athletics. However, it did not remain an institution exclusively devoted to athletic exercises and soon began to be used for other purposes through the recognition by the Greeks of the importance of the relationship between the body and mind. Gymnasia accordingly became connected with education and became places where Greek youths were taught music, poetry, rhetoric, philosophy, good conduct and behaviour, as well as athletics, wrestling, boxing, javelin and discus throwing.

2.6 Timgad: City Plan [AD100]
Square plan is used with chequer-board grid almost symmetrical in both directions. Sides are about 350 metres enclosing area of 12,00 hectares. Rigid gridiron pattern has eleven streets in each direction which intersect to form square *insulae* [city blocks] with sides of 21 metres. Grid changes in centre to accommodate forum, theatre & other civic buildings [Benevolo, 1980]



2.7 Odeum of Herodes Atticus at Athens.
Restored longitudinal perspective & schematic roof structure & seating in 180° arc [Izenour, 1992]

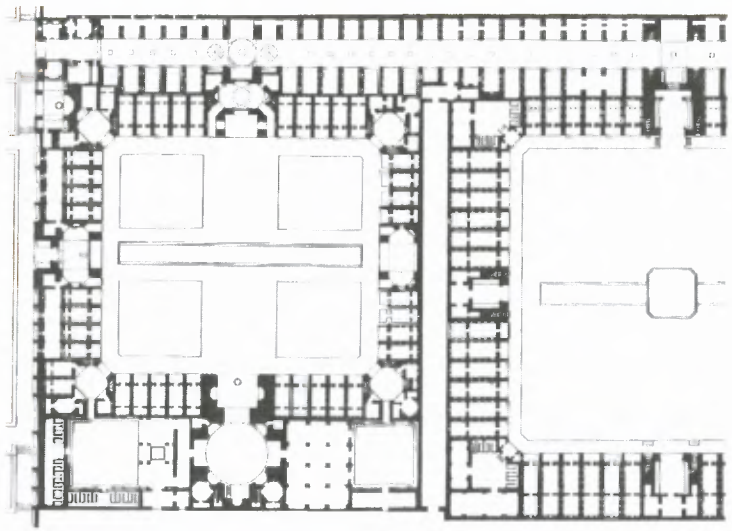
The Greeks also developed large roofed theatres, or Bouleuteria which, although not used by the academies or gymnasia, were the prototypes of the large lecture theatres which were to be found in universities towards the end of the 18th century [Fig. 2.7]. These had spans of up to 20m. and seating capacities of 600 to 1 200. The Roman covered theatres were developed from the Greek prototypes to accommodate up to 5 000 people. This was done by providing only a partial permanent roof together a light membrane or velarium, since the spans were probably too large for contemporary timber truss construction [Izenour, 1992].

Architecturally, the Romans contributed little extra to the external elements of the Greek cities. However, It was in the internal spatial development and adornment of meeting places, basilicas, public baths and 'covered theatres' that the Roman architecture had significance for the later universities. Later, under Augustus, public libraries were opened and facilities for readings and lectures in the public baths provided opportunities for continuing education for large numbers of the city's residents.

2.1.2 The Alexandrian Library

Libraries were to become an essential component of the, later, monasteries and, of course, the universities. One of the earliest libraries was the Alexandrian Library in Egypt. Little is known about the formal and spatial characteristics of the School of Alexandria which was influenced by both the Greeks and Romans. The Library and Museum complex was supposed to have been sited within the walls of the Royal Palace, the grounds of which were in the Brucheion, the Greek sector of the city . Archaeologists have, however, excavated portions of the 'daughter Library' in the nearby temple of Serapis. From scattered sources it seems that a covered marble colonnade connected the Museum with the Library of Alexandria, the 'mother library', where the myriad manuscripts were housed in ten great Halls lined with spacious armaria, numbered and titled. Each of the Halls was assigned to a separate department of learning the divisions of Hellenic knowledge. The Halls were used by scholars for general research, with smaller separate rooms for individuals or groups engaged in special studies [Wikipedia, www.wikipedia.org/wiki/].

2.8 Madrasa-i Sultani in the Chahar Bagh, Isfahan
Courtyard with student accommodation with iwans in centre, planned around garden with water feature



2.9 Plan Madrasa-i Sultani in the Chahar Bagh, Isfahan
Shows residential accommodation with *iwans* in centre of each range
[Herdeg, 1989]

The complex was surrounded by courts, gardens and a zoological park containing exotic animals from far-flung parts of the Alexandrian empire. At its heart was a Great Hall and circular domed dining hall with an observatory on its upper terrace, surrounded by classrooms. Here 100 scholars lived, carried out scientific research, published, lectured, performed the first systematic studies of Greek literature and collected Greek classics, as well as translations of Assyrian, Persian, Egyptian, Jewish, Indian and other nations literature, having nearly a million works in its holdings.

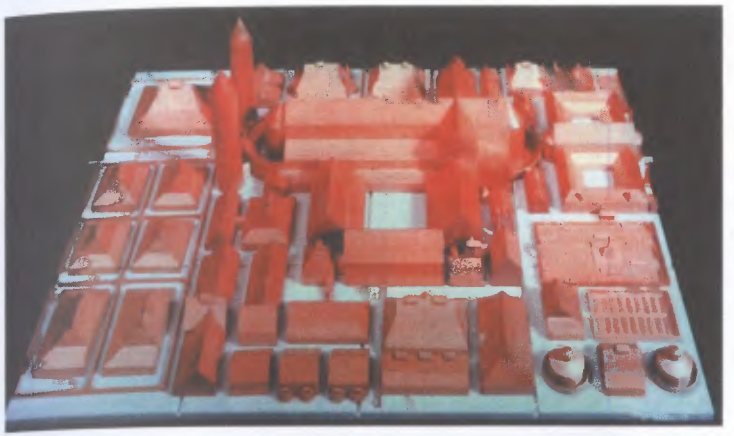
The shelves of the Library may have been housed in one of the outlying lecture halls or in the Great Hall. They consisted of pigeonholes or racks for the scrolls, the best of which were wrapped in linen or leather jackets. In Roman times, manuscripts were increasingly written in codex [book] form, and were stored in wooden chests called armaria.

2.1.3 The *Madrasa*

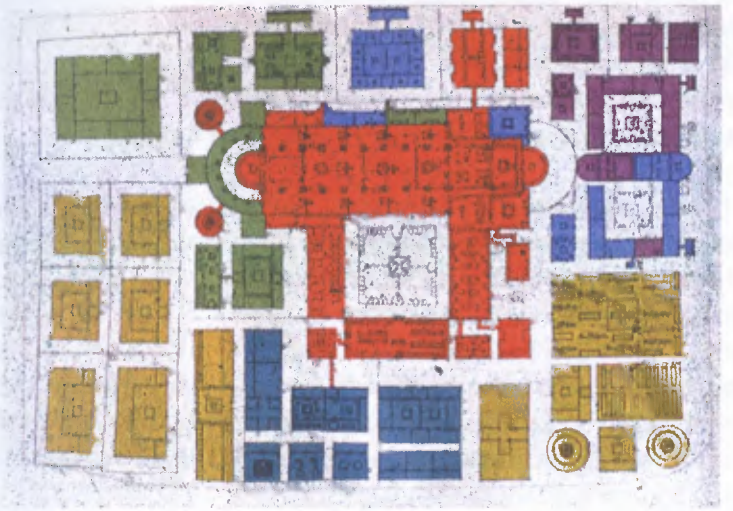
Madrasas were Islamic institutions for the training of spiritual and legal leaders, the *ulama* [religious scholars], *qadis* [judges] and *muftis* [interpreters of the law]. Sometimes called collegiate mosques, *madrasas* are a unique type of religious building complex, which have long been a part of Islamic civilization and one of its major building forms. They were a response to the specific needs of the Moslem community and the creation of a self confident, well established civilisation near the peak of its achievements [Figs 2.8-9].

Madrasas were established in the early 10th century and were often located within or adjacent to the mosque precinct. They comprised a mix of residential and teaching facilities, grouped around a central courtyard. These courtyards became settings enclosed by facades which were punctuated at intervals by symmetrically placed *iwans,* or teaching rooms, at the centre of each side.

These activities of the Moslem centres of learning in Spain and the Schools of Translators of Toledo were fundamental in adapting and transmitting this heritage from the Iberian peninsula to Italy and influenced the monastic movement in northern Europe.



2.10 St Gall in Switzerland [829]
Model of the monastery of St Gall in Switzerland showing the organisation of Abbey, dormitory, refectory, seminary and infirmary [829] [Price, 1982]



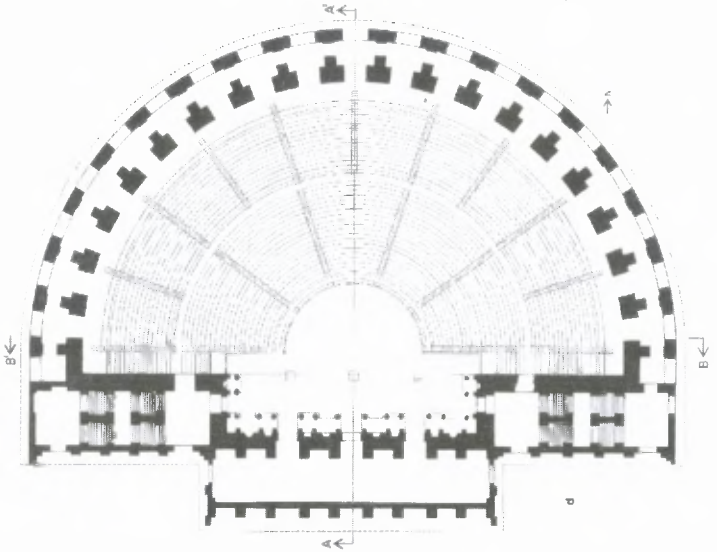
2.11 St Gall
Plan of Monastery. See Figure 2.17 for details [Price, 1982]

2.1.4 The Monastery of St. Gall

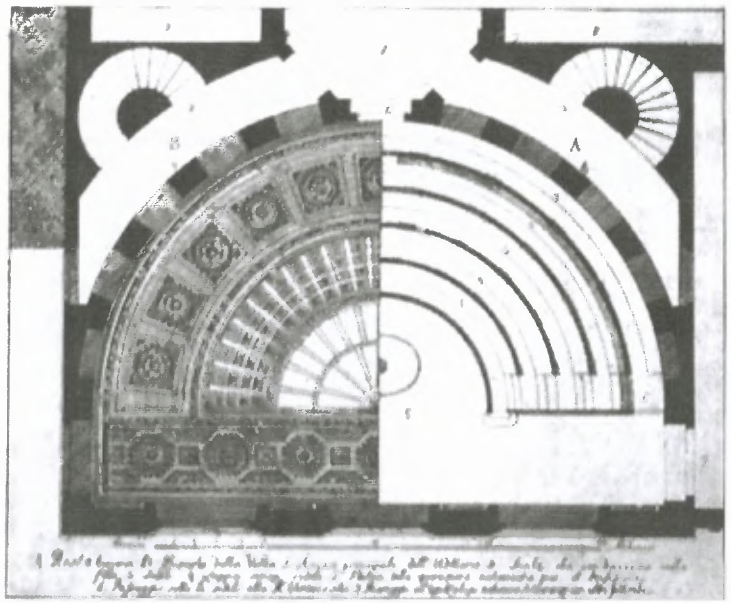
The plan for the monastery of St. Gall was one of the first attempts to integrate religion and education into a coherent complex.The plan emerged at the height of a search for cultural unity in Carolingian life. To some extent, it was both agent and result of a uniquely intensive quest for unity. It was part of a web of intellectual, political and religious life that briefly appeared as a close woven tapestry under Charlemagne and left behind images of dramatic potency to the future of Europe and the West [Price, 1982].

The plan is a precious and unique document in the library of St. Gall in Switzerland. It shows the desire to organise monasteries on a regular spatial pattern. In about 829, an architect drew up a detailed plan for Abbot Gozbert of St. Gall who wanted to rebuild his monastery. The plan portrays a great church surrounded by buildings of a monastic community designed to serve some 110 monks and 260 laymen. What the architect presented was a small self-contained town with its religious life ordered around the cloister, an extension of the abbey church to the south. To the east was the dormitory, to the south the refectory and to the west the cellar with the pantry above. The other buildings were grouped like islands around neatly drawn rectangles. To the east, behind the abbey, was the second church, flanked on the south by the convent for novices and to the north by the infirmary. Nearby were the doctor's house, the herb garden and a sanatorium. The cemetery was situated south-east of the abbey church, next to the garden. To the north, from west to east, were the hospice for outsiders, the school and the abbot's house and to the southeast, the hospice for the poor. Farther south was the barn and the building for the trade associations, with the farm buildings on the west. [Figs 2.10-11]

The plan of St. Gall represented an ideal architectural scheme, formed as part of an effort to guide Benedictine monastic planning in the Age of Charlemagne as not only a spiritual and educational centre but an administrative, cultural and agricultural model for entire regions.



2.14 Odeum of Herodes Atticus at Athens
Restored plan with seating for about 5 0000 in 180 degree arc & maximum sight distance 36,3m [Watkin, 1986]



2.15 Pavia University
Plan shows 18C anatomy lecture theatre with seating for about 250 in 180 degree arch based on Greek theatres [Library, Pavia University]

2.2 Relationship of Spatial Development to Conceptual Framework

There is no direct relationship between the academies, *madrasas* and monasteries described in this chapter and the universities which were to follow. There are, however, a number of archetypal elements, spaces, buildings and plans which were to influence, or be incorporated in, later university development and become part of the timeless heritage of university building. For reasons of completeness, these indirect influences are incorporated in the conceptual framework used in subsequent chapters, despite the lack of cohesion.

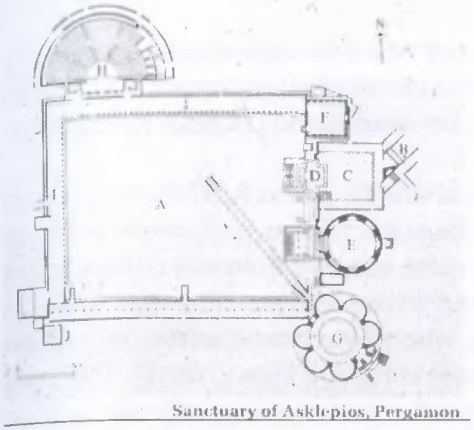
2.2.1 Space Structure

At the smallest scale, a typology of these archetypal elements included the classical columns, pediments, mouldings, colonnaded stoas, arcades and peristyles from Greece and Rome, which were to be freely incorporated in different ways in European universities from the 16C to 19C and in the colonial classicism of the American campus.

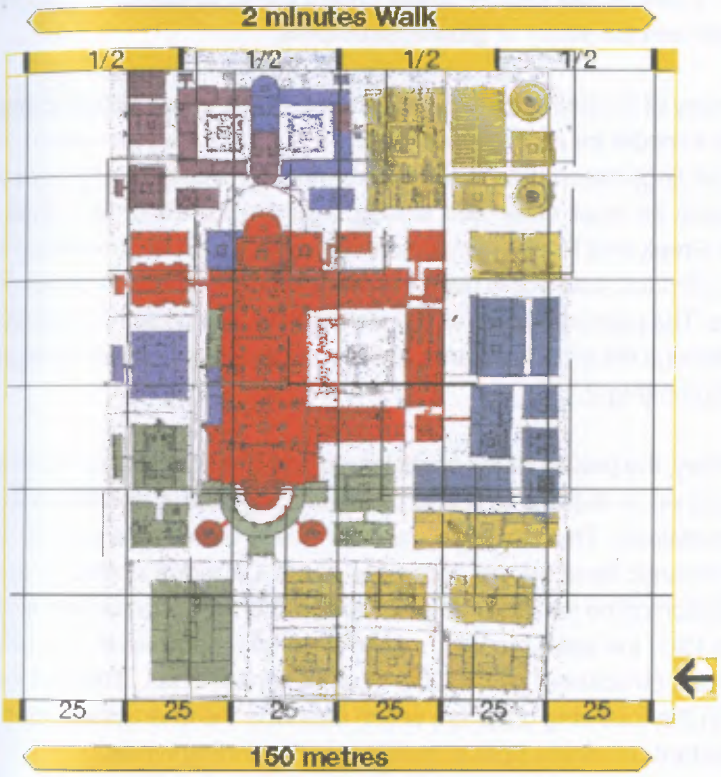
More directly, the space structure of the English cathedral monastery, with its cloister, chapel, library, refectory, kitchen, buttery, cellarium, dorter and abbot's house, provided an important model for spaces in the early university colleges at Oxford and Cambridge, although the emphasis placed on the various spaces was to be different.

In the analysis of space structure can be found many simple flat floor short span spaces used for different purposes as well as surprisingly complex, long span Greek and Roman raked and tiered auditoria and theatres, some roofed, partially roofed and unroofed [Fig 2.14]. In addition, several large-span spaces can be found in the cathedrals and refectories of the monasteries.

It should be noted that the Romans had developed the lamp and candles for lighting purposes, had brought water into the urban settlements through a monumental system of aquaducts, introduced public latrines and the bath house, with an efficient system of central heating by means of the 'hypocaust' system with plenums below the floors and ducts in the walls. These sophisticated environmental services were lost with the fall of Rome when Europe descended into the Dark Ages. They were not to be re-incorporated in university building until the 18th and 19th centuries.



2.16 Asklepios
Plan of Temple Sanctuary
[Norwich, 1984]



2.17 St Gall
Plan in 150m. Template
Red: Church, Monks Dormitiry, Refectory, Larder, Cellar & Privy
Blue: Workshops, Brewery, Mill, School & Scriptorium
Yellow: Sheds for Sheep, Cattle, Goats, Poultry & Pigs as well as Vegatable Garden, Orchid, Herb Grden & Cemetry
Green: House for Distiguished Guests, Kitchens & Brewery for Guests
Maroon: House Physician, Novitiate, Infirmary & House for School Master & Visiting Monks [Price, 1982]

2.2.2 Building Structure

At the building scale, important influences included the internalised gymnasia and many forms of meeting place. The meeting halls for the senate *[Bouleterion]* and the roofed theatres *[Odeum or Theatrum Tectum]* had particular relevance for universities from the 18th century onwards, when they became models for the large lecture theatres.

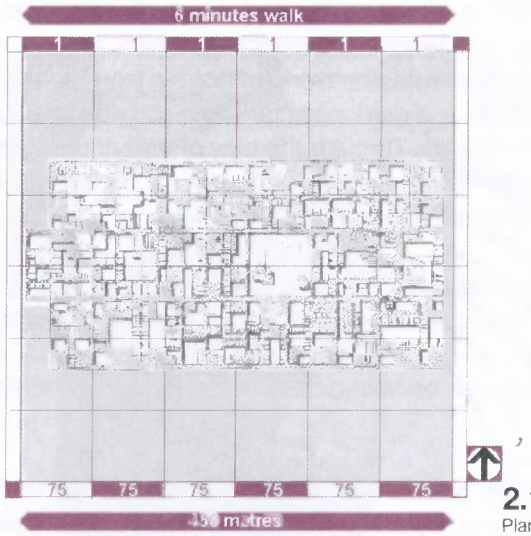
Buildings for the Greek gymnasium included stoas, baths, dressing rooms and classrooms around an internal open space, the *palaestra*. They sometimes had residential accommodation. The *palaestra* at Epidaurus was 40m. square surrounded by peristyle, changing rooms and storage facilities for athletic apparatus. Other elements were statues and stone benches for spectators and competitors. The Temple Sanctuary at Asklepios [Fig 2.16] is an interesting example of an assembly of various space types structured by the colonnaded cloister, anticipating the structural separation of the large theatres which was to occur in some of the 18th century universities.

In the world of Islam, plans of Mosques were extended to include *madrasas,* providing a mix of residential and teaching facilities grouped around a central court. As with the Greek gymnasia, the world of Islamic learning was internalised, but with arcaded edges and gardens of paradise comprising fruit trees, scented shrubs, colourful flowers. Through the play of light and shade and above all, the magnificent use of water, these gardens were transformed into poetic, naturally conditioned contemplative environments.

The plan of St Gall illustrates a small self-contained town with living, eating, sleeping, educational and medical facilities ordered around the abbey church [Fig 2.17]. The plan of St. Gall is an example of a monastery organised on a regular geometric pattern, which can be traced back to the Roman tradition of modularity.

The English Cathedral Monastery was structured around the cloister, with chapter house and cathedral, dorter, frater or refectory and kitchen complex all accessed from the cloister, forming a closed building form with access through a monumental gateway. This became the model for the assembly of the earliest university buildings in 14th century Oxford [Fig 2.13]

2.18 Priene
Plan of city in 450m. template



2.19 Free University of Berlin.
Plan in 450m. template

2.2.3 Planning Structure

At the planning scale influences included the public open spaces, gridded city plans, gardens and the *peripatos*, or the philosophers and poets walks which were to be found later in the German universities and Oxbridge colleges.

Framing the Greek and Roman physical structures was fluent manipulation of a geometric order. Starting with Hippodamus at Miletus, plans were developed for settlements which were much the same size as the modern university. The planning of these geometrically ordered settlements has influenced several of the two dimensional 'web' schemes, which have characterised much of the post-war university planning movement in Europe [Figs 2.18-19]. They have also included another major concern of the post-war university: the dynamic of growth with it's concern for flexible development plans, as opposed to rigid master plans and serious study of growth structures.

With the monastery of St. Gall, a carefully structured micro-urban environment was planned as a model for monasteries. It was a sophisticated architectural scheme, with buildings assembled in an ideal manner for a community whose outer form reflects its inner order and whose laws govern it's organisation. Building on the Greek and Roman city plans, the overall plan is ordered by a complex series of macro and micro planning modules derived from a series of sacred numbers. The plan comprises all the elements of a small self-contained town with its religious life organised around the cloister which is an extension of the abbey church [Fig 2.15].

By the 13th century, the predisposing spatial conditions for the first universities had been established by the Greek, Roman, Alexandrian, Islamic and Monastic heritage and traditions. This heritage was to have a direct influence at a practical and romantic level on the assembly of the Oxbridge colleges, the spatial differentiation of the renaissance and neoclassical European universities in the 18C and 19C, the ideal planning of the American campus in the 19C and on the spatial structuring of the 20C Postwar universities. This will be demonstrated in the following chapters which describe the characteristics of these four important university space, building and planning types.

CHAPTER THREE

The First University Buildings

CHAPTER THREE

The First University Buildings

3 The Open Architecture of Oxford and Cambridge

This chapter examines the development of university building at Oxford and Cambridge from the 14C to the 17C. It shows how the original colleges came into being as communities of masters and scholars living and learning together. Based on the English cathedral monastery model, they were, initially, self contained communities with their own refectories, common rooms, chapels and libraries. Instruction was by individual tutor or in very small group tutorials. Educational curricula were based on the higher faculties of theology, medicine and law and the lower faculty of arts.

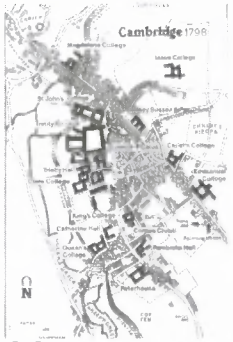
The chapter describes the duality that has always existed between the university and the colleges and how this relationship has changed over time. In the Medieval period, the only specialised, central facilities were classrooms required for teaching large classes, mainly for divinity. The impact of the applied sciences with their need for specialised facilities was still in the future.

It is organised in three sections: an

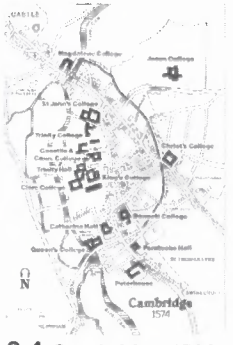
- overview of the Universities and their Colleges; the
- formal and spatial development of the Colleges in the City; and the
- relationship of this spatial development to the conceptual framework

3.1 Navigator Image
The Navigator Image presents an overview of Chapter 3.
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.

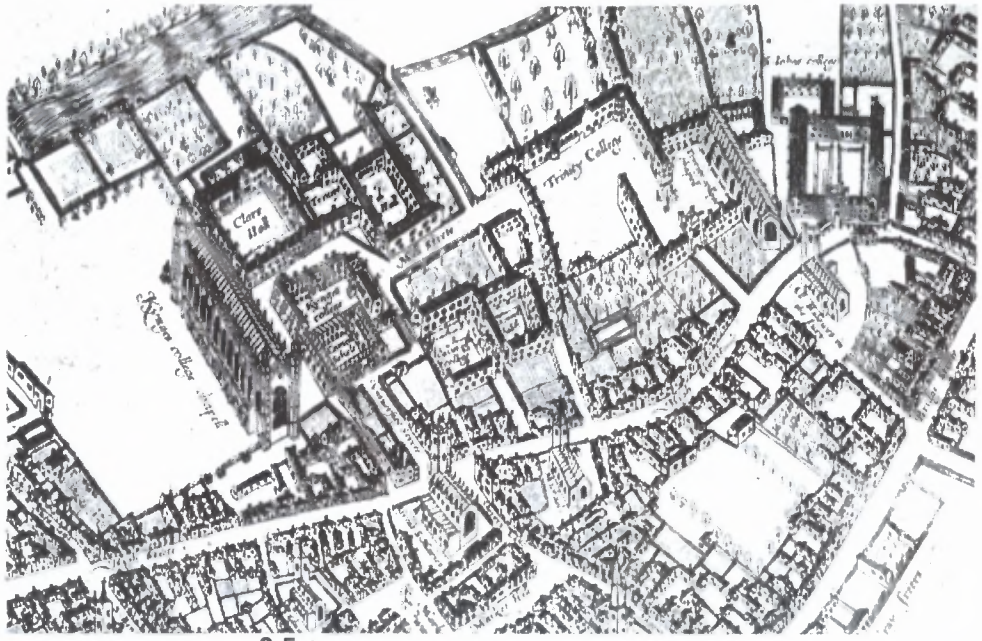
3.2 Cambridge 1280
Plan c.1280 shows that the University had no property of its own after about 70 years [Parker, 1983]



3.3 Cambridge 1574
Plan shows how by 1574, the University has taken over virtually the whole of the western half of the town [Parker, 1983]



3.4 Cambridge 1798
Plan of 1978 shows how growth is still contained within the previous limits but with further infill development [Parker, 1983]



3.5 Cambridge 1592
John Hammond's axonometric of Cambridge drawn in 1592.The college 'Backs' have not yet been created. Kings consists solely of the vast chapel & the original small Old Court. Trinity is shown in its original state just prior to reorganisation by Dr Nevile and St Johns consists only of two courts [Rawle, 1985]

3.1 An Overview of the Universities and their Colleges

3.1.1 Colleges

As at Bologna and Paris, the Oxbridge colleges came into being in order to create a secure community of scholars, safe from exploitation of ruthless landlords and, often hostile, towns folk. Originally the university undertook all teaching which was offered. Students ranged in age from grown men to children of 12, but most were boys of 15 or 16. They looked after themselves, stayed in garrets and lived a life which was wild, free and uncontrolled. Although the students liked this lifestyle, their parents, the teachers and the towns folk did not, so almost from the beginning there were attempts to get them out of lodgings and into boarding houses. Boarding houses were cheaper and students could live four or five to a room and have medieval fare of salt meat, salt fish, beer and bread, in common. The boarding houses had nothing to do with teaching, but sometimes a teacher stayed in the same house in order to keep an eye on them [Snow, 1951] [Fig 3.2].

In the 14C, the boarding houses became colleges, a term which was medieval jargon for a collection of men. Some were endowed by ecclesiastical politicians, country clergymen, noble ladies or local guilds. At first, endowments for these glorified boarding houses were small and went into buildings providing the bare essentials for a medieval community: a kitchen; a large room to eat in; stark unheated rooms for two, three or four students; and a small chapel. There was also a set of rooms for a Master, an unmarried priest at that time, who was paid to look after the college which, typically, comprised eight fellows and thirty six scholars [Snow, 1951] [Fig 3.3].

Towards the end of the 14C, a mysterious thing happened at both Oxford and Cambridge. It could not be explained rationally and did not happen at Paris or Bologna, nor at any other medieval university. The colleges flourished and began attracting considerable benefactions. Alumni gave their farms and manors, complete outsiders threw in a lease of land or a piece of plate and the colleges became wealthy, autonomous and far more important than the university. With this wealth, they could attract the good teachers to be

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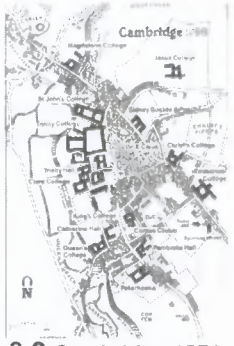

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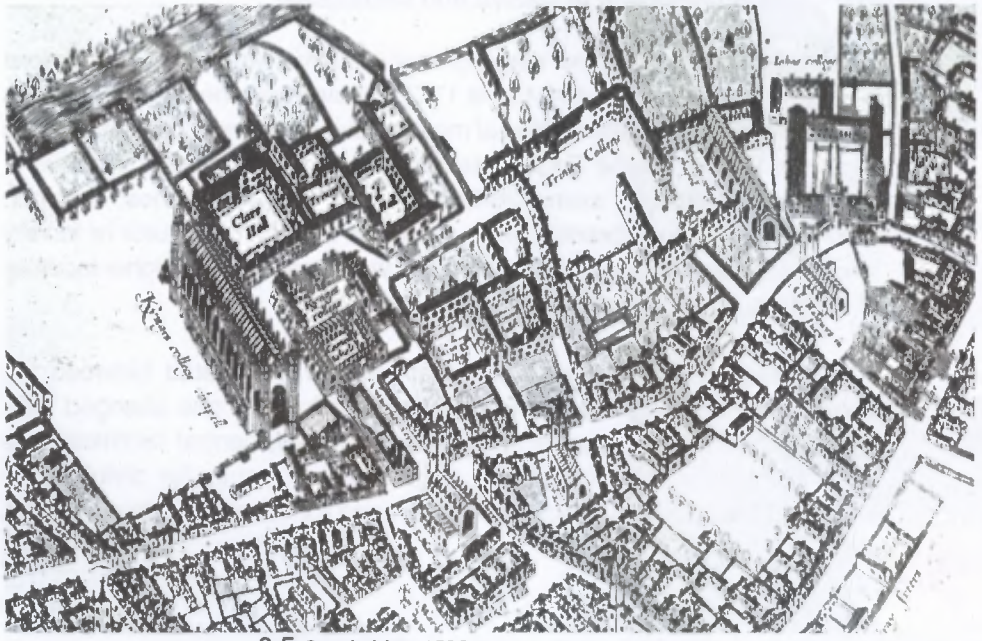

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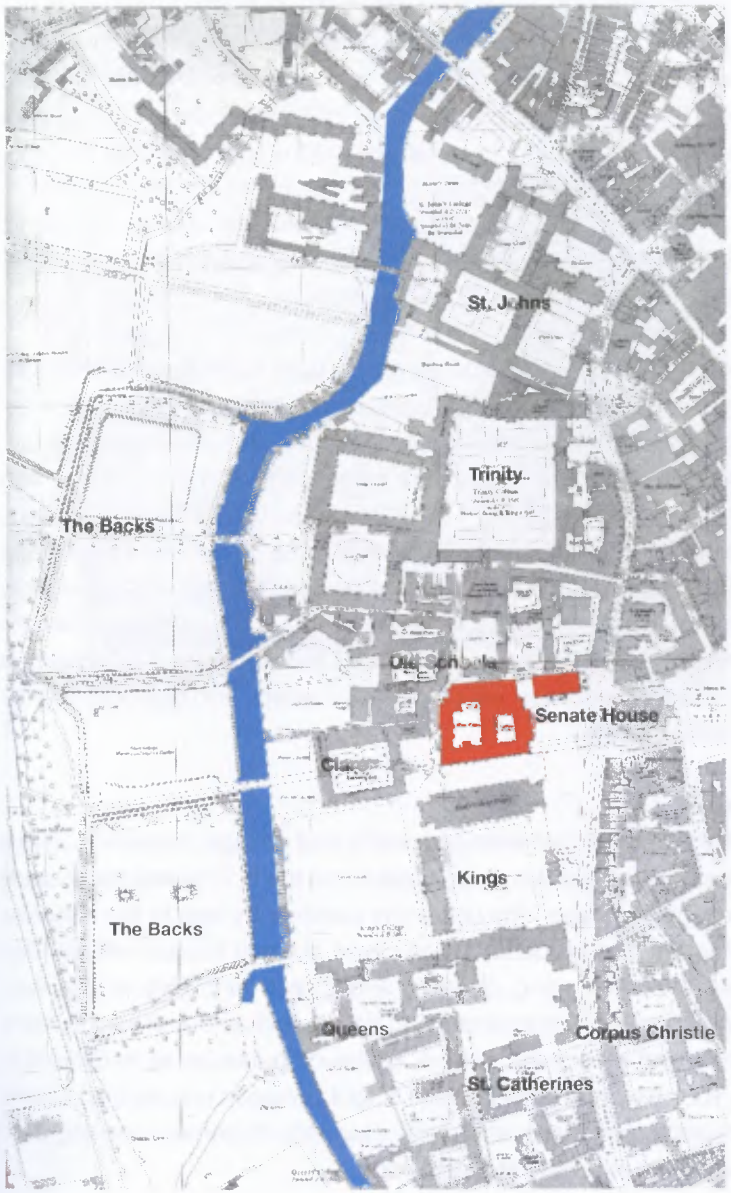


3.6 Cambridge University Buildings
Plan showing development of first University facilites, the Old Schools precinct [1350-1400] & Senate House in the 1722-30
[Base: Ordnance Survey 1967]

Masters or fellows with attractive salaries. The university, in contrast, was poor and had just enough money to pay its few professorships although it still had the right to examine and confer degrees. All other functions passed to the colleges. They did all the serious teaching, had the popular teachers, the power, prestige, glamour and the riches [Snow, 1951] [Fig 3.4-5].

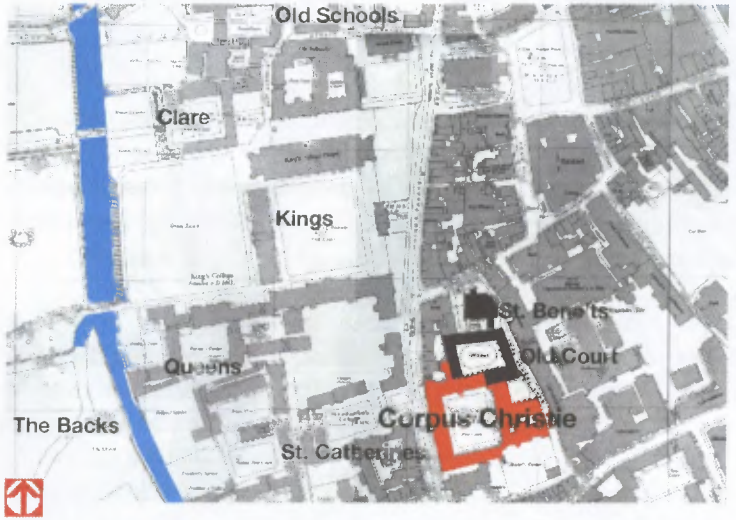
Thus, the peculiar dualism between university and college, unique to Oxford and Cambridge, came into being. Initially, the university was dominant but soon the colleges achieved a primacy that lasted until the 19C and still exists, to a lesser extent, today. From very early on the university became a federation of colleges. They nominated the Proctors from among their own members for the annual term of office and their heads often served, with the Vice-Chancellor and senior doctors, as members of an advisory council which was called the *Caput Senatus*. From the 16C until almost the end of the twentieth, the office of Vice-Chancellor of the University has been held by the Head of one of the colleges.

Independent and self governing, the colleges formed a core element of the University. They selected and admitted students, provided accommodation, meals, common rooms, libraries, sports and social facilities and were responsible for students' tutorial teaching and welfare. While the university determined the content of courses within which college teaching took place, set and marked examinations and awarded degrees [www.ox.ac.uk/].

3.1.2 University

The university had three functions: it was the body that awarded degrees; it shared teaching with the colleges; and it enforced jurisdiction over its members.The colleges and university had their own statutes and, although the colleges were not administered by the university, they were subject to its jurisdiction. Colleges had two direct responsibilities to the university: they contributed to its income; and they were obliged to reserve a number of fellowships for university professors. This was an important link between the two bodies, in that almost all university dons [professors, lecturers, readers or demonstrators] held college fellowships as well as being linked to a particular university faculty or department [Rawle, 1985].

3.7 Old Schools Precinct, Cambridge The Old Schools precinct at the back; Senate House & it's lawn in the right foreground; the classical 18C front of the Old Schools also faces the lawn



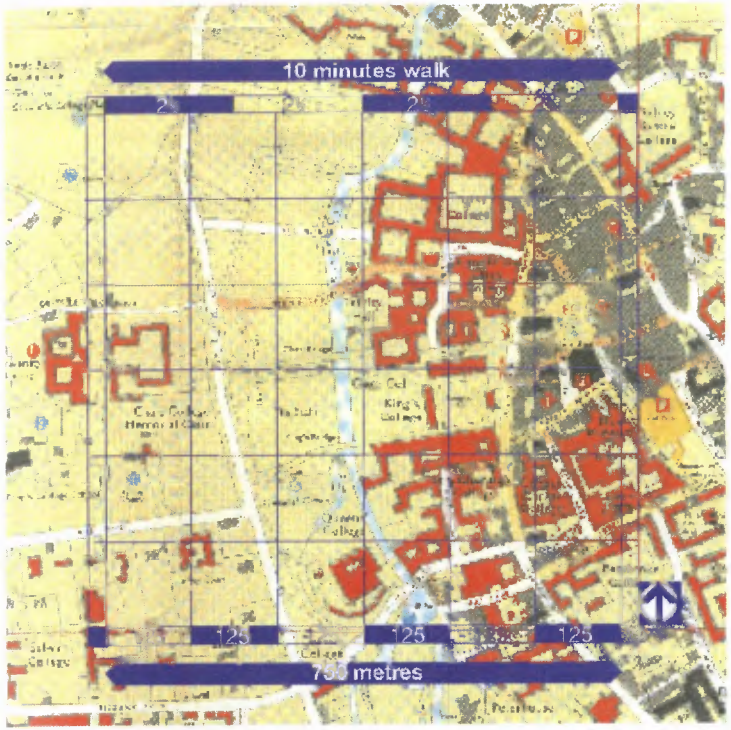
3.8 Corpus Christi College, Cambridge Cambridge. Old Court, Corpus Christi in black, showing relationship to St. Bene'ts church. Later developments of the College are in red [Base: Ordnance Survey 1967]

The balance between centralised and decentralised systems at both Oxford and Cambridge was expressed in the binary nature of their spatial development. It was a system which sought to balance crown and mitre, town and gown and importantly, college and university. It was not until the 14C, with the building of Congregation House in Oxford and the Old Schools Building in Cambridge, that either university had any property of its own. Cambridge relied on parish churches, especially Great St. Mary's and St. Bene'ts and on premises of religious orders, to provide sites for its public ceremonies. Lectures, disputations and lodgings occurred in private houses which frequently changed hands or went out of use.

The first central university buildings to be built in both Cambridge and Oxford were the Divinity Schools. These 15C university teaching buildings were followed by administrative facilities, as well as the early university libraries. It was the increase in the teaching role, particularly in the sciences, and the collection of books during the 17C, that began to change the balance between university and college. At Cambridge, the University Library had expanded with the rest of the University and, during the late 17C, it outgrew its original quarters in the Old Schools. With the construction of Senate House in front of the Old Schools, a series of alterations and adaptations were made to the old buildings, which provided space and splendid fittings for the Library [Fig 3.6-7].

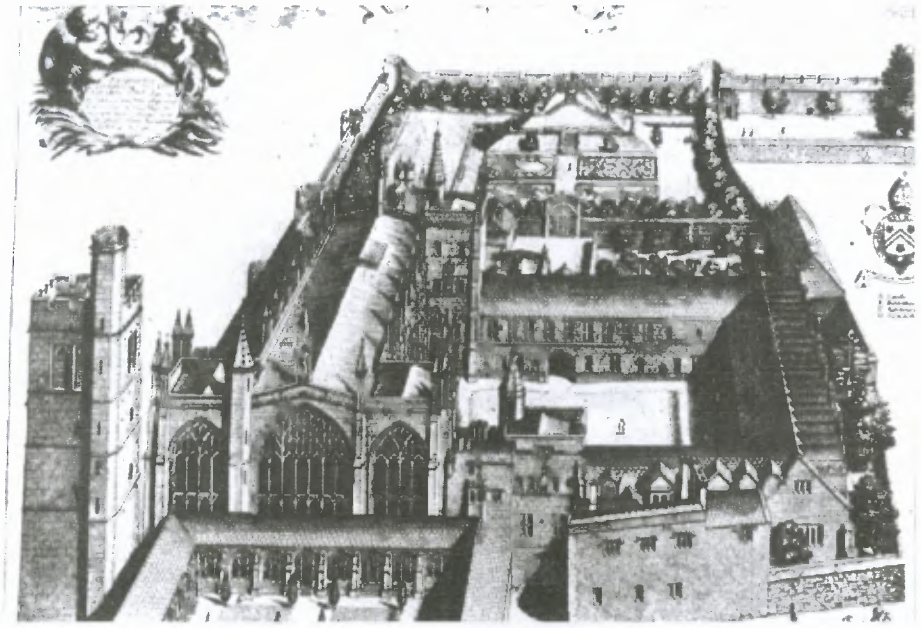
3.1.3 Town and Gown

Together with the dualism between university and college, there was also a polarity between the universities and people of the town. This was particularly severe at the beginning when the university community was in the minority. As shown, Masters and students initially lived in hired houses where they were subjected to overcharging, cheating and ill treatment. This, in turn, was often a consequence of ill-disciplined and riotous behaviour of young men. One of the first, and most momentous, of the disputes arose in Oxford in 1209 when a young woman was killed in a fight between scholars and town folk. The University took alarm and many students dispersed, moving east to establish a sister university at Cambridge.



3.9 Cambridge Town Map
Contemporay map showing major clustering of colleges [Base: Ordnance Survey 1980]

In the long strife between town and gown, the streets were often scenes of pitched battles with, at Oxford, the bells of St. Martin rallying the citizens and those of St. Mary the Virgin summoning the scholars. In the short term, the University, usually backed by Church and King, was emphatically the victor. However, with the growth of the universities the balance of power changed to a more sustainable one, with the town economy depending heavily on the universities.



3.10 New College, Oxford
New College with buildings from 1386 was the first unified expression of college architecture
[Etching by David Loggan]

3.11 New College Oxford
New College chapel from cloister quad

3.2 Formal and Spatial Development of the Colleges

This section starts with a general overview of the Oxbridge colleges. It then examines two colleges in detail. New College, Oxford, was the first university building. It is the college prototype, while Trinity College, Cambridge, represents a flowering of college architecture and embodies many of the important contributions of the Oxbridge college type to university planning. The section then examines the spatial implications of the binary nature of college and university and concludes with a description of the gardens, walks and landscaped setting.

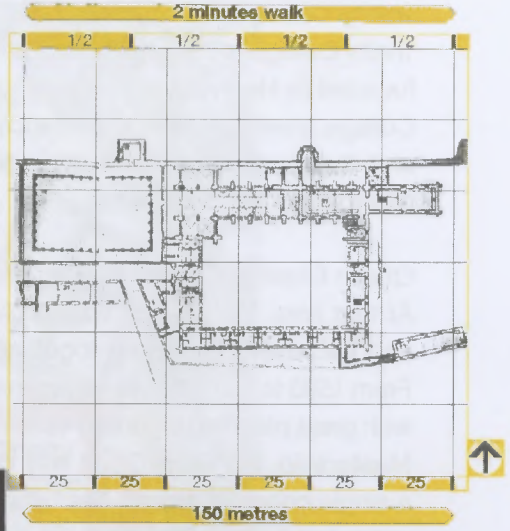
3.2.1 College Overview

During the latter part of the 14C, formal college plans began to emerge. College building started with the Old Court of Corpus Christi College, Cambridge, completed in 1377. It consisted of chambers, refectory kitchens, library and masters lodge, ranged around an enclosing court with the neighbouring St. Bene'ts acting as the college chapel [Fig 3.8]. Though buttressed for strength in the 15th and 17C, it's exterior remains much as it was in the 14C and it is the best surviving example of a medieval court in Cambridge. Old Court was only a part of a college. A special university architecture began with New College, Oxford in 1379. It was the first expressly designed complete university building comprising facilities for both masters and students and it formed an important model for later colleges [Fig 3.10].

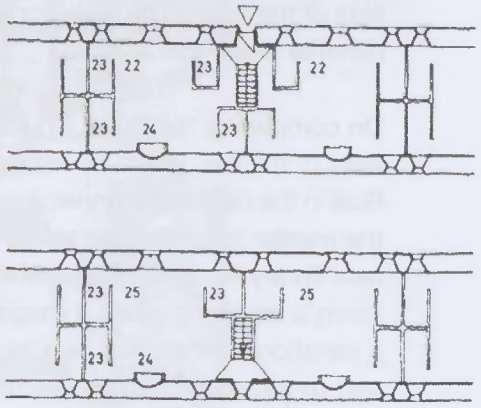
Generally, the Oxford colleges were smaller and more tightly packed than those at Cambridge. The buildings themselves were grander at Oxford, with stone facings and busy skylines whereas the Cambridge buildings, many in simple brickwork, are more modest.

Six new colleges were founded at Cambridge in the 14C but it was not until the 15C that planned courts came to be built at Magdalene, King's and Christ's Colleges. The first comprehensive college development at Cambridge was at Queens College in the 15C and 16C. Later, in the 16C with the development of Gonville and Caius College, the three sided court was introduced. This was called the 'sanitary arrangement', as it was thought to be more healthy because of the additional ventilation. It was a scheme which was also used at Emmanuel and Sidney Sussex Colleges. It also became the model for the early development at Harvard in the following century.

3.14 New College Oxford
New College 14C cloister



3.13 New College Oxford
New College plan in 150m. template [Willis, 1988]



3.12 New College Oxford
New College student chambers showing traditional staircase access [Willis, 1988]

New College, Oxford [Figs 3.10-14]

New College was a grand and prestigious college, founded by William of Wykeham, an architect of some repute, as well as a lawyer-ecclesiastic [Headlam, 1904]. It is one of the few colleges where the wealth of the founder enabled his designs to be carried out in full. The principal buildings around the cloister and great quadrangle were completed in 1386 and were an excellent example of English perpendicular architecture. The garden quadrangle at the back was built in the 17C.

It was organised on a large and comprehensive system, having benefited from previous piecemeal developments. For the first time, a complete self contained university building was planned and built in a single phase. Strongly influenced by the English cathedral monastery, it was structured by the internal open spaces, principally the large quadrangle [45x38m.]. It had all the architectonic elements of the monastery, such as gateway, chapel, cloister, library, refectory with its attached kitchen, buttery [storage area for ale and wine], treasury, domestic offices and masters lodge.

Most importantly, it incorporated student accommodation. However, whereas a monastery had dormitories, the college provided student chambers. A cloistered walkway at ground level gave access to staircases leading to the rooms above. It was as though they were row houses, each with its own entrance and staircase. There have been many variations of this theme, but the basic idea of providing a self contained living and learning environment, with study bedrooms structured by staircases, has survived to the present day.

These enclosed quadrangles functioned as a defence against potential enemies, who included the townspeople themselves, as well as outside armies. This ability to close off a college at a few gate points also gave the authorities a greater control over the movement of students, a concern which was a major factor in the growth of the collegiate system.

3.19 Cambridge Colleges
The ratio of gross building area to open space for the old colleges at Cambridge [Kings, Clare, Gonville and Caius, Trinity and St. Johns] is 1:1. That means that the total building area equals the area of land they use
[Model by Architectural Students, Bath University]

Where did this order come from? Of course it was not planned; there was no master plan. And yet, the regularity, the order, is far too profound to have happened purely by chance. Somehow the combination of tacit culture defined agreements, and the traditional approaches to well-known problems, insured that even when people were working separately, they were still working together, sharing the same principles. As a result, no matter how unique and individual the pieces were, there was always an underlying order in the whole" [Alexander, 1975].

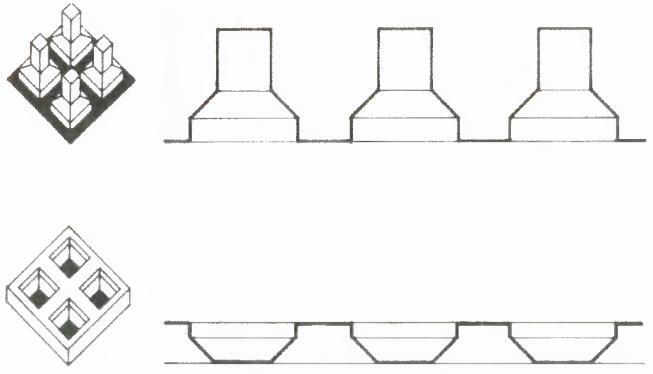
As an aside, Alexander goes on to decry the state of present university planning where the individual parts have taken control and the whole has been lost or, conversely, where the whole has been made to take control and the integrity of the parts has been lost.

Architectural Style

This sense of unity between the parts and the whole achieved in different contexts, over long periods of time, integrating the large variety of styles used at the different periods of development. These range from Early Gothic to Baroque and Neoclassical, as the following table indicates [Mason, 1982].

Style	Oxford	Cambridge
Gothic	Merton College 1308-78	Kings College Chapel 1446
Early 12th-13th C	New College 1379	Queens College 1448
Decorated 13th-14th C	Divinity School c. 1483	Queens College, Presidents Gallery
Perpendicular 14th-16th C	Magdalene 1474	Gonville and Caius c.1565
	Jesus College 1571	Kings College Chapel screen & choir stalls 1533
Early Renaissance	Wadham College 1610	Nevile's Court, Trinity College 1612
	Bodleian Library 1613	Pembroke College Chapel 1665. Trinity College Library 1676-90
Classical	Sheldonian Theatre 1663-69	Senate House 1722-30. Fellows Building, Kings College 1666-77
		Emmanuel College Chapel 1666

3.20 Kings College Chapel, Cambridge
Kings College Chapel was founded in 1441, building commenced 1483, the fabric was completed in 1515 with the screen, choir stalls & casing for the organ completed by 1688
Chapel is 88m. long, 28,6m. high &12,2 m. wide



3.21 Pavilion & Court
Research shows that the court is a building form which uses land most efficiently. The relative characteristics of the tower or pavilion & it's antiform, the court were studied. It shows that the court form places the same amount of floor space on the same site area with the same condition of building depth but in only one third of the height of the pavilion form or tower.
[Martin & March: 1972]

Adaptability

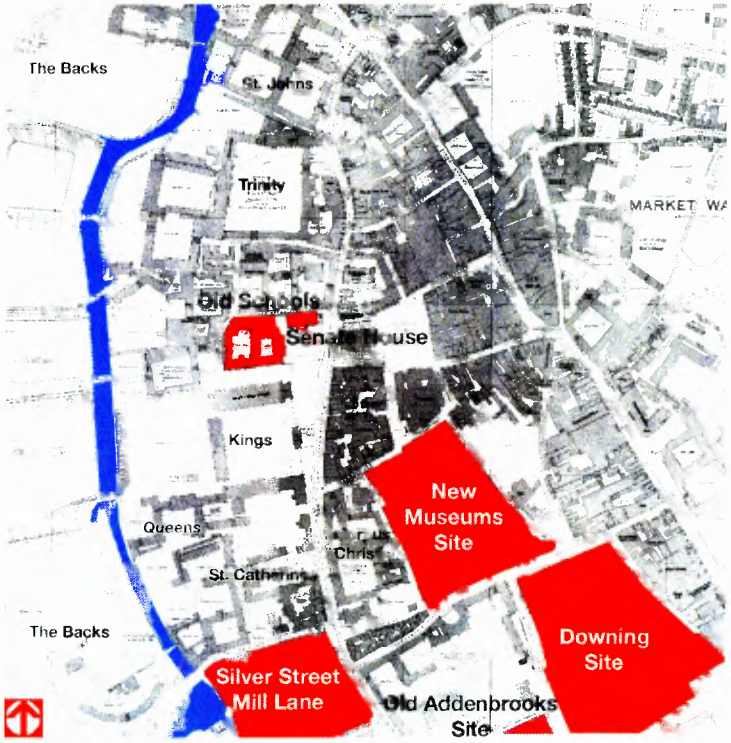
The major elements of the generic plan were gateway, chapel, hall or refectory and students chambers. The latter were planned around a staircase providing only vertical circulation. All these spaces have been able to respond to the changing needs over the centuries and are still in use today with the student chambers providing very desirable accommodation.

Balance of Building and Open Space.

One of the most remarkable aspects of the old medieval colleges was the balance of buildings to open space. While there was great variety in the size of the courts, the overall impression was one of a very comfortable environment. There was a sense that, overall, an intuitive balance between built form and its enclosed open space had been achieved. According to Professor Michael Brawne of Bath University, who directed student research on the old colleges of Cambridge [Kings, Clare, Gonville and Caius, Trinity and St. John's] in early 1980's, the area factor or ratio of gross building area to open space is 1:1 [Brawne, 1984] [Fig 3.19]. Today, this ratio can be considered a water-shed which divides the open space dominated suburban campuses from the building dominated urban universities.

The Court as Building Form.

The Oxbridge courtyard system created a remarkably satisfactory environment which provided for degrees of community and privacy. It also created defensible space secure from the [hostile] external world and allowed for the regulation of the movement of students. Finally, it was a building form which uses land most efficiently. This issue, relating to the morphology of the environment, was researched by Leslie Martin and Lionel March in their book 'Urban Space and Structures' [1972]. One of the issues studied was the relative characteristics of the tower or pavilion and its antiform, the court. They found that the court form places the same amount of floor space on the same site area with the same condition of building depth but in only one third of the height of the pavilion form or tower [Fig 3.21] [Martin and March, 1972].



3.22 Cambridge University Buildings
Plan showing proliferation of University facilities in the18C, 19C & early part of the 20C
[Base: Ordnance Survey 1967]

3.2.3 Spatial Characteristics of University Building

From the late 14C a group of buildings called the 'Old Schools', were built at Cambridge. These accommodated the University's ceremonial and administrative functions with a meeting place for Senate, facilities for the Registry and lecture rooms, initially for Divinity.

As pressure began to mount for more centralised facilities in the 17C, Senate House was constructed in front of the Old Schools and alterations were made to accommodate the University Library in the old building. From this time onwards, the Old Schools precinct and Senate House, although very modest in size, became the spatial heart of the University, as opposed to the colleges.

At Oxford, the first university building was Congregation House, built adjacent to the church of St Mary in the late 14C. In the mid 15C, one of Oxfords very fine buildings, the Divinity School was built as a central teaching facility. In 1602 the Bodleian Library was built to house 2 000 books close to the Divinity School. This precinct of university buildings was expanded by Wren's Sheldonian Theatre in 1669 to provide a venue for occasions such as graduation, disputations, large public meetings, lectures and concerts. On the right of the Sheldonian is the old Ashmolean Museum of natural history [1673-83]. This group of university buildings was completed by the Radcliffe Camera in 1749, founded as a science library [Fig 3.40].

Increasing activity in the experimental sciences at Cambridge was later to attract men such as Rayleigh, Thomson, Rutherford and Cockcroft. Later these scientific activities resulted in the development of specialised laboratories on the Cavendish, New Museums and Downing sites with which no college could compete. Similarly the need for centralised lecture venues saw the later development of university facilities scattered throughout Cambridge [Fig 3.22]. This shift of the balance of power between colleges and the central university was accelerated by the need to store more and more information and the increased need for administrative and operational services.

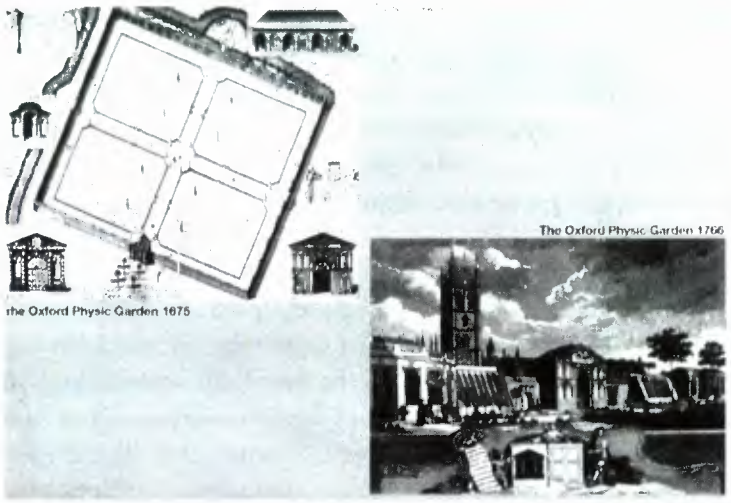
3.23 Cambridge Backs
Part of David Loggan's plan of Cambridge showing the Backs

Landscape, Gardens and Walks

The gardens, quadrangles, courts and meadow walks of both Oxford and Cambridge, were an important and necessary part of university life. Each college appointed its own garden master from its fellows. The gardens varied from the formal baroque gardens with 'parterres', water works and topiary imported from Europe, to the picturesque riverside walks along the Cherwell.

The 'Backs' at Cambridge are one of the great examples of environmental transformation. Over the centuries, they have been transformed from the natural wetland of the fens, to wharves lining the river Cam, to waterlogged tradesman's entrances and, later, into the town's most memorable landscape setting [Fig 3.23]. Before the 18C colleges, which owned land on both the town and country side of the river, treated such land as service entrances for supplies including fuel and building materials. Land on the opposite side of the river was also used for grazing livestock. Loggan's plan of 1688 shows a bowling green, a small enclosed garden and a tree lined avenue behind Kings College. In the 18C Kings College employed landscape designer Charles Bridgeman to plan their section of the Backs. Similarly, in 1772 St. John's employed the famous Capability Brown to plan their Backs for 'leisure and amenity'. Brown's most ambitious scheme was to remodel the whole of the Backs, but this came to naught because of the jealously independent nature of the colleges which were totally opposed to central planning [Walters, 1993]. The Backs, therefore, like the colleges, are not the work of one master planner but the "summary of many hands working to improve the natural advantages of the site, the *genius loci*" [Browne, ca.1970].

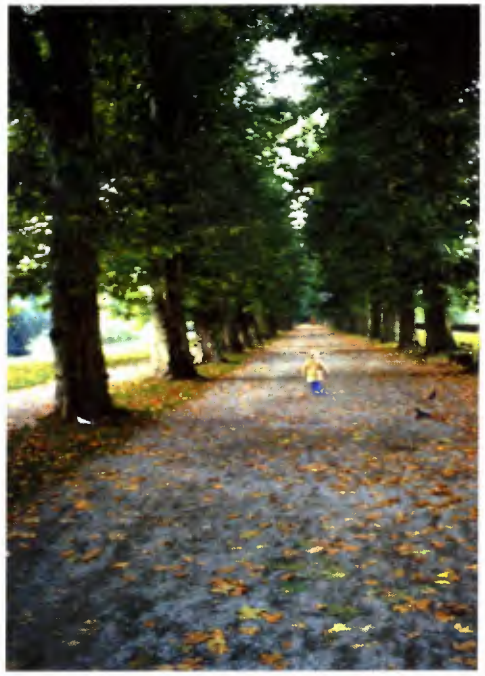
The Oxford Physic Garden, renamed the Botanic Garden in 1840, was founded by Henry Danvers in 1621 [3.24]. From the great Medical Schools of Padua and Pisa, the concept of botanic gardens spread north to Leiden and, later, to Oxford where the 'physic garden' still stands on its original site beside Magdalene Bridge. These gardens were intended for the advancement of medicine but, from the outset botanical, medicinal and practical gardening were linked in systematic study.



3.24 Oxford Physic Garden
Oxford Physic Garden [Botanical Garden] founded in 1621
(Batey, M. [1986])

The use of landscaped walks as a structuring device has been used at many universities, inter alia, the Broad Walk at Christ Church in Oxford, the poets walk at Heidelberg [Fig 3.25] and the forest walks at Göttingen and Tübingen Universities [Fig 3.26].

3.26 Tübingen University
Forest Walk at Tübingem University



3.25 Heidelberg University
View of the University town from the Poets Walk

3.27 & 28
Cambridge Gateways
King Edward's Tower, the gateway to Trinity College 1427-37. Nevile moved the tower 21 metres to the north to fit in with his re-development plans.

3.29 & 30
Refectory at Trinity College, Cambridge
Ackermans illustraion of the Kitchen and contemporary photograph of Nevile's Hall showing hammerbeam roof construction

3.3 Relationship of Spatial Development to Conceptual Framework

This part of the chapter reviews the spatial development previously described in terms of the conceptual framework as outlined in the Prologue.

3.3.1 Space Structure

The following were the primary spatial components of the plan.

College Facilities

- **Gatehouse or Gateway** [Figs 3.27-28]. This was usually in the east or west wall, generally placed symmetrically in Oxford and asymmetrically in Cambridge, reflecting their respective degrees of formality and informality.

- **Chapel** [Fig 3.20]. In the early days colleges used neighbouring churches. Kings College, Cambridge was given special privileges in 1446 to build a separate chapel. The Kings chapel, founded by Henry IV in 1441, was commenced in 1483 and completed in 1515. It is, perhaps, one of the finest remaining medieval buildings in England. A great rectangle 28,6m. high, 12.2m. wide and 88m. long, it is spanned by the famous fan vaults which evolved during the second phase of building in about 1480. The screen which divided the ante chapel from the choir is an outstanding example of Renaissance woodwork. For all its soaring architectural quality it is a very simple building, a unique single space relying on proportion, delicate structure and exquisite detailing.

  No subsequent privilege was given until after the Reformation, when a chapel was included in every newly founded college, as well as in some of the older colleges. The Chapel was generally placed in the north range of the court. Apart from the normal requirements for it to be placed on an east-west axis, it enabled the warmer south and east ranges to be used for the student chambers.

- **Hall and Kitchen** [Figs 3.29-30]. Typically this was found in the range opposite the gatehouse with the buttery forming part of the hall range and the kitchen planned in 'dead space' in the re-entrant corner, so that it did front onto the court. Later kitchen and buttery were separated from the hall, providing access to a second court.

3.31 St. Johns Library
Interior of library at St. Johns College Cambridge, 1624.

3.32 Trinity Library
Interior of Christopher Wren's library at Trinity College, Cambridge. 1676.

3.33 St. Johns Combination Room
Senior Combination Room, St. Johns College, Cambridge

- **Library** [Figs 3.31-32]. Initially book collections were housed in ordinary college rooms, but as they became more numerous special rooms were built. In 1320, a special room was built above the Old Congregation House at Oxford. This was for the use of all colleges with access to books chained to shelves and lectern. In 1399 a special library [11.25x5.5m.] was constructed at Trinity College, Oxford, for the express purpose of containing the College's collection of books. The library occupies nearly the whole of the first floor of the east side of the quadrangle.

  At Cambridge, the first recorded library was at Peterhouse with a room 18.2x6m. in 1431. At Kings, in 1447 a noble library, 33.5x7.3m. was proposed on the western side of the court. These libraries were located far from the hustle and bustle of the street and hardly ever on the ground floor because of problems with dampness. Sometimes, as in the case of Wren's Library for Trinity College [1695], which has a span of 11.3m, the space below was left completely open to assist in ventilating the structure.

- **The Combination Room** [Fig 3.33]. This was originally a large room for students to warm themselves around a common fire since no chimneys were provided in the chambers. It was a comfortable large room, usually on the ground floor adjacent to the refectory and was used for social activities, particularly by those students who did not live in the college.

- **Masters Lodge.** Normally, this was connected to the opposite end of the hall range, providing direct access to the dining room.

- **Treasury or Muniments Room.** These were rooms for the safe keeping of college documents and valuables, including gold, silver and copper coins which were usually kept in a chest made from oak panels, two to three inches thick, bound with iron bands and secured with locks and padlocks. They also housed valuable documents such as the seals, statutes of the college, charters, royal letters patent and other valuable documents. In the case of New College, Oxford, the treasury

was accommodated in four floors of a tower situated near the entrance. This plan arrangement was repeated many times at Oxford colleges, but not at Cambridge, where the treasury was sometimes attached to the chapel, the combination room or the masters lodge.

- **The Chambers** [Fig 3.11]. Accommodation for students was planned on two or three floors, sometimes with garrets. They were planned around a vertical staircase. Originally each chamber was occupied by several students and used for living and sleeping. In some cases, small cubicles were partitioned off for studying. Chambers varied in width between 4,5 and 6m. with garret floors about 3m. wide.

University Facilities

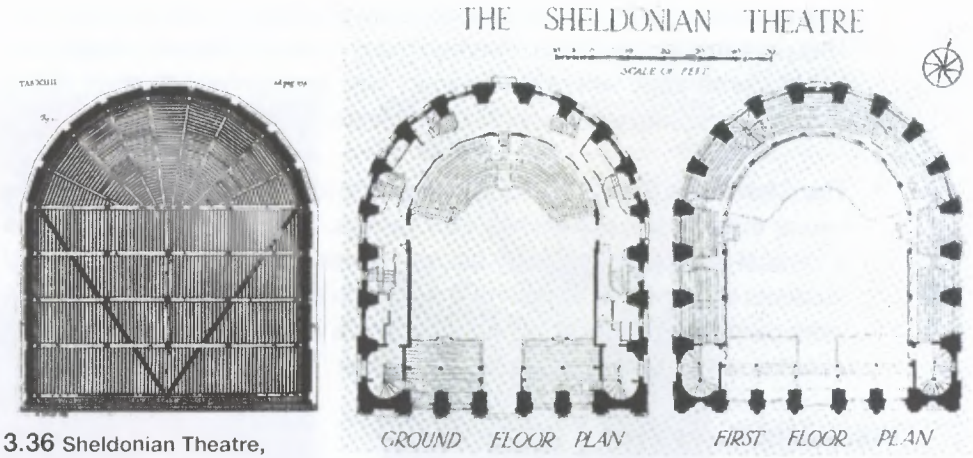
- **Lecture Rooms** [Fig 3.34]. Specific rooms for teaching started to appear in Oxford and Cambridge in the 15C. The celebrated Divinity School at Oxford, with its rib and pendant boss ceiling, is dated around 1483. At Cambridge, central classroom accommodation for the Schools of Theology, Canon and Civil Law were built at about the same time. These rooms have a maximum width of 8.5m.

- **Theatres** [Fig 3.35-36]. The Sheldonian Theatre marks the end of one period of micro-spatial development and the beginning of another. It was a precursor to the many lecture theatres which were to become such a feature of university building from the 18C but, whereas these were integrated into the general building fabric, the Sheldonian was free standing. Built by Christopher Wren in 1699, it had a 'D' shaped plan based on the Roman Theatre of Marcellus but, unlike the Roman theatre which had a canvas awning, the Sheldonian had steeply tiered seating and a roof with a 70ft [21.5m] span, unobstructed by any supports.

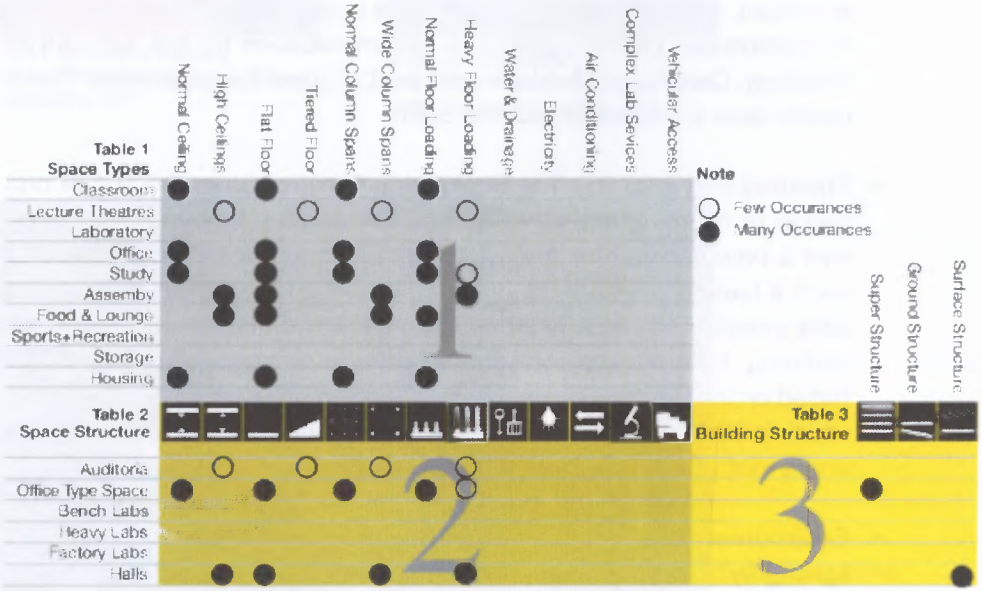
- **Environmental Services.** These were rudimentary in this period, with lighting by lamp and candle. Heating was by log fire in the wardens house and common rooms and cooking was carried out on a wood stove in the kitchen. There was no central plumbing or sewerage system. Lavatories were provided, but there is little evidence of where they were located

3.34 Divinity School, Oxford
The Oxford Divinity School, mid 15thC. First space designed for teaching

3.35 Sheldonian Theatre, Oxford
Sheldonian Theatre by Christopher Wren, 1699



3.36 Sheldonian Theatre, Oxford
Sheldonian Theatre Floor & ceiling plans [Jardine, 1999]



3.37 Medieval College Structures: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

except at Kings Hall, where a lavatory made of lead is recorded. There are indications of similar conveniences in Queens and Christ's Colleges. The effluent was led to a cesspit or soakaway, with serious results regarding the pollution of surrounding ground water and the consequent spread of disease. There were strict laws prohibiting students from bathing in a river, pond or any other state water within the County of Cambridge, under pain of receiving a public flogging in the common hall in the presence of the fellows, scholars and other members of his college [Willis, 1986].

Space Structure Template

Tables 1 and 2 of the space template [Fig 3.37] classify the spaces found in the Oxbridge colleges from the 14C to the end of the 17C. These can be described as follows.

- Office type space with spans up to 6m. for general accommodation. Later, measures were taken to provide additional structure for heavier floor loading in libraries. There is no evidence of any provision of services except for fireplaces in the common rooms and master's lodge and stoves in the kitchens.
- Halls which include some of the later libraries chapels and refectories with high ceilings, clerestory windows with spans up to 12 metres.
- Auditoria such as the Sheldonian Theatre, which is the only example of a large auditorium with a tiered floor and roof span of 21.5m.

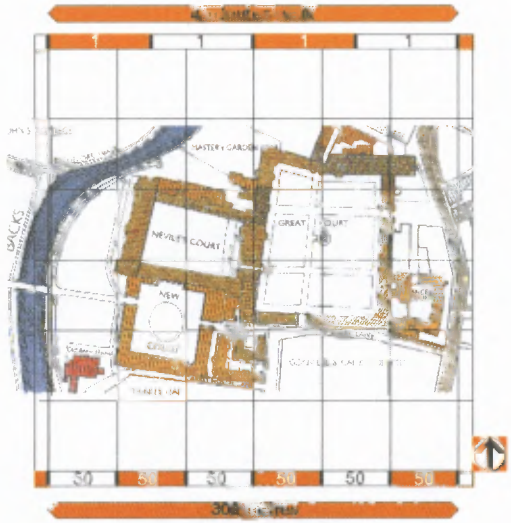
3.3.2 Building Structure

The Oxbridge space or room types were assembled into the following three types of building structure.

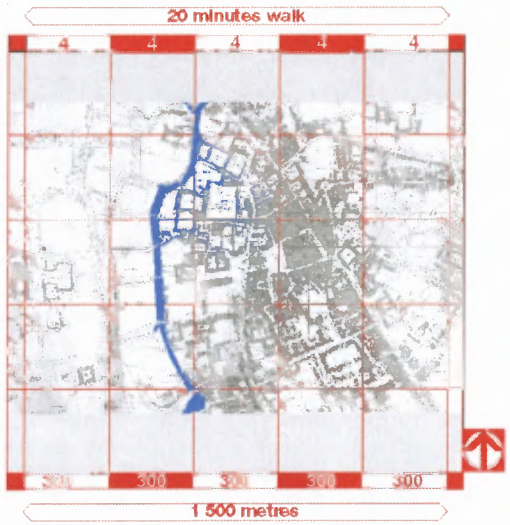
- **Super Structure** or 'office' type accommodation, stacked up to 3 floors, sometimes with an attic. This included the student chambers, common rooms, masters lodge and some of the early libraries;
- **Surface Structure**, with lofty column free spaces for chapels, refectories and some of the later libraries.
- **Ground Structure**, for large tiered auditoria and theatres.

These three types of structure were assembled in very elementary ways by

the differentiation of ranges. For instance, at Trinity College, Cambridge, the chapel formed part of the north range of the Great Court, the hall formed the west range and student chambers on the south and east. Similarly, in Nevile's Court, student chambers occurred on the south and north and Wren's library formed the western enclosing range. This elementary assembly is common to most colleges. The highly specific Sheldonian Theatre was totally free standing' without any connections to other buildings.



3.38 Trinity College Plan
Trinity College, Cambridge. Plan in 300m template



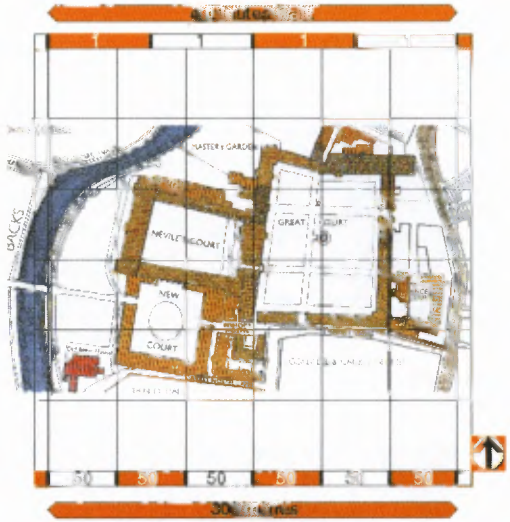
3.39 Cambridge Town Plan
Town plan in 1500m template

3.3.3 Planning Structure

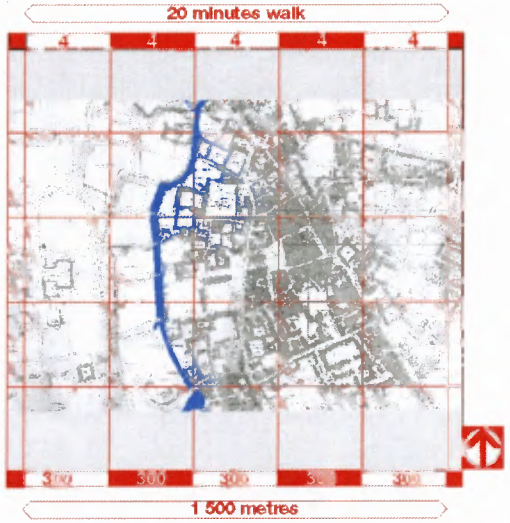
The following were the major characteristics of the Oxbridge planning structure.

- **Use of Land.** The use of land in Oxford and Cambridge was different. Oxford initially developed within the confining walls of the medieval city. Consequently, the colleges competed with each other for space and their distribution was more concentrated than Cambridge. Oxford had a hierarchy of streets, with major roads [the High Street, St. Giles and Broad] intersecting at right angles, and minor roads occurring behind [Figs 3.40-41]. Cambridge was somewhat different, with narrow frontages onto the street, opening up at the back to the green space of the meadow. It was structured on a rambling triangular street pattern, the major winding street changing its name four times from Trumpington to Kings Parade, Trinity and St. John's Streets [Figs 3.38-39].

- **Organic Balance.** The dynamic balance between centralised and decentralised facilities at both Oxford and Cambridge expressed the binary nature of the university system. Initially, it was the colleges which were independent and self contained accommodating all their academic and social needs. However, this changed slowly with growth of Old Schools and Senate House in Cambridge [Fig 3.22] as well as the Divinity School, Bodleian Library, Sheldonian Theatre and Ashmolean Museum in Oxford. These university facilities were more developed in Oxford [Fig 3.42-43]. where the overall planning structure was stronger and the balance of college and university was more legible.



3.38 Trinity College Plan
Trinity College, Cambridge. Plan in 300m template



3.39 Cambridge Town Plan
Town plan in 1500m template

the differentiation of ranges. For instance, at Trinity College, Cambridge, the chapel formed part of the north range of the Great Court, the hall formed the west range and student chambers on the south and east. Similarly, in Nevile's Court, student chambers occurred on the south and north and Wren's library formed the western enclosing range. This elementary assembly is common to most colleges. The highly specific Sheldonian Theatre was totally free standing' without any connections to other buildings.

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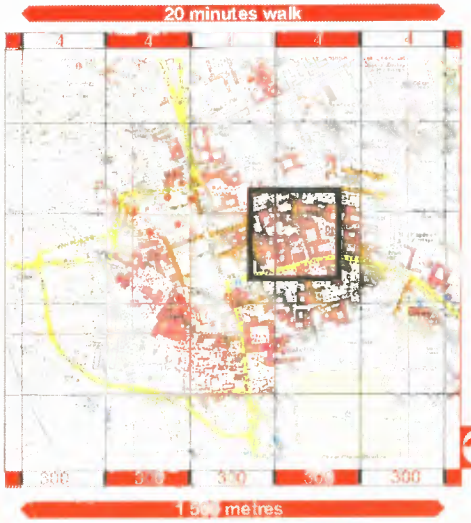
3.40 Oxford
Town plan structured by High street. Magdalene College in middle foreground [University of Cambridge]

3.41 Oxford
Town plan structured by High street. Christchurch College in middle foreground [University of Cambridge]



3.42 Oxford Town Plan
Oxford town plan in 1500m template with University facilities in box

3.43 Oxford University Buildings
Central University facilities [Base: University of Cambridge]

- **Gradation of the Environment.** An important feature of many of the Cambridge colleges and a few of the Oxford colleges, was the environmental gradation from the hard urban high street environment, with entrances to the colleges, through a variety of courts to the soft recreational open space, river and meadows of the Backs. This is described in some detail by Christopher Alexander in the previous section.

Planning Structure Templates

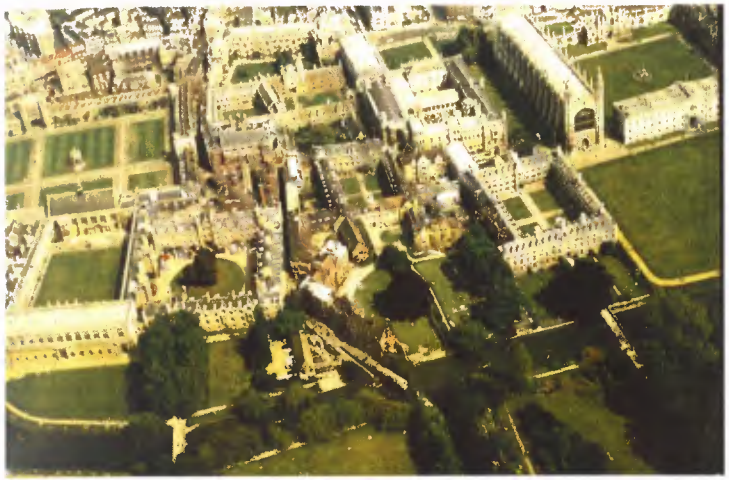
Growth within the colleges took place range by range and court by court, in an organic structure which has been able to accommodate the needs of the colleges over centuries. The proliferation of colleges at Oxford occurred within a rectilinear grid while the plan of Cambridge was structured on a rambling triangular street pattern. However, the organic growth pattern is similar in both cases, at the micro-planning level of the college and the macro level of the university in the town.

Most of the colleges were contained within the 300m. template with some of the smaller colleges within the 150m. template. Most of the university in both Oxford and Cambridge is contained within the 1500m. template, while the grouping of older colleges is within the 750m. template.

3.3.4 Conclusion

The 'open' architecture of Oxford and Cambridge was the first distinctive university type to emerge. It arose out of the needs of church and state, enjoying patronage in an increasingly prosperous England. By the 17C, Oxford and Cambridge represented a unique balance of the polar opposites of church and state, town and gown and built form and open space

At a micro-planning level the study has demonstrated how the deeper structures of the collegiate system were the result of piecemeal organic growth informed by an architectural pattern language and a plan providing for the needs of community, privacy, security and control, in an environment which made the best use of land and balanced the fabric of open space and building form [Figs 3.44-45].



3.45 Cambridge Aerial
Cambridge Backs [University of Cambridge]

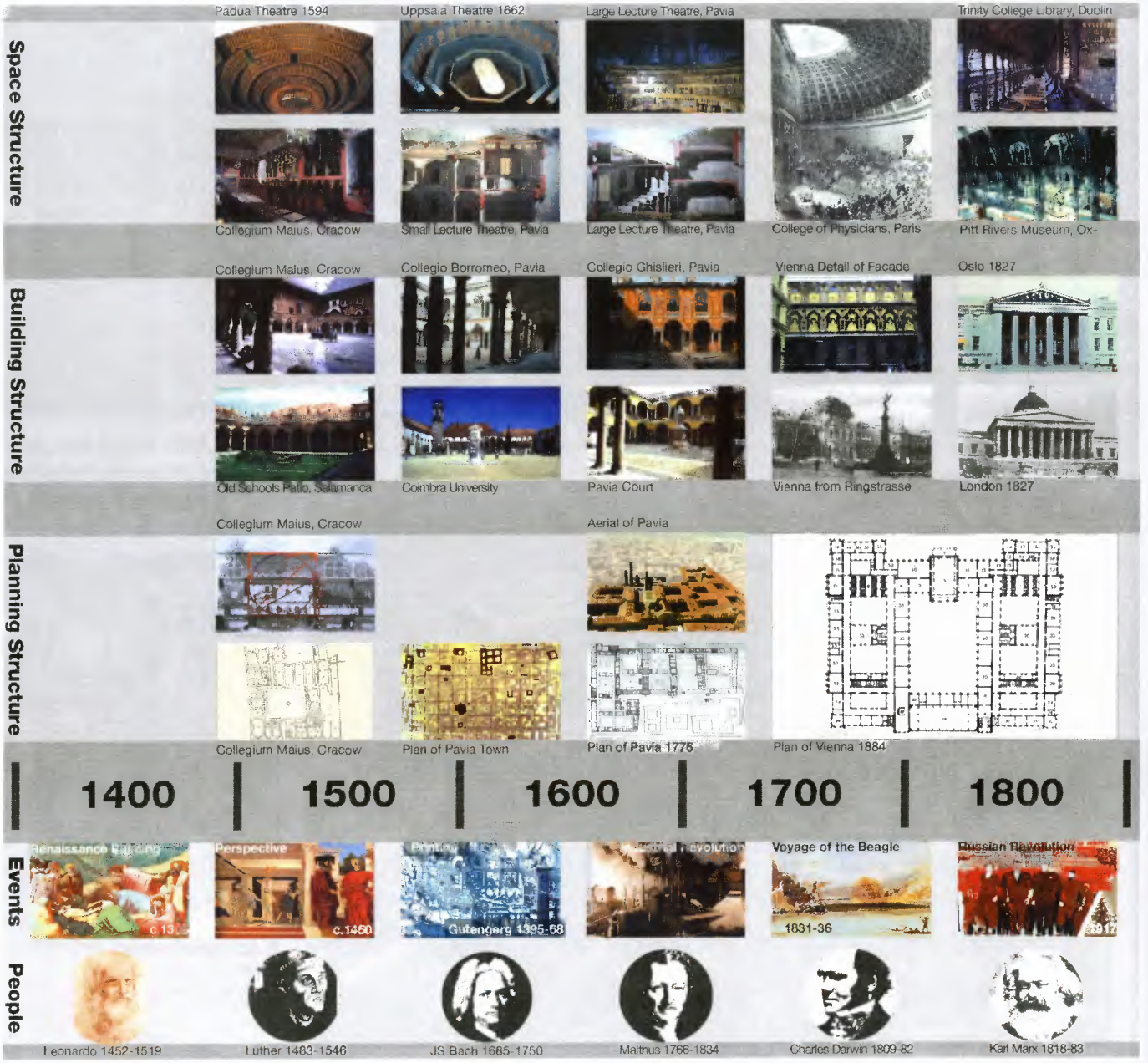
3.46 Oxford Aerial
Central University buildings [Thomas Photos, Oxford]

At a macro-planning level, the spatial development of colleges within the city showed how the binary nature of college and university reflected the changing emphasis from the independence of the colleges in the early days, to inter-dependence at the end of the 17C. This process continues to this day [Fig 3.42]. The balance of open space and built form at a planning level is best demonstrated by the Cambridge colleges, where the Backs have been transformed over the centuries into a landscaped setting which is one of the finest examples of environmental culture in the world.

Although open to brilliant scholars and the privileged classes, the Oxbridge colleges were closed to society at large. Thus, whereas their planning structure reflects an open architecture capable of growth and adaptive re-use, their building form expresses the friction between town and gown in closed, defensible spaces. They are exceptional examples of the transition from the closed, insular monastic communities to the urban developments of European universities in the 18th and 19th centuries and later, the democratic American campus model.

CHAPTER FOUR

University Buildings in Europe from 15Cto 19C



CHAPTER FOUR

European University Building from the 15th to 19th Centuries

4 The Grain in the Stone

The previous chapter described the flowering of the medieval university at Oxford and Cambridge. This chapter sketches the development of the university in Europe from the 15C to the 19C. During this period the demands of increasing enrolments and advances in science, particularly the medical sciences, led to increasingly complex buildings and the emergence of several distinctive space and building types. It is this emphasis on the new space types, or the grain of the building, which is one of the main characteristics of this period.

The chapter deals mainly with universities in southern Europe, where most development took place from the 15C to the 17C. Exceptions to this were the universities of Cracow and Prague. There was considerable academic activity in Paris, but little new spatial development. Development in the north increased from the late 17C to the 19C with the emergence of several large urban universities. The chapter is organised in three sections:

- an overview of the early southern European universities; the
- formal and spatial characteristics of three typical European universities, an early Eastern European university [Collegium Maius in Cracow]; a typical Italian renaissance university [University of Pavia], and a large 19C neoclassical urban university [University of Vienna]; and a
- concluding section which relates these spatial developments to the conceptual framework of the thesis.

4.1 Navigator Image
The Navigator Image presents an overview of Chapter 4.
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.

4.2 Salamanca University, Spain
Old Schools Patio 16th Century

4.3 Coimbra University, Portugal
Founded 1290. First Buildings 1517

4.1 Overview of the Early Southern European University Buildings

The 14C and 15C were a great founding period for European universities. According to Rashdall, during the 13C there were fifteen universities in Europe [Rashdall, 1895]. The most important of these were; Bologna, Padua, Venice and Naples in Italy, Paris, Anger, Orleans and Toulouse in France, Oxford and Cambridge in England, Salamanca, Valladolid, Palencia and Seville in Spain; and Lisbon in Portugal. By the end of the 15C some 50 new universities were established throughout Europe, including three in Scotland. Although there is no precise agreement about the founding dates of these universities, they do, however, reflect a comparative view for the whole of Europe for the period from the 11C to 15C.

It should be noted that, unlike the southern European universities, most of the northern universities did not develop specific university buildings, but rather adapted existing structures which were undifferentiated from the city fabric. Hence, the discussion that follows tends to emphasise those in the south.

4.1.1 Portuguese and Spanish Universities

It was noted previously that the early universities, wary of secular and religious power, tended to locate far from power centres in the large cities. In Portugal, for example, the old University of Coimbra was distant from Lisbon, and in Spain, Salamanca was remote from Madrid. Salamanca [Fig 4.2], founded in 1218, was for many years on an equal footing in status with Oxford, Paris and Bologna. Significant buildings were the Patio Las Escuelas [1428] in the Salamanca Plateresque style and the principle meeting room, the old library and University chapel built in second half of 15C.

Coimbra University [Fig 4.3-4] was founded in 1290 in Lisbon but it moved to Coimbra in 1537, partly to distance itself from power in the capital. The University was installed in a palace with the main buildings ranged around three sides of an open space with good views over the town. These buildings date from the 16C, 17C and 18C. They included the magnificently decorated

4.4 Coimbra University, Portugal
Biblioteca Joanina 1724

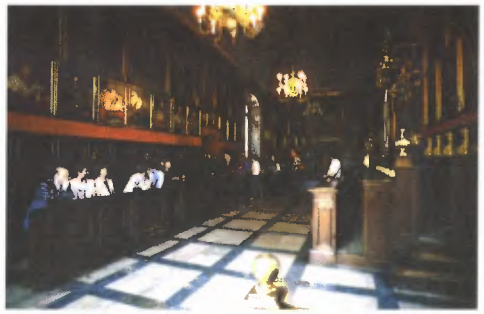
4.5 Collegio di Spagna
Cortile of the Collegio di Spagna in Bologna, built for Spanish *transmontane* students [University of Bolgna, Places & Museums]

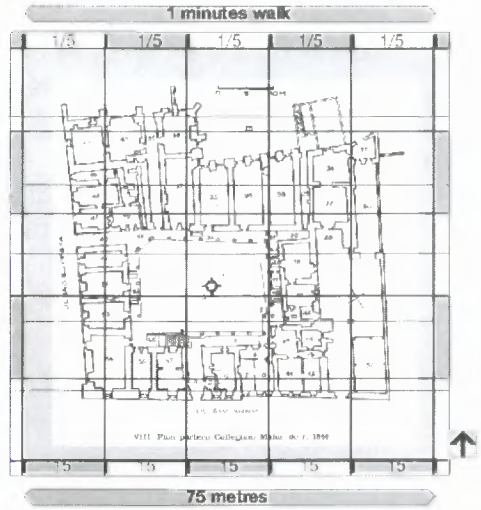
baroque library, Biblioteca Joanina, with ceilings painted in false perspective built in 1724, the Capela de Sao Miguela and the Salo Grande dos Actos, where major university events took place.

4.1.2 Italian Universities

Some of the main buildings of the University of Bologna built in this period were L'Archiginassio 1563-1803, an example of a grand building on the two storey palazzo model, built on the instruction of Pious IV, to provide a large new building for a more functional and decorous seat for the Arts and Jurists; the courtyard of the Palazzo del'Archiginassio [1562]; the magnificent anatomical lecture theatre in the Archiginassio [1734], which was to have a major influence on later university buildings; and the courtyard of the Palazzo Poggi, seat of the University of Bologna [1549], and the Collegio di Spagna, built for 24 [*transmontane*] Spanish students of noble origin [Fig 4.5].

The University of Padua was the second oldest university in Italy. It was founded in 1222 but the oldest specific university building was the Bo, dating from the 16C. It was designed by Sansovino and originally housed the Medical Faculty, which was renowned throughout Europe. It has what was probably the very earliest anatomical lecture theatre built in 1594. It was a circular facility with steeply tiered standing room for students who looked down on the dissecting table which connected to a lower floor for the collection of body parts. It also had the original lectern from which Gallileo gave his heretical lectures, insisting that the earth travels around the sun.





4.6 Cracow University : Collegium Maius
Plan of College in 75 metre template [Esteicher, 1968]

4.7 Cracow University : Collegium Maius
Various internal & external Views showing courtyard used as outdoor room

4.2 Formal and Spatial Characteristics

Following from the social and educational background examined in Chapter 1, this section describes the formal and spatial qualities which emerged as a response to these conditions, using three case studies; the Collegium Maius in Cracow, an early Eastern European university; the University of Pavia, probably the best example of an Italian renaissance university; and the University of Vienna, which is a typical example the architectural development of a large, Neoclassical urban university building in 19C Europe.

4.2.1 Collegium Maius : Cracow University

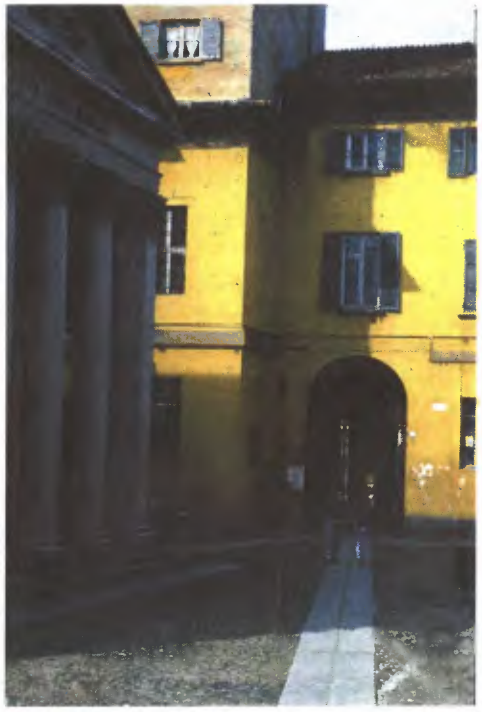
The Collegium Maius was the oldest building within the Academy of Cracow which is now the Jagellonian University. The history of the Collegium goes back to the year 1400 when it began in a large house. During the 15C the Collegium was able to purchase the houses contiguous to the College and to combine them into a harmonious whole, complete with a courtyard enclosed with a ring of arcades, interrupted by the professors staircase, leading up to the first-floor balconies. On the ground floor there were lectoria [lecture rooms], which were low-vaulted, dark and often wet rooms. On the first floor was the Library [added c.1515-1519], the Stuba Communis [refectory for Professors], the Treasury rooms and Assembly Hall. The Professor's chambers were scattered all through the building.

The design of the lower portion of the building was influenced by the Collegio di Spagna [1390] in Bologna and the Palazzo Bargello in Florence. However, it incorporated the traditional steeply pitched roof common in this part of Poland. It was this roof that gave the internal courtyard its special sense of enclosure, making it a multi functional outdoor room.

Up to the second half of 19C, the external facade and interior arrangements of the Collegium Maius did not change much. The neo-gothic reconstruction in the years 1840-1870 effectively blurred the austere elegance of its original structure, which is now the seat of the Jagellonian University Museum, home to ancient university collections, including the collection of the old scientific instruments. These included those of its most eminent alumnus, Nicolas Copernicus [Fig 4.6-7].

4.8 Pavia University
Aerial View of University in town [www.unipv.it/campus]

4.9 Pavia University
Towers mark entrance [Azienda. Fotografica.



4.10 Pavia University
Aula Maxima & entrance

4.2.2 Pavia University

Dating back to pre-Roman times, the town of Pavia was a municipality and an important military site. Subsequently, it became a fortified citadel and the last bulwark of the Goths and the Byzantines. After the Lombard conquest, Pavia became the capital of their kingdom and, later, of the Regnum Italicum until the 12C. Subsequently, Pavia continued to be an important and active town. Conquered by the Visconti family which ruled over Milan, it became an intellectual and artistic centre, as well as being the seat of the University which attracted students from many countries. After the Franco-Spanish war and the battle of Pavia [1525], the town fell under Spanish occupation until 1713. It was then ruled by the Austrians until 1796, when it was occupied by the French army under Napoleon. In 1815 it passed again under Austrian administration until the Second War of Independence [1859] and the unification of Italy [1860].

Even in Roman times Pavia was a literary centre. Later, in the tenth and twelfth centuries there were professors of dialectic and law at the University, as well as professors of literature. Until 1361 there was no studium generale at Pavia, so whoever sought legal training went to Bologna. In 1361 Galeazzo II obtained from Charles IV a Studium Generale with the privileges accorded to the most renowned universities. Lectures in astronomy and philosophy were held from 1374 and the study of rhetoric and the classics began in 1389, mathematics in 1425, theology in 1432, Hebrew in 1491, archaeology in 1500, military architecture in 1645 and medicine in the 17C [Benigni, 1999].

Pavia became part of the Austro-Hungarian Empire and in 1763 Maria Theresa reorganized the University courses by increasing the number of chairs and adding various institutes and collections. Specialist courses were introduced in anatomy, gynæcology, physiology, neurology, experimental pathology, physics, chemistry and oriental studies. In the eighteenth and nineteenth centuries studies in mineralogy, numismatics, applied engineering and pharmacy were introduced. By 1910 there were 50 professors holding 102 different chairs, 103 tutors, and the students numbered 1507 [Benigni, 1999].

4.8 Pavia University
Aerial View of University in town [www.unipv.it/campus]

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Towers mark entrance [Azienda, Fotografica,

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4.11 Pavia University
One of the Main Courts

4.12 Pavia Ghieslieri College
Example of one the grand satellite colleges

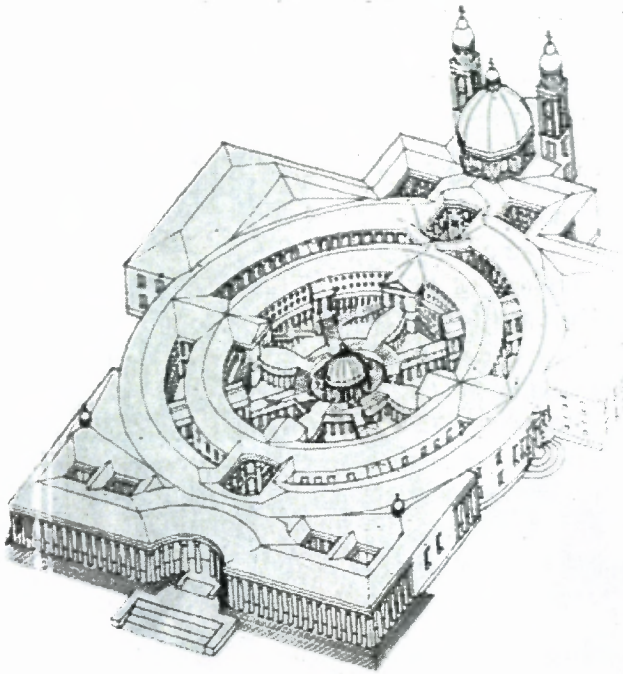
Pavia town is structured on a strong Roman grid of about 80m. in both directions. The 'new' central University buildings, which date from the middle 17C, were set within this grid and became an integral part of the city fabric. Like Oxford and Cambridge, the university had several satellite colleges which ringed the institutional core. Ghislieri College [1564] [Fig 4.11] and Borromeo College [1567] provides some idea of the grandeur of some of these satellite residential colleges which accommodated a library and some study rooms. However, unlike Oxford and Cambridge, it was the institutional core which was dominant in all matters relating to the major university instruction and research programmes, as was the case in most Italian universities.

The buildings of the University were based on the model of a two storey Italian Renaissance palazzo. The central core was extensively rebuilt and extended in 1776 by the architects Piermarini and Pollack. Pavia today is one of the best examples of a university from this time. It was more dense than the Oxbridge colleges with the gross area of building about 1,5 times the area of land they occupied. They could also grow incrementally through the proliferation of courtyard modules although not as readily as the Oxbridge colleges [Fig 4.8-12].

Pavia, however, demonstrated something different from earlier universities. It showed how, with the increasing complexity of teaching activities, the new spaces could no longer be accommodated within the constraints of a narrow band of construction [Fig 4.19-20]. From this time onwards, as discussed at the end of this chapter, the 'grain' of university buildings, or their 'fundamental space particles', started to change. The large lecture theatres were a dramatic example, but with needs for a wide range of laboratories, libraries, large top-lit exhibition areas and halls, the assembly of the various space types became much more complex.

4.2.3 19C Universities in Europe

The overall size of university buildings were becoming much larger and architectural design imperatives meant that they could no longer be built incrementally. One of the first university master plans was Piranesi's project for the Ideal University in 1750 [Fig 4.13]. This massive closed Neoclassical structure was a precursor to the large monumental university buildings which were constructed in all the major cities of Europe in the 18C and 19C.



4.13 Ideal University by Piranesi 1750

[Rückbrod, 1977]

The Ecole Polytechnique in Paris [1794] was an immediate result of the French Revolution [Fig 4.21]. Others, established in this period, were the Sorbonne [1885-1901], Berlin [1800], the Vienna Technische Hochschule [1815], Oslo [1811], Helsinki [1827], Dresden [1828], Stuttgart [1829] and University College, London [1827-29]. These Neoclassical blocks reflected the rise of capitalism and imperial power and established them as important university building types emerging from the previously adaptive process.

Examples of the spatial differentiation illustrated in the sections on Pavia and Vienna can also be found at the Ecole des Beaux Arts, completed in 1839, where the courtyard of the Palais des Etudes was glassed over in 1867 to form an exhibition studio; the libraries at Trinity College, Dublin and St. Génevieve in Paris; and the Pitt Rivers Museum at Oxford [1855].

4.2.4 Case Study : Vienna University

Vienna University was first accommodated in Collegium Ducale [1384]. In the course of time, other buildings were added for the "School of Lawyers" and the 'House of Physicians'. Around the Collegium Ducale, student residences were established, so that over a very short period of time an impressive number of university buildings were scattered about the precinct. Until the 17C, this was a characteristic of the University quarter near the Stubentor, with merchants, craftsmen, churches and monasteries all operating in the immediate vicinity [www.univie.ac.at].

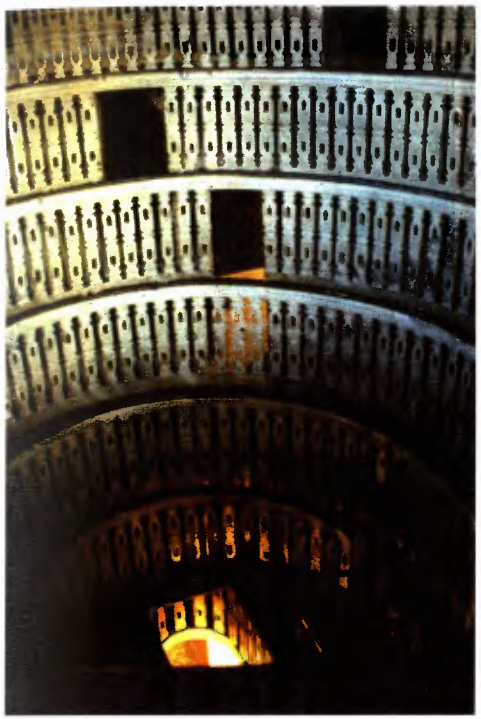
By about 1650 there had grown up, on the site of the medieval Collegium Ducale, the extensive early baroque development which is still known as the 'Old University' and that has survived largely unaltered. Apart from the University Church, the complex included a large library, an observatory, a theatre, the Academic Grammar School, lecture halls, residences, shops and even a wine cellar. Nearby, a separate administrative building was adapted as the seat of the Rector; which accommodated a large Senate Chamber, the university Chancery, the Archive and the detention room. In the reign of Maria Theresa, a further extensive new building, the 'New Aula' [1756], was constructed in the style of a late baroque palace. This has been the home of the Austrian Academy of Sciences since 1857. Finally, under Emperor Joseph II, the 'General Hospital' was opened in 1784, accommodating the various University clinics. Subsequently, it became the centre and starting point of the Vienna School of Medicine [www.univie.ac.at].

4.15 Vienna University
Aula Maxima [Fillitz, 1984]

4.14 Vienna University
Long section through Library [Fillitz, 1984]

The construction of the Main Building for the University of Vienna took place between 1877 and 1884, planned by the architect Heinrich von Ferstel. It combined forms of the Renaissance with the monumentality of the Baroque era. On the site of the former military parade area on the Ringstrasse the Parliament, the City Hall and the University were all built at the same time. In 1871 Ferstel had studied the older university buildings in Bologna, Padua, Genoa and Rome during a trip to Italy. The arcaded courtyard scheme is based on the Palazzo Farnese in Rome. The original intention of accommodating all activities of the University in one central building could not be fulfilled, in spite of the size of the complex. In addition to the Rector's suite, two ceremonial halls and the central administration, the building accommodates the four Deans, University Library and many departments and lecture halls. However, a considerable proportion of the University's institutions had to be located in many other buildings away from the centre. The ceremonial opening of the new "University Palace" took place October 11, 1884 in the presence of Emperor Franz Joseph I [www.univie.ac.at] [Fig 4.14-16].

4.16 Vienna University
Perspective from Ringstrasse by
Architect Heinrich von Ferstel [Fillitz, 1984]



4.17 Padua University
The oldest survivng anatomy lecture dating from 1594 is found in the Palazzo del Bo which was built in the 15th century

4.18 Uppsala University
Rudbeck's anatomical lecture theatre in the roof of the Gustavianium with the dissection table beneath a large skylight with a domed copper roof

4.3 Relationship of Spatial Development to Conceptual Framework

This section of the chapter reviews the space, building and planning structures in terms of the conceptual framework.

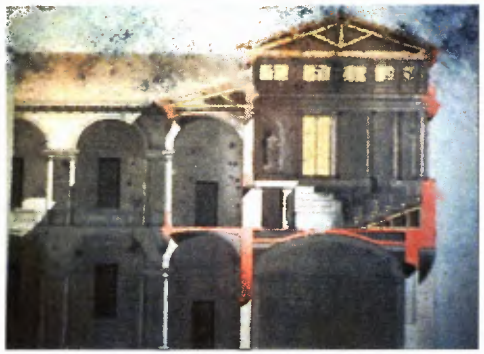
4.3.1 Space Structure

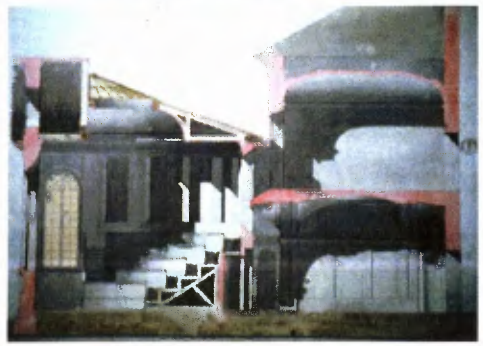
The 17thC and 18thC period was one of increasing growth and complexity in universities; a period in which specialised space types started to emerge. At the end of the last chapter, it was shown how the Sheldonian Theatre in Oxford had introduced a large auditorium into the range of space types required for university building by 1699. This chapter describes how these large raked floor lecture theatres became a major factor in developing structural forms able to integrate these specialised theatres into buildings accommodating normal 'office type' facilities.

- **Lecture Theatres**

  The earliest surviving raked lecture theatre was at Padua University. The anatomical lecture theatre [Fig 4.17], a relatively small facility with steeply tiered standing room around the dissecting table, was added in 1594. A similarly configured theatre was found in the Gustavianum at Uppsala University in Sweden. Designed in an elegant Scandinavian style [Fig 4.18], it was built in 1662 by Olof Rudbeck. It comprised standing room for 200 in a series of steps around the dissecting table, beneath a large skylight with a domed copper roof. This was an example of a theatre breaking out of the roof of typical university accommodation.

  Pavia University, built in 1776, was planned in a series of courtyards surrounded by buildings modelled on the two storey palazzo. It demonstrated how, with the complexity of teaching activities now having to be accommodated, the new spaces required for teaching anatomy could no longer be accommodated within the constraints of a narrow band of construction. It was shown very clearly at Pavia, how the small lecture theatres could be accommodated within the traditional 8 metre span [Fig 4.19], but the anatomy lecture theatre with its longer spans, steeply raking floor and wide viewing arc broke out of these narrow confines [Fig 4.20], demonstrating the need for the student to be as close as possible to the demonstrator, in order to both see the delicate





4.19 Pavia University ca. 1776.
Because of the relatively high ceiling heights, small tiered lecture theatres could be accommodated in the 8m. band building width
[Pavia University Library]

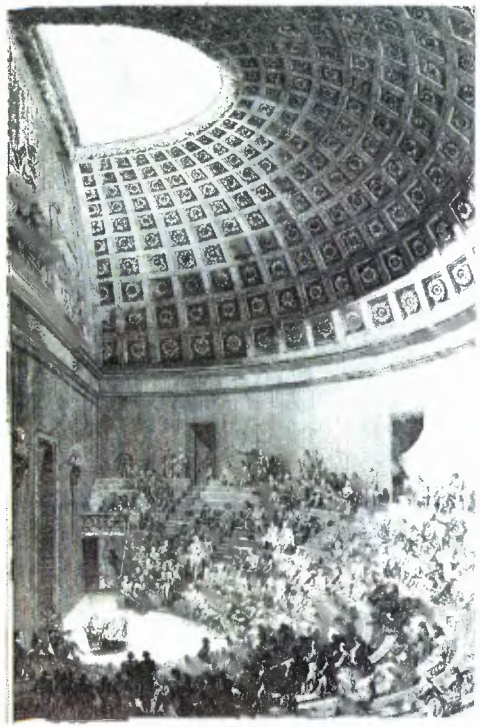
4.20 Pavia University ca. 1776.
The large anatomy lecture theatre with a longer span and a steep raking floorh could no longer be accommodated within the two storey buildings
[Pavia University Library]

operations and to hear the spoken word. In this case the lecture theatre was configured in a 180^0 arc although, as described, some of the early ones were in the round [Fig 4.21].

- **Laboratories**
  The first examples of laboratories as they are known today, date back to 1606 with the recorded project for a laboratory building published in Andrea Libavius' book 'Alchymia'. There were purpose built laboratories in German universities at Altdorf as early as 1682. This prototypical bench laboratory was the model for the School of Chemistry designed by Liebig at Giessen in 1824 [Fig 4.22] where, for the first time, a laboratory was built with fully equipped benches with cupboards and drawers, a reagent shelf above and special rooms for glass blowing and balances. These early laboratories, however, were little more than adaptations of existing classrooms. It was only during the early part of the 20C that the design of the laboratory became a specialised space type [Musgrove, c.1970-80].

- **Halls**
  Large halls, which were used as refectories, places of assembly and worship, existed in universities from the earliest times. These increased in size to become the 'Aula Maxima' [Fig 4.15] accommodating the growing student body for ceremonial occasions, graduations, lectures and performances. Besides these, a new type of large hall, often top-lit, was needed for exhibitions and the display of cultural and scientific collections.

- **Libraries**
  Libraries, too, evolved during this period. Books were de-chained at Cambridge by the end of the 15C but only much later at Oxford, in the 18C. Chapter 3 described how the width of libraries increased from a typical 7m. width to 12m. at Trinity College. This increased to 14m. at Trinity College Dublin, which houses the famous Book of Kells, one of the finest examples of medieval illuminated manuscripts. The Long Room [Fig 4.25] formed the main part of the Old Library. It was built between 1712 and 1732 and originally had a flat plaster ceiling, but by



4.21 College of Physicians
19C Lecture theatre at the College of Physicians in Paris [Middleton & Watkin, 1980]

4.23 Vienna University
Section through Library [Fillitz, 1984]

4.22 Liebig's Laboratory at Giessen, 1824.
School of Chemistry designed in 1824 is a laboratory is built with fully equipped benches having cupboards & drawers & a reagent shelf above [Musgrove, c.1970-80]

the 1850's the roof had been raised and the barrel-vaulted ceiling and gallery bookcases were constructed to provide more space. At Vienna University in the late 19C the library increased to 18m. wide and was provided with extensive space in basements [stacks] for the storage of book material [Fig 4.23].

- **Environmental Services.**
  The period from 1750 to 1900 was a critical phase in terms of technological change. This was the time when the power of steam was harnessed, coal-gas production was invented, and the generation of electricity perfected [Hawkes and Forster, 2002].

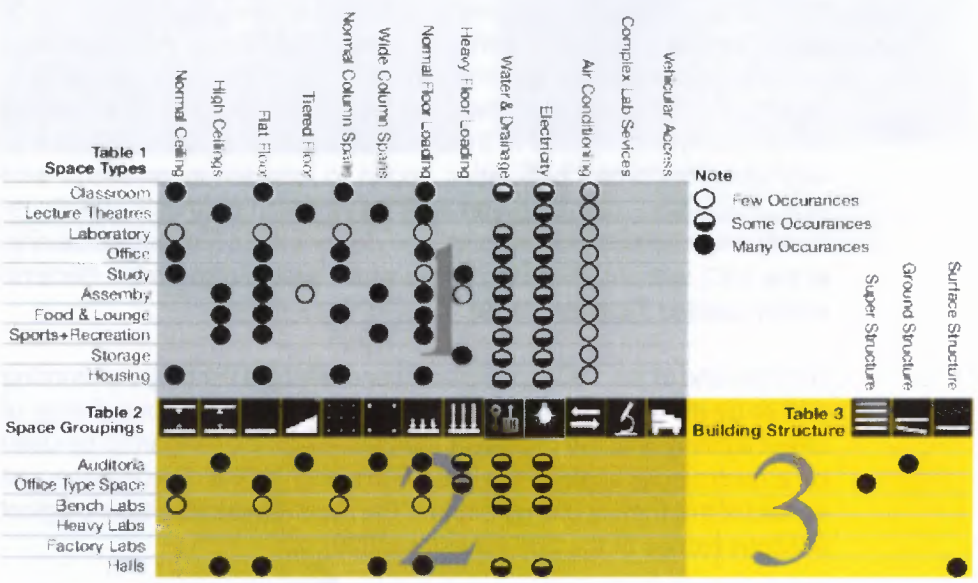
  Before the Industrial Revolution the supply of heating, lighting, ventilation and the removal of waste from buildings was very limited. The Romans had developed high standards of domestic and urban comfort by applying their engineering skills to the construction of public toilets and baths and by bringing water supplies to the city. In the Middle Ages most of this early knowledge was lost. In towns and cities, the disposal of sewage was generally to a cesspit which became offensive and often overflowed, contaminating the surrounding soil, affecting the water supply and leading to the outbreak of serious epidemics. It was only when the urban population began to increase in numbers, with industrialisation, that attention was again given to these questions. The first indoor water close toilet was designed in 1596 but it was only in the 18C, with the invention of the water sealed trap, that it became widely applied [Guedes, 1979].

  Until the end of the 19C lighting was generally by a fishtail jet of burning gas or by the gas mantle, which remained popular for some forms of street lighting until the middle of the 20C. Electricity began to be used on a commercial scale in the late 1880's and 1890's. The subsequent spread of this form of energy is one of the most remarkable technological success stories of the 20C [Guedes, 1979].

  In Britain, Michael Faraday demonstrated the elusive relationship between electricity and magnetism in 1831. His experiments provided the point of departure for the mechanical generation of electricity and

4.25 Trinity College, Dublin
Long Room in the Old Library 1712

4.24 Pavia University Library [Imperial Regia Biblioteca]
Founded in the central buildings in 1778.



4.26 European Universities: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

the utilisation of such current in electric motors, while Thomas Edison in the United States showed how, with the invention of the carbon filament lamp, this form of lighting could rival gas as a domestic illuminant [Guedes, 1979].

The first 'environmental service' to be introduced into buildings was control of heating and ventilation. Most of this took place in Britain at a time when increasing industrialisation created both the need and opportunity for the application of innovative technologies. Initially, central heating supplied by the distribution of warmed air from 'cockle stoves', through networks of ducts incorporated in floor and wall as in the hypercaust system used in glasshouses. Later hot water was used as a heat distribution system, first in low temperature, large diameter pipes and then in high temperature small diameter pipes. In the early days heating was almost always considered in combination with ventilation. By the middle of the 19C centralised heating and ventilation systems were widespread in Europe and North America. Buildings such as theatres, hospitals, prisons, exchanges, schools, clubs and the new office buildings benefited from the opportunity to create internal environments that were more uniform, predictable and comfortable than any that had gone before [Hawkes and Forster, 2002].

Space Structure Template

Tables 1 and 2 of the space template [Fig 4.26] classify the spaces found in European universities.

- **Office Type Space** with up to 8m. spans with flat floors and relatively high ceilings, allowed the construction of small tiered lecture theatres on top of the flat slab. Relatively few environmental services were provided in the early part of the period but, by the end of the 19C, all basic mechanical and electrical services were provided.
- **Laboratories,** which were classrooms adapted for experimental research and practical teaching and which were equipped with simple benches, cupboards, drawers and reagent shelves, emerged during this period. Later, in the 19C, these were fitted with running water and drainage. Gas was available from early in the 19C and electricity later in the century. Facilities were also provided for primitive instruments.

4.27 University Museum [Pitt Rivers], Oxford
Designed in 1855 to meet growing need for scientific museum facilities.

4.28 Ecole des Beaux Art, Paris 1867
Courtyard glazed over to form large exhibition studio integrated into the building

- **Halls,** including assembly halls, libraries, chapels and refectories with high ceilings, clerestory windows and spans of about 12 metres.
- **Large Auditoria** for various uses, of different sizes and configurations were always difficult to accommodate comfortably within the structural frame of the typical 'office type accommodation'.

4.3.2 Building Structure

The variety of space types now needed resulted in the large and complex space types bursting out of the old buildings horizontally, as at Pavia [Fig 4.19-20], or vertically, as at Uppsala [Fig 4.18].

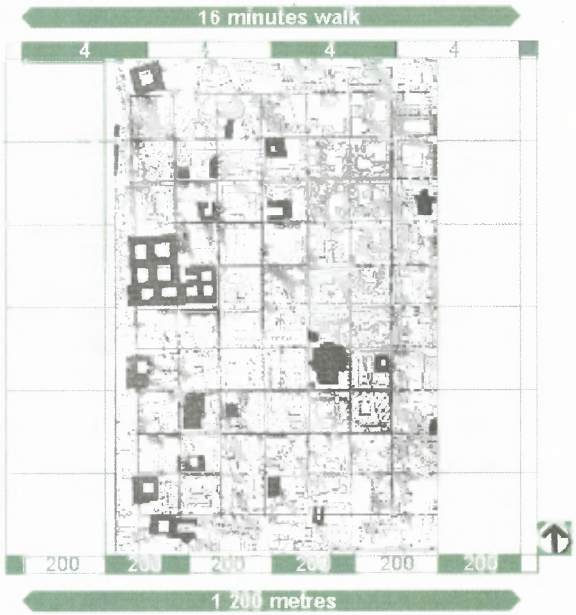
In Vienna, the building was built in a single phase and was large enough to plan wide band accommodation for the Library and Aula Maxima, in zones which accommodate their special needs in terms of room widths, heights and floor loading. The building was planned with two three band wings on either side of the large central courtyard. The Library and Aula Maxima occurred above the Entrance Foyer and linked the two wings at either end. The three band wings had a centre band of wide accommodation, lit and ventilated by small courtyards

Large specialised halls, often with top lighting, emerged in this period. These were free standing in the case of the libraries at Trinity College Dublin, St. Geneviéve in Paris and the Pitt Rivers Museum in Oxford [Fig 4.27]. At the Palais des Etudes [Ecole des Beaux Art Paris, Fig 4.28], however, the courtyard was glassed over in 1867 to form a large exhibition studio integrated into the building.

Building Structure Template

Tables 2 and 3 of the template [Fig 4.34] translate the generic space types into building structure where all three types of structure are found.

- **Super Structure**, to accommodate the 'office' type facilities, stacked up to 3 floors plus an attic floor and two basements in the case of the University of Vienna.
- **Surface Structure**, with lofty column free spaces and high level lighting to accommodate the hall.
- **Ground Structure**, for large tiered auditoria and theatres.



4.29 Pavia Town
1 200m. Template

4.30 Pavia University
300m. Template

4.3.3 Planning Structure

Most European universities constructed during this period were an integral part of the city. This was true of Heidelberg, Tübingen, Prague and most of the other Germanic and Central European universities. Unlike the Oxbridge colleges, buildings were largely undifferentiated from the adjacent city fabric, as can be seen in the case of Cracow.

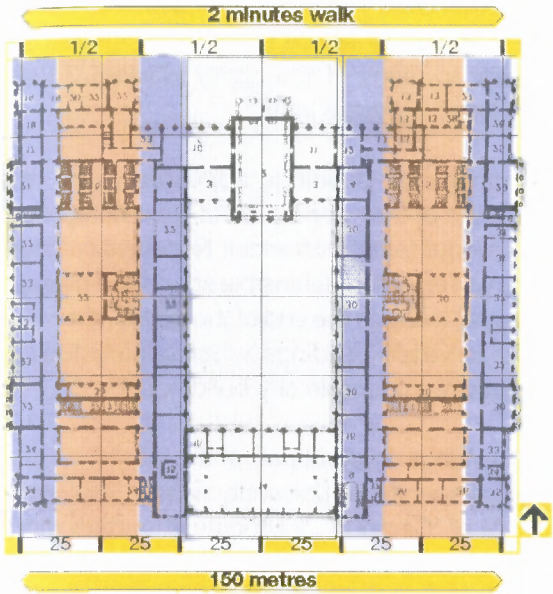
Pavia was more complex since the central university buildings, although embedded in the 80m. city grid, were of a different type [Fig 4.29]. To move from the city streets into the Pavia courts was to experience a totally different world. Pavia is similar to many Italian universities, in that it had a very strong development of the central university facilities with a number of separate colleges such as Ghieslieri, Borromeo and Cairoli. Unlike the Oxbridge situation, however, the balance of power in this binary system was tilted very much in favour of the central university

In the latter stages of the period, universities located close to the centre of power reflecting the greater control of the national, regional or local authority. They were city block developments in a similar way to other civic buildings and, consequently, were part of urban planning and design regimes, and not driven by specific university needs.

These Neoclassical 'megastructures' were large unified blocks, presenting hard edges to the street but opening into internal courts of various kinds. There were single courts at Cracow but generally there were several courts, as has been shown at Pavia and Vienna. They were high density urban structures, with area factors of about 1,5 at Pavia and 3,0 at Vienna.

Planning Structure Templates

The plan of the Collegium Maius in Cracow [Fig 4.6] was contained within the 75m. template. Interestingly, the University of Vienna fitted exactly within the 150m. template, which indicates the density of this monumental development [Fig 4.31]. Pavia, with its very comfortable and yet urban environment, was easily contained within the 300m. template [Fig 4.30].



4.31 Vienna University
150m. Template

- Central Zone with Entrance with Aula Maxima above in front of central court with Library on four levels at back of court
- Two Outer Zones
- Two narrow bands of blue accommodation flank a medium red band with light and ventilation from smaller courtyards

4.3.4 Conclusion

University accommodation in Europe started with individual houses which were used for teaching and student lodgings. Special buildings for universities started in a manner similar to Collegium Maius in Cracow with meeting rooms, classrooms, offices, refectories and kitchens and a limited amount of staff accommodation. The next step, as seen at Pavia, was a single court growing into a 12 court complex. Pavia also illustrated how the Italian binary model differed from Oxbridge where satellite colleges located around the dominant central university complex.

The period between the 17C and 19C was one of massive change in Europe, with increasing industrialisation from late in the 18C, rapid urban growth and the rise of capitalism in the early 19C, leading to unprecedented creation of wealth and the development of new infra-structure for railways and, later, roads. This was reflected in increasing growth and complexity in universities. It is a period in which specialised space structures started to emerge. It was the spatial demands of the large anatomy lecture theatres, which had served so well until the late 18C, but which could no longer be accommodated in the narrow band buildings, that heralded the emergence of a complex range of space types required by the new universities. The 'grain' of university buildings became much finer and richer, with specialised spaces for lecture theatres, rudimentary laboratories, academic libraries and large top-lit spaces for exhibition areas and halls. The assembly of these various space types into building structures became increasingly complex, with the attendant need to accommodate simple mechanical and electrical services. Developments in environmental services in the period just before and during the Industrial Revolution, were now being applied to buildings generally. What was different in universities, however, was the pioneering of the early laboratory space type. Although these were of a rudimentary nature, they foreshadowed the highly serviced laboratories which were to become such a feature of university buildings by the middle of the 20C.

In the 19C, with pressure on land brought about by increasing urbanisation and the political need for control and status, universities located in capital cities in high density Neoclassical structures. The assembly of these

structures became intricate and complex. The plan organisation of Vienna, for example, accommodated a variety of space types in a high density structure which was a precursor to many of the highly efficient 3 band buildings used in universities a hundred years later.

Initially, architecturally these university buildings appeared to be little different from other public buildings of their period. Most were designed in the late Renaissance or in the monumental, historicist Neoclassical style, organised around courtyards, which provided defensible space and pleasant environmental conditions. However, towards the end of the period, they were starting to evolve into distinctive university buildings, which accommodated a larger range of space types than comparable city buildings.

The fact that these buildings formed an integral part of the city fabric gave little opportunity to explore plans specific to university needs. This was in marked contrast to the concept of 'Campus', a Utopian suburban model which was being developed at this time in the new world and is the subject of the next chapter.

4.32 Vienna University
Elevation to side street

4.33 Vienna University
Main courtyard

4.34 Vienna University
Main arcaded courtyard

CHAPTER FIVE
The American Campus

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The American Campus

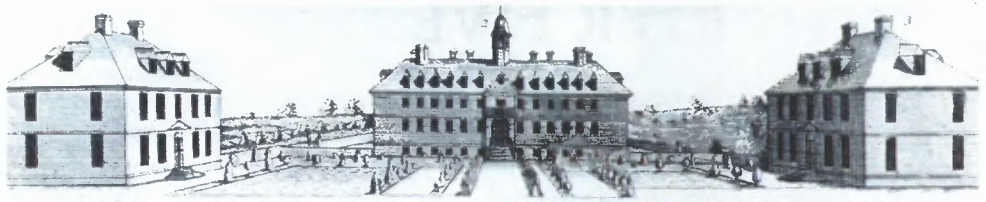
5 Piecemeal Growth in the Elysian Fields

Previous chapters summarised the gradual emergence of the university in Europe, using the examples of Bologna and Paris, it's early spatial development in the medieval Oxbridge colleges, leading to the grand European Renaissance and Neoclassical universities in the 18C and 19C. This chapter explores how these spatial models were exported to, and developed in, the new world commencing with Harvard in 1636. Borrowing heavily from the Renaissance concepts of the Ideal City, campus planning in America from the 17C to the early 20C became the dominant model influencing university planning throughout the world, including European universities.

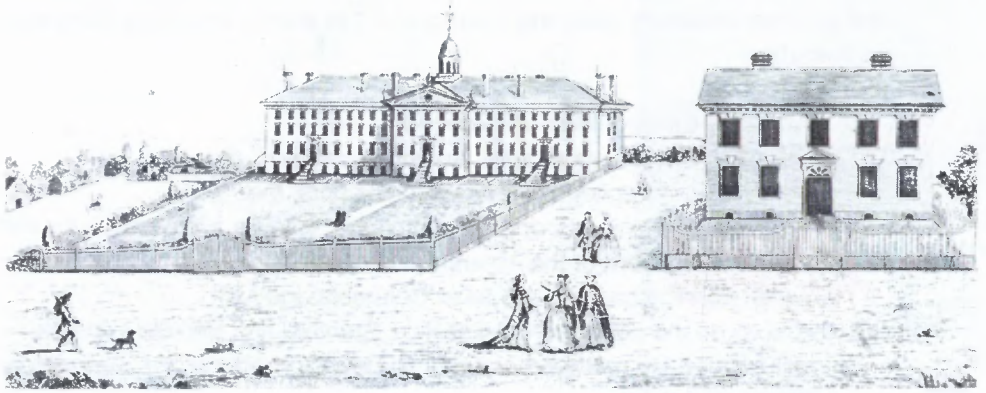
The Chapter is divided into seven sections: an

- overview of the evolution of the American campus; the
- the early colonial colleges and their informants; the
- University of Virginia, its origins and classic role as a prototype for the spatial development of the American campus;
- variations on the campus model at Columbia and MIT;
- variations on the campus model at Rice, Stanford and Berkeley; and the
- conclusion which relates these spatial developments to the conceptual framework of the thesis.

5.1 Navigator Image
The Navigator Image presents an overview of Chapter 5.
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.



5.2 College of William & Mary
Mid 18C engraving showing Brafferton Hall, the Wren Building & Presidents house [Turner, 1984]



5.3 College of New Jersey, Princeton
1764 engraving showing Nassau House & Presidents house [Turner, 1984]

5.1 Overview of the American Campus

The American campus is a distinct variant of the European model. Influenced at first by the Oxbridge tradition, the early colonial colleges developed their own character, locating on large tracts of land on the edge of, rather than clustering within, cities. According to Turner, the "romantic notion of a college in nature, removed from the corrupting forces of the city, became an American ideal". In this way, colleges tended to become self-contained micro urban units and their planning and design became experiments in city planning [Turner, 1984].

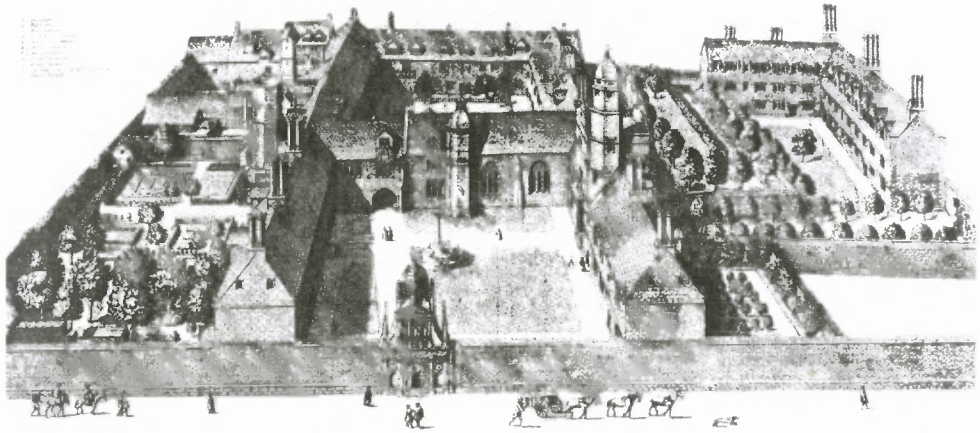
Today, it is taken for granted to talk about the university estate as a campus. However, the study of the spatial development of the Oxbridge colleges and European universities for 6 centuries has not revealed a single campus. Campus is an important American planning tradition, which has had an extraordinary influence on university planning world-wide since the beginning of the 19th century.

The early colonial colleges exploded the Oxbridge model to form quadrangles open at the corners. All nine of the colonial colleges, chartered between 1636 and 1780, were plain, individual structures on open land. It is this open space dominated suburban environment which is the dominant characteristic of the American campus and which led Le Corbusier to observe that "each college or university is an urban unit in itself, a small city. But a green city..... The American university is a world in itself" [Turner, 1984] [Figs 5.2-3].

These qualities are characterised by the word '*campus*'. According to Turner, the term was probably first used at Princeton University in the late 18C. It is derived from its simple Latin meaning, a field, and it described the green expansiveness of college grounds. Gradually the word assumed wider significance, until it came to mean the entire property, including buildings. Campus sums up the distinctive physical qualities of an American college, as well as its integrity as a self contained community, its utopian social ideals, architectural expression and genius loci [Turner, 1984].

5.2 The Early Colonial Colleges

The three sided quadrangle, found among some of the later colleges at Cambridge, became the model for the early colonial college in America. In 1557, a new court was built onto Gonville and Caius College, which had ranges of accommodation on three sides and was bounded, on the fourth, by a wall and gateway [Fig 5.4]. The ostensible reason for this was that this configuration would be healthier, by allowing greater ventilation through the court. Similar plans were developed at Emmanuel and Sidney Sussex Colleges, both centres of Puritanism and, in the case of Emmanuel, with special links to New England and Harvard in the following century [Turner, 1984].



5.4 Gonville and Caius College, Cambridge
Loggan's engraving showing three side court with monumental gateway in enclosing wall. 1560-1580 [Turner, 1984]

The three sided quadrangle represented a new attitude to planning which created the possibility of an axial organisation which was not always possible in the closed quadrangular form. It also allowed an openness to the surrounding community. This model was adopted at Harvard, founded in 1636 [Fig 5.5]. The Oxbridge idea of a community of scholars was also adopted. It would have been much easier and less costly to adopt the Scottish or European model of students finding their own lodgings, but the governing board explicitly stated that "it is well known.....what advantage to Learning accrues by the multitude of persons cohabiting for scholastical communion, whereby to actuate the minds of one another, and other waies to promote the ends of a Colledge-Society." [Turner, 1984].

Suburban location, integration with the surrounding community, the three side articulated court or quad with potential for axial development and the community of staff and students living and learning together were the defining characteristics of the early colonial colleges. These continued through to the later development of the American campus in the early 19C.

5.5 Harvard College
Engraving from the late 17C [Turner, 1984]

Such a three sided quad was also built at the College of William and Mary and most other colleges. Yale College, however, took a different approach with a line of buildings facing New Haven Green, that came to be known as Yale Row. A campus plan drawn up in 1792 by John Trumbull is probably the oldest surviving master plan for an American college. Trumbull anticipated the concerns of later campus planners in that his design "would admit of being pursued gradually, and whether partially or completely executed, would be in all its stages handsome". [Turner, 1984].

5.3 The University of Virginia and the Academical Village

5.6 Downing College, Cambridge
Designed by Wilkins in 1807. Contemporary aerial view [University of Cambridge Aerial Photography]

5.7 Union College, Skenectady NY
Designed by Rameé in 1813. Contemporary aerial view [Union College]

It is interesting to note that the prototype for the American Campus can be seen at Downing College in Cambridge, England. However unlike Cambridge's direct influence on Harvard and the colonial colleges, this was probably indirect and perhaps, coincidental. Downing College was founded under the will of Sir George Downing, grandson of Emmanuel Downing, one of the founders of Massachusetts and son of one of the first graduates of Harvard College. At a spatial level, it was a precursor to the first campus plan of Union College at Schenectady and the defining campus of the University of Virginia, ten years later.

In 1807 William Wilkins won an architectural competition for the design of Downing College in what has been called the Grecian style. Instead of the quadrangular format, it consisted of separate buildings and pavilions, all in Neoclassical Greek Revivalist style. Wilkins' intended plan had buildings on three sides of a large expanse of grass forming an open space roughly 90m. square. The College was entered through a Greek Doric *propyleum* [gateway]. The whole feeling of Wilkins' plan was one of space with the buildings set in a landscape, with all buildings designed as separate units joined in places by low screen walls. However, the plan was not completed and changes were made to link some of the discrete building blocks [Fig 5.6].

This was followed in 1813 by the plan for Union College at Schnectady in upstate New York, where Joseph-Jacques Ramée, an immigrant from Paris, realised the first American campus plan. Ramée emphatically rejected the Oxbridge model and in a gesture of "extending opportunity for all", planned a U shaped set of buildings with a Pantheon-like building as its focus. The origins of this radical step in university development can be traced to chateaux outside Paris and to Pierro della Franscesco's painting of the Ideal City. Along with Thomas Jefferson's plans for the University of Virginia, four years later, the design for Union College epitomises the visionary collegiate dreams of the early American Republic. The large campus open space, 180m. in width and open to the west, was lined by buildings on either side linked by arcades,

one of which forms a semicircle at the back of the space, with the President's House at its eastern end. In the centre of the open space is a Pantheon-like structure, originally a chapel [Fig 5.7].

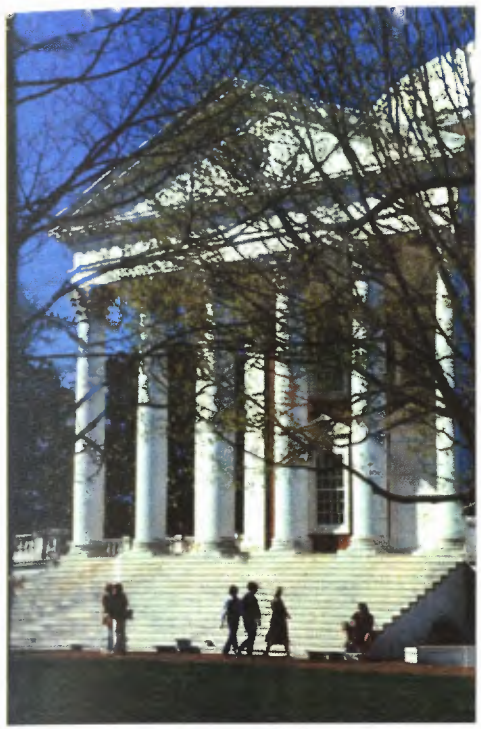
However, the best known American campus plan is almost certainly the one drawn by Thomas Jefferson for the University of Virginia in 1817. Jefferson was a uniquely talented man and a self taught architect. His inter-related principles of tertiary education and college architecture were shaped during his 1801-1809 term of Presidency. His concept for the University of Virginia is described as a village, not a house. "I consider the common plan....of making one large and expensive building as erroneous. It is infinitely better to erect a small and separate lodge for each professorship, with only a hall below for his class, and two chambers above for himself, joining these lodges by barracks for a certain proportion of students...." [Guiness and Sadler, 1973].

This was to become, in 1825, his completed academical village, which was the educational counterpart of a typical village green, surrounded by modest private houses. The University of Virginia plan, not widely copied at first, was exceptional in that, for the first time, the central focus of an American campus was the library, an expression of Jefferson's aspiration to create an architecturally democratic university, where research played a role it never had in the traditional American college. Equally significant was Jefferson's omission of a chapel from his plans, since "he intended his institution to be fully secular and progressive" and symbolically opened it up to the expanding west [Turner, 1984].

The plan accommodated the activities of the University in a rational and functional manner. It was arranged around a rectangular lawn, 60m. wide and 300m. long, with five pavilions on either side linked by colonnades. The linking colonnades were of different length; the ones at the bottom of the lawn were longer than those at the top, thus increasing the apparent size when viewed from the bottom of the lawn. Each pavilion was in a different Roman or Palladian order, ostensibly to provide a didactic model for architectural students. This difference, however, gives a dynamic sense of variety in a unified composition [Fig 5.8].

5.8 University of Virginia, Charlottesville VA
Designed by Thomas Jefferson in 1817. Contemporary view of Lawn, Rotunda, colonnades and pavilions

5.9 University of Virginia
Aerial view showing closure of Lawn by Stanford White's building in the 1890's [Dober, 1963]



5.10-12 University of Virginia
Views of the Rotunda, colonnades & pavilions

www.virginia.edu

The two rows of pavilions provided staff accommodation above ground floor classrooms. They were backed by a second arcaded row of dormitories, known as the east and west ranges, facing outwards, The two parallel rows were connected by gardens and serpentine dividing walls.

At the head of the shared lawn stood the Rotunda, housing the library, its dome shape inspired by Rome's Pantheon and symbolic of the enlightened human mind [Figs 5.10-12]. The three sided composition was meant to be open ended, providing a spectacular view of valley and mountains beyond. "With a sublime stroke of insensitivity, the vista was closed with new construction in the 1890's by McKim, Mead and White. Thus do architects treat each others aims and achievements" [Huxtable, 1975] [Fig 5.9].

Jefferson's University of Virginia created an urban environment modelled on the ideal city of the Italian Renaissance. It was set in the arcadian Elysian Fields of suburban Charlottesville, which even today is a fairly small town. It is this low density development of pavilions set in an open field which was to be such an influence in university building throughout the world in the years to come.

In the early decades of the 19th century the Greek Revival style dominated the American imagination. It was charged with connotations of Athenian democracy, purity, wisdom and independence and it fortified the ideal of the classical curriculum and its nobility. In short the classical environment created at Virginia became the hidden curriculum which influenced university architecture in the states and elsewhere for almost 150 years. "The Jefferson design..... suggests the whole range of values to which American democracy aspired; unity in variety, the subordination of parts to the whole, a humanistic order and the dignity of the individual. Delight was also there" [Huxtable, 1975].

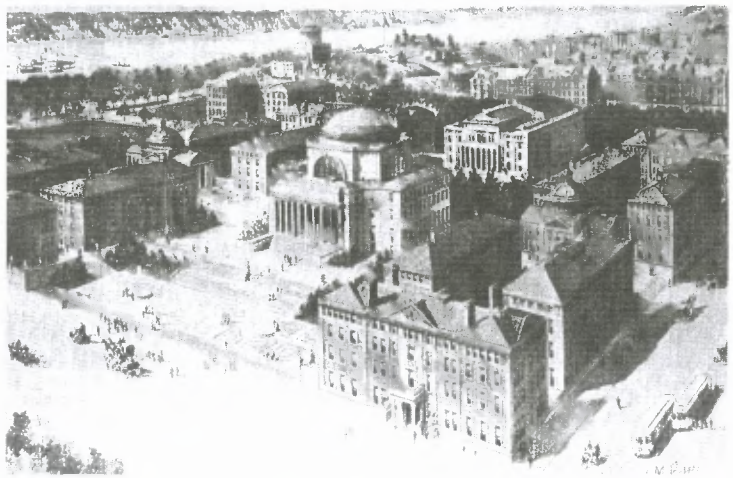
5.4 Variations on the Campus Model at Columbia and MIT

Most American campuses built in the 19C were based on the Virginia model. These included Emory in Atlanta, Southern Methodist in Dallas, Delaware, Rochester, Duke and the Divinity School at Yale University. Two high density variants were Columbia University in New York City and MIT in Cambridge, Massachusetts. These show the range of applications of the campus model from the low density suburban to a very high density urban context.

Columbia University

Columbia University was founded by the royal charter of King George II of England in 1754, as King's College . It was the oldest institution of higher learning in the state of New York and the fifth oldest in the United States. The American Revolution brought the growth of the College to a halt, forcing a suspension of instruction in 1776, suspension that lasted for eight years. The College reopened in 1784 with a new name - Columbia - which embodied the patriotic fervour which had inspired the nation's quest for independence. Cloistered campus life gave way to the more common phenomenon of day students who lived at home or lodged in the city.

In 1849, the College moved from Park Place, near the present site of City Hall, to 49th Street and Madison Avenue, where it remained for the next fifty years, before moving to its present Morningside location on a four block site at 116th Street and Broadway. The architect for the new site was Charles Follen McKim of the renowned architectural firm, McKim, Mead & White. McKim had studied at the Beaux Arts in Paris and produced a scheme which was a high density urban variant of the campus model. A decision was taken that the University would not have any student accommodation and would remain a commuter institution with a "wholly municipal character..... identical in this respect to the Sorbonne in Paris" [Turner, 1984].



5.13 Columbia University, New York
By McKim, Mead and White. Rendered in 1894
[Turner, 1984]

5.14 Columbia University, New York
Contemporary photograph

5.5 Variations on the Campus Model at Stanford, Berkeley and Rice

As discussed, the characteristic American campus was based on the Jeffersonian model at Virginia, with its emphasis on plans of classical simplicity and symmetry generating buildings in the Greek, Roman, Renaissance or French Baroque styles. This does not mean, however, that other influences were not at play. Reaction against what was perceived as the elitism of these styles took hold, especially after the founding of the first land grant colleges in the 1860's. Many of these institutions were influenced by the renowned landscape architect, Frederick Law Olmsted, who participated in the design of more than 20 campuses, among them the universities of Maine, Massachusetts, Cornell, Stanford and Berkeley, California.

5.17 Stanford University
Model by Olmsted and Coolidge constructed 1887-ca 1903. From centre left to right: Gatewy, Memorial Court, Inner Quad and Chapel. Outer quads flank Memorial Court

5.18 Stanford University
Contemporary view from Memeorial Court of gateway, Inner Quad and Chapel

Olmsted, best known as the designer of Central Park, New York, preferred to organise campuses in a picturesque manner in the belief "that a college planned as a domestically scaled suburban community, in a park-like setting, would instill in its students civilised and enlightened values" [Turner, 1984]. This view was well received in the land-grant institutions as an expression of modest rural values, in contrast to the elitism and formality of the traditional colleges.

Stanford

It is ironic that the campus most associated with Olmsted, Stanford was not park-like at all, but had the character of an Italian Renaissance university merged with Romanesque architecture, Californian Mission style details and Beaux Arts axial planning. His proposal for Stanford in 1888 was for a relatively modest arrangement of buildings, set in the hills of Palo Alto. However, Senator [later Governor] Leland Stanford insisted on a flat site that would allow an axial composition. This interaction between client, architect and landscape architect was to be a feature of the Stanford plan, with the client always insisting on greater formality and monumentality, as a fitting memorial to his son, who had died earlier on a trip to Europe. Both Olmsted and the architect, Charles Coolidge of the firm Shepley, Rutan and Coolidge, were from Boston. Coolidge was a protege of the famous Chicago architect HH Richardson, whose work was heavily influenced by the Romanesque.

5.19 Stanford University
Contemporary view from colonnade to Inner Quad and Chapel

5.20 Stanford University
Contemporary view from colonnade to Outer Quad

The assembly of buildings was structured by four internal open spaces, the Inner Quad, two Outer Quads and Memorial Court. The mainly single story buildings around these open spaces were linked by deep arcades, forming the earliest example of the fully enclosed quadrangle in American campus planning. The planning of these quadrangles was symmetrical with a major north south axis, defined by a mile long approach lined with palm trees. The Palm Drive axis penetrated the assembly of buildings and quads through a monumental Memorial Arch, culminating in the focal Memorial Church, which was inspired by San Marco in Venice. Despite the difficult relationship between Stanford and his architects, and the eclectic nature of the process, the scheme had a clarity and monumentalism that foreshadowed the coming era of Beaux Art formalism [Figs 5.17-20].

The main quadrangle defined a secondary east west-axis, which was to be extended in both directions by additional quadrangles in order to accommodate future expansion. The dormitories of both men and women were sited to the east and west and in the four angles between the intersecting axes, with diagonal streets accommodating faculty housing, thus making the whole complex a self-sufficient university city [Turner, 1983].

Berkeley

The roots of the University of California go back to the gold rush days of 1849, when the drafters of the State Constitution required the legislature to "encourage by all suitable means the promotion of intellectual, scientific, moral and agricultural improvement" of the people of California. California had a sparse population in 1849, but these early planners dreamed of a university which eventually, "if properly organized and conducted, would contribute even more than California's gold to the glory and happiness of advancing generations." On March 23, 1868, the governor signed into law the Act that created the University of California.

5.21 Berkeley University
Perspective of plan by Emile Bénard 1899
[www.berkeley.edu]

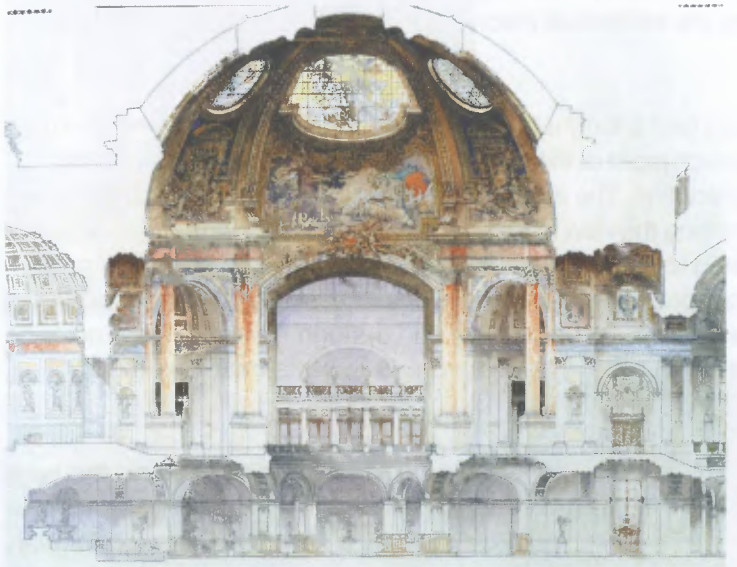
5.22 Berkeley University
Detail of plan by Emile Bénard 1899 [www.berkeley.edu]

5.23 Berkeley University
Plan by John Galen Howard ca. 1910
[www.berkeley.edu]

Olmsted had developed a park-like plan for the College of California in 1866 which was never executed. Bernard Maybeck, a local architect educated at the Beaux Arts in Paris, drew up a master plan in 1895, but in the end the governing council believed that the University needed a grand and comprehensive plan to match its growing size and importance. By this time, taste was moving away from picturesque styles with their asymmetry, informality, and textured materials, to a preference for the formal planning and classicism taught at the Ecole des Beaux Arts. Bernard Maybeck convinced the University that an international competition should be held.

This was championed by Phoebe Apperson Hearst, one of the University's most generous benefactors, who conceived of, and financed, an international competition with $200 000 as prize money. The competition, which was one of the largest in American history, was remarkable for the visionary tone of its prospectus, which called for a city to be created - a City of Learning - in which there was to be no sordid or inharmonious feature and no definite limitations on cost, materials or style [Turner, 1983].

The Hearst competition in 1899 attracted a wide range of entries from America and abroad. The designs reflected the differing attitudes of the American and European university planners, with the former more open and spacious and the latter more compact and urban. It was won by Emile Bénard of Paris, with a design which was steeped in the Beaux Arts tradition, with buildings arranged along axial boulevards and around city squares linked to the community by continuous streets and tram lines. Bénard's plan brought Berkeley not only a building plan but worldwide attention. The London Spectator wrote that, "On the face of it this is a grand scheme, reminding one of those famous competitions in Italy in which Brunelleschi and Michaelangelo took part. The conception does honour to the nascent citizenship of the Pacific states" [Turner, 1983].



5.24 Berkeley University
Second Scheme by Emile Bénard 1899 Section through Gymnasium. [www.berkeley.edu]

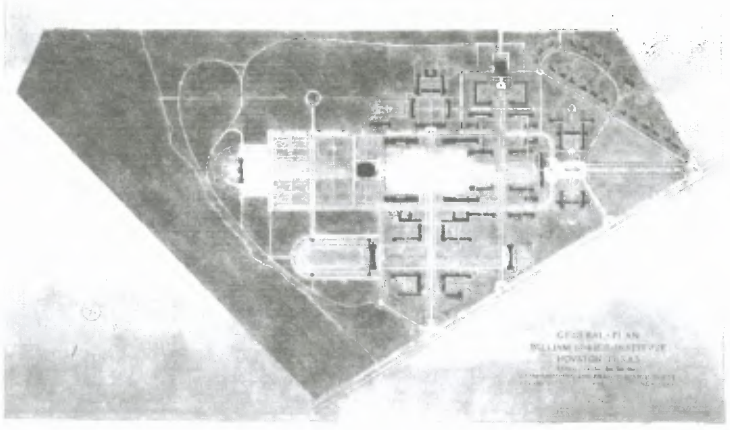
5.25 Berkeley University
Second Scheme by Emile Bénard 1899. Longitudinal and transverse sections through site. [www.berkeley.edu]

He produced a second plan responding to comments by the council and criticism in the local press. The new plan was again a formal Beaux-Arts composition arranged around a central east west axis with minor cross axes. The buildings were to be monumental structures in classical styles built of uniform materials. However, his plan exaggerated the importance of such secondary facilities as the gymnasium and sports stadium and did not fit the contours of the sloping site in the Berkeley hills [Figs 5.21, 22 and 24]. Although Bénard went to California to develop his plan, he declined to stay on as supervising architect, largely due to the adverse local criticism he had received.

Accordingly, the University commissioned a runner up, John Galen Howard, to assume the role of supervising architect. Although Howard was directed to execute Bénard's plan without any substantial departure, for seven years he continued adjusting programme to site until finally the Bénard plan became the Howard plan which was formally adopted in 1914 [Dober, 1963] [Fig 5.23].

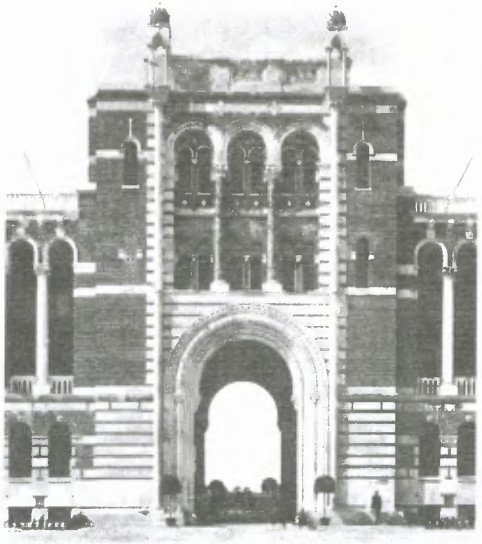
Howard spared no effort or expense and developed a style of architecture that reinterpreted the grace, dignity and austerity of classical lines to suit the California environment. Some of most elegant and stately campus structures were built during Howard's tenure from 1902 to the early 1920's.. Among them were the Hearst Memorial Mining Building, the Hearst Greek Theatre, California Hall, Doe Library, the Campanile, Wheeler Hall, Gilman Hall and Hilgard Hall.

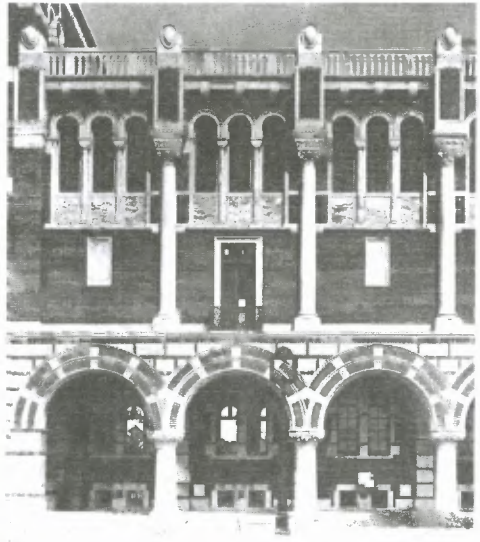
Thus the Berkeley campus came to have buildings in a great variety of sizes, materials and styles. In some areas the buildings were placed along axial avenues while others located on curving picturesque pathways. This diversity is the result of many years of layered campus plans and changing theories and styles starting with Olmsted's picturesque layout growing out of the natural topography to Bérnard's Beaux Arts formal organisation as modified by Howard and subsequent additions by other architects. Each architect siting his building to his own advantage thus dissipating the space organising axial plan, although fortunately the view of the bay remained.



5.26 Rice University
Master Plan drawn up in 1910 by Cram, Goodhue and Ferguson [Fox, 1981]

5.27 Rice University
Administration Building on left. Elevations of sallyport and south cloister on the right [Fox, 1981]





Rice University

In 1909, the firm of Cram, Goodhue and Ferguson of New York and Boston, which had guided the development of Princeton campus from 1906, was commissioned to develop a general architectural plan for what was to become Rice University. The original campus master plan was by Ralph Adams Cram, the intellectual theoretician, as well as Goodhue, the romantic artist.

The early plan had a long east-west axis crossed by shorter north-south axes about which most of the buildings were structured, grouped according to use and discipline. The administration building was focal, with wings on either side framing the view over the large forecourt to the west. These wings were separated to improve ventilation. Other flanking buildings defined the major central space. Behind these was a second layer, connected to the first by arcades that ran both along and through the buildings. Enclosing the major open space on its western end was the main auditorium [Fox, 1981].

By the end of May 1910, the scheme had been approved and the large rendered plan prepared, a plan which became the official master plan for subsequent development [Fig 5.26]. It was a strong and thoughtful plan, both in the overall strategy and in the detail, which has proved remarkably flexible over the years. This was, largely, because the University believed in it, and because one of Crams assistants became campus planner and so guided development in the all important early years.

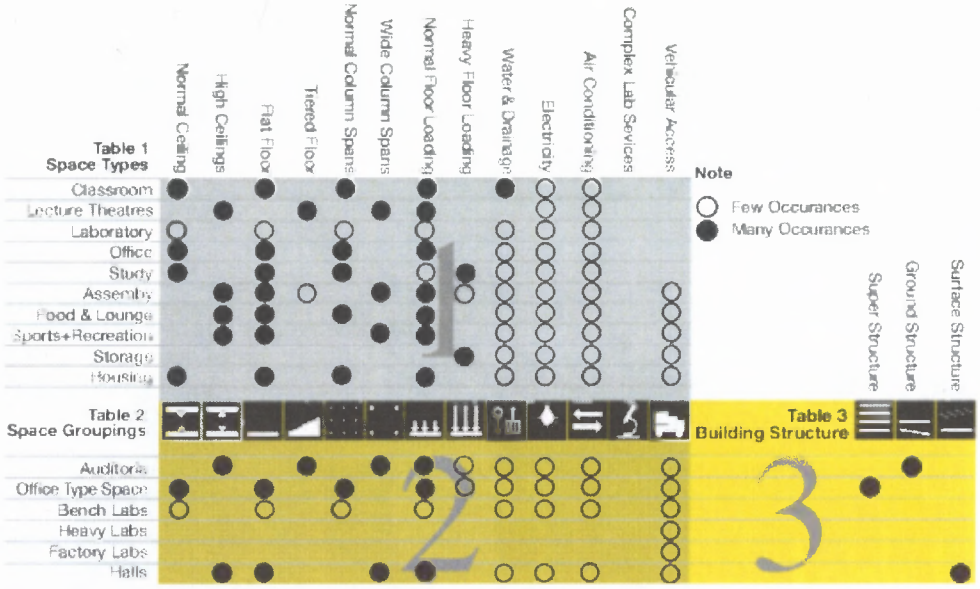
There were certain planning principles that were established in the original plan. One was that Rice was to be a campus of medium-sized and smaller buildings. Another was the establishment of a conceptual framework that could provide Rice the freedom to realize its continuing academic aspirations in a manner that preserved the graceful academic livability and aesthetic quality of the original campus. Yet another was the need to create an intense and tightly packed campus, because of the importance of being able to walk from building to building between classes in arcaded cloisters or oak lined walks.

[Fox, 1981]

5.28 Rice University
Original and contemporary details of Cloister

At an architectural level, Cram's search for an appropriate expression of place and purpose could be viewed as a more general reaction to the dominance of Neoclassical architecture in America since the turn of the century. It was not a rejection of eclecticism as such, but rather reflected the need to free design from the "repressiveness of a single encompassing style" [Fox, 1981].

In his search for an appropriate style, Cram invented a style he considered suited to a Mediterranean-like climate, combining elements from Southern France, Italy, Dalmatia, the Peloponnese, Byzantium, Anatolia, Syria, Sicily and Spain. The resultant language included Roman triumphal columns, Byzantine masonry, Romanesque arches, Venetian balusters and allegorical sculpture, with architecture used to transform human accommodation into an object of culture [Fox, 1981] [Figs 5.27-28].



5.29 American Campus: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

5.6 Relationship of Spatial Development to Conceptual Framework

This section reviews the space, building and planning structures relating to the American campus from the 1636 to the early 20C. It is a period which contributed little at the micro-scale to the development and assembly of spaces in buildings but a great deal at the campus planning scale.

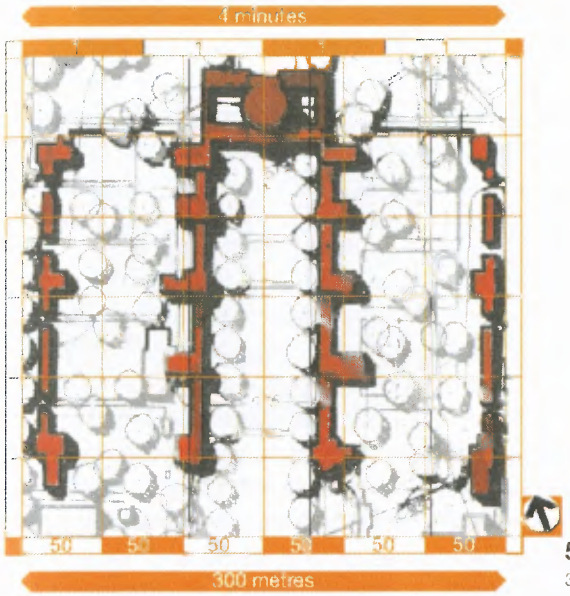
5.6.1 Space Structure

The facilities provided in buildings during this period were similar to those found in the European universities at the time, although of a more modest standard. There is little evidence of the dramatic evolution of the lecture theatre as a specialised space type, as seen in the large Europe universities nor of the grand halls and exhibition spaces.

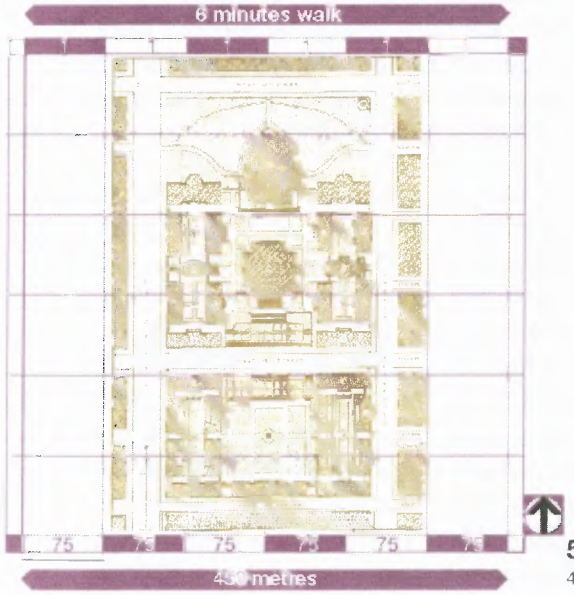
The European idea of research as one of the basic functions of a university was also embraced in the new world and the scientific laboratory and workshop became part of the normal range of university buildings. At first these were very simple work spaces but, by the first half of the 20C, they started becoming more complex. Bench installations become fairly heavily serviced, with different types of water, electricity and gas. Often they were placed at right angles to the walls to ease service runs, but these were not very demanding, having none of the highly specialised arrangements for ducting, pipes and wiring which were to appear after the war [Fig 5.29].

5.6.2 Building Structure

The campus buildings were low rise and set in spacious surroundings so there was no need for high density assemblies of the various space types. However, with no architectural tradition, there was considerable borrowing of styles from Europe. Initially, these were modest reinterpretations of the Oxbridge models of the 17C, with the early buildings at Harvard being influenced by the three sided court, while early in the 19C there was the intriguing parallel between Downing College and the University of Virginia. Virginia [Fig 5.30] showed the architectural potential of synthesising sophisticated Palladian architectural styles within the emerging campus model. This synthesis gathered pace later in the century, with the many campuses developed on the Virginia pattern.



5.30 University of Virginia.
300m. template



5.31 Columbia University
450m. template

Monumental examples of this were Columbia [Fig 5.31] and MIT with their high density variations of the Beaux Art model. At Stanford [Fig 5.32], Berkeley [Fig 5.33] and Rice [Fig 5.34], the full range of the eclectic palette is displayed, from the typical Beaux Arts plan for Berkeley to the Renaissance and Californian Mission style at Stanford and the mixed menu of southern European styles at Rice. These dubious exterior stylistic explorations do not, however, conceal the very important contributions which were being made at the macro level.

5.6.3 Planning Structure

American campuses had three major planning characteristics which distinguish them from European universities in the same period. These were:

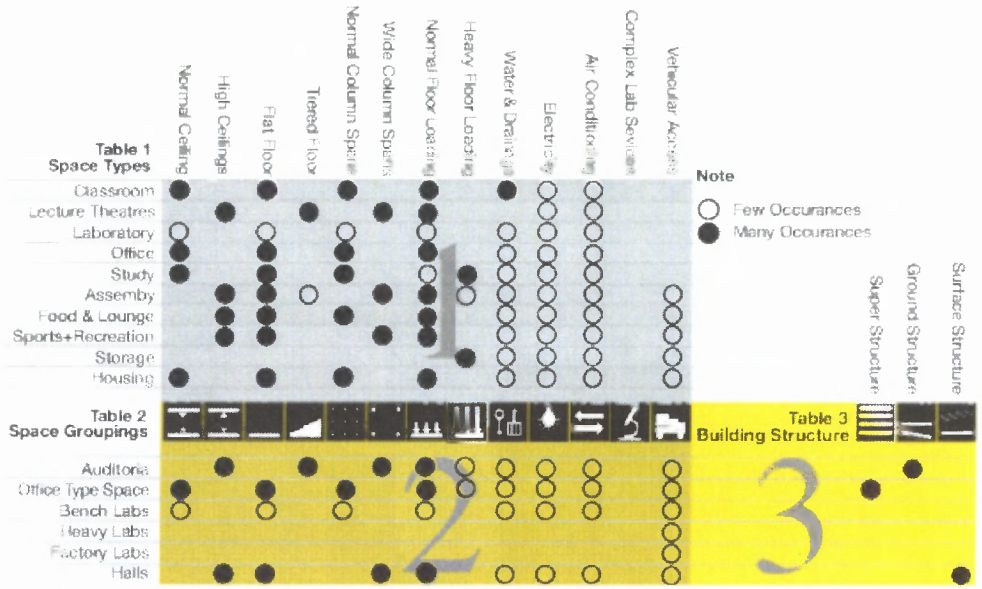
- the suburban context of their sites;
- the arrangement of campus buildings into coherent spatial designs;
- piecemeal growth within the framework of master planning systems.

Suburban Context

In Robert Stern's television series on architecture, he titles the episode on universities as a 'world apart'. Yet he is at pains to show how the American Campus differs from the English model in that, although it was located on the edge of urban settlements, it was an inclusive institution which embraces the community it served and, in the case of the University of Virginia, opens out to the expanding western hinterland.

Campus Design

The self contained community of scholars at the University of Virginia was an 'academical village' in a low density open space dominated setting. The University of Virginia has a Floor Area Ratio [FAR] of less than 0.2. If a FAR of 1 is taken as the watershed between an urban and suburban university, the early American campuses with FAR's of considerably less than 1, were suburban campuses. However, many of the later campuses, with similar design qualities, are clearly urban campuses, with FAR's greater than 1. Low density was not a prerequisite for good campus design but a dispersed group of buildings did create the freedom to explore many different spatial development frameworks and design configurations.



5.29 American Campus: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

5.6 Relationship of Spatial Development to Conceptual Framework

This section reviews the space, building and planning structures relating to the American campus from the 1636 to the early 20C. It is a period which contributed little at the micro-scale to the development and assembly of spaces in buildings but a great deal at the campus planning scale.

5.6.1 Space Structure

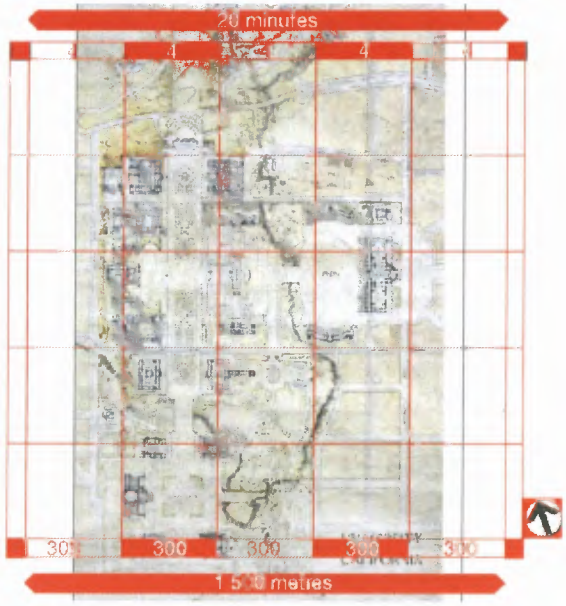
The facilities provided in buildings during this period were similar to those found in the European universities at the time, although of a more modest standard. There is little evidence of the dramatic evolution of the lecture theatre as a specialised space type, as seen in the large Europe universities nor of the grand halls and exhibition spaces.

The European idea of research as one of the basic functions of a university was also embraced in the new world and the scientific laboratory and workshop became part of the normal range of university buildings. At first these were very simple work spaces but, by the first half of the 20C, they started becoming more complex. Bench installations become fairly heavily serviced, with different types of water, electricity and gas. Often they were placed at right angles to the walls to ease service runs, but these were not very demanding, having none of the highly specialised arrangements for ducting, pipes and wiring which were to appear after the war [Fig 5.29].

5.6.2 Building Structure

The campus buildings were low rise and set in spacious surroundings so there was no need for high density assemblies of the various space types. However, with no architectural tradition, there was considerable borrowing of styles from Europe. Initially, these were modest reinterpretations of the Oxbridge models of the 17C, with the early buildings at Harvard being influenced by the three sided court, while early in the 19C there was the intriguing parallel between Downing College and the University of Virginia. Virginia [Fig 5.30] showed the architectural potential of synthesising sophisticated Palladian architectural styles within the emerging campus model. This synthesis gathered pace later in the century, with the many campuses developed on the Virginia pattern.

5.32 Stanford University.
1 500m. template



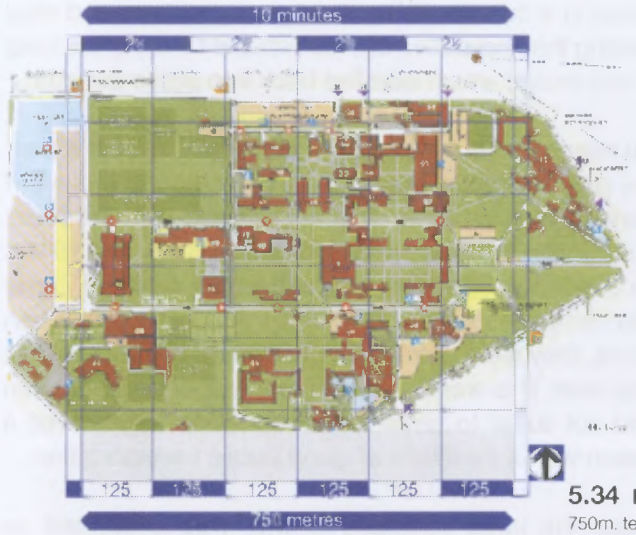
5.33 Berkeley University.
1 500m. Template

Master Planning

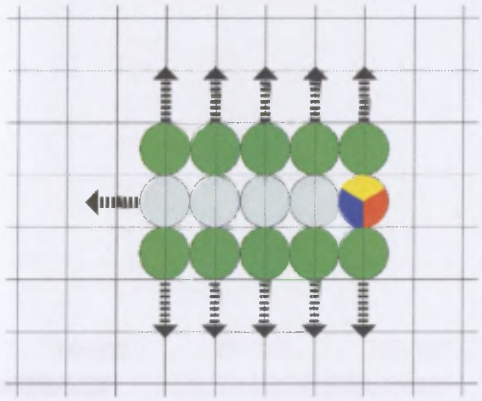
With large tracts of land and the open space dominated plan, it was possible to design a variety of spatial frameworks and to encourage piecemeal growth within various master planning strategies. Campus master planning probably started at Yale in 1792, with a plan drawn up by John Trumbull. Trumbull anticipated the concerns of later planners, in that his design "would admit of being pursued gradually, and whether partially or completely executed, would be in all its stages handsome" [Turner 1984].

Many planning structures were used in these master plans. The open quadrangles of the colonial colleges, the closed quadrangles of, inter alia, Stanford and Chicago, structured on a web system, and the linear malls on the Virginia model. These 'head and tail' linear systems [Fig 5.34] were the most prevalent and they varied from the very simple systems for the small institutions, to the more complex systems with several cross axes at the larger universities such as Rice, Minnesota and Berkeley. These space structures were realised by a series of foreground and background buildings. The former were usually a chapel, library or administration building; the latter the general academic and supporting service buildings. Together with these buildings, the open space frameworks were formed by architectonic elements such as campaniles, clock towers, symbolic sculpture and landscaped spaces, making each individual campus liveable and vesting it with particular dignity and meaning.

Conceptually, the American campus idea allowed for loosely structured piecemeal growth which, as in the case of Rice University, was controlled by a realistic plan. The plan was guided through its early development stages by a resident campus planner, who had worked in the office of Ralph Adams Cram on the original designs. It is a plan which has been consistently adhered to since 1910. This has not often been the case where influential donors or ambitious presidents have sought to leave their mark on the campus environment, by appointing major architects to design signature buildings which compete with the intentions of the master plans and which pay little regard to the contextual fabric within which they were constructed. For instance, at Virginia, Stanford White closed the open ended vista of Jefferson's lawn with a monumental academic building in 1898.



5.34 Rice University.
750m. template



5.35 Typical Linear Campus Structure
Growth along a major spatial axis anchored by foreground building at one end, usually Library, Assembly Hall or Administration Building

5.6.4 Conclusion

The major contribution of the American campus in the period from early 16C to mid 20C was in overall campus design. These were, arguably, the first examples of conscious spatial organisation of universities. They differed from the organic growth patterns of the Oxbridge colleges and from the European universities embedded in city development.

Turner concludes his definitive work on the American campus by noting that it is a uniquely American place. "As a kind of city in microcosm, it has been shaped by the desire to create an ideal community, and has been a vehicle for expressing the utopian social visions of the American imagination. Above all, the campus reveals the power that a physical environment can possess as the embodiment of an institutions character" [Turner, 1984].

The origins of the University of Virginia have been traced to Union College and, possibly, Downing College, Cambridge. Perhaps, more important are the origins at the city scale. Jefferson was also a classical scholar who had spent five years in Paris from 1784 to 1789 as Minister and Ambassador. He was a Francophile and certainly aware of the late 18C traditions of Baroque urbanism from France and Italy. He would also have been aware of the many Renaissance paintings of the Ideal City, mostly from the school of Piero della Francesco [Figs 5.36].

As an amateur architect/planner he had advised President Washington on the planning of the Federal capital, favouring a more compact plan than the one proposed by Pierre L'Enfant, the French artist/engineer assigned the task of drawing up a plan in 1791. He had also been an anonymous entrant in the competition for the 'President's Palace' [Whitehouse] in 1801. After his term as President [1801 to 1809], he was able to apply these architectural and urban explorations to his major interest, the plan for the University of Virginia in 1817 [Fig 5.37].

American campuses, therefore, can be seen as micro urban units which were assemblies of buildings on large sites, under single land ownership, unconstrained by the myriad regulations affecting urban development. They

5.36 Renassance Ideal Cities
Three paintings from the School of Piero della Francesco, ca 1480.

5.37 University of Virginia
The Rotunda & Lawn

were, generally, realised in a comparatively short period of time and thus were ideal beds for testing the application of urban spatial theory at the level of campus planning and design which later fed back into urban planning.

Located on suburban edges, these campuses were, initially, self contained communities. As they grew, however, the suburbs grew around them and they developed a commuter population. This accelerated with the mass production of the automobile in the early part of the 20C. By the 1940's they were starting to experience new forces which would eventually tend to turn the green field campuses into parking lots. Fortunately, with open space dominated plans, they were able to accommodate these loads but at great environmental cost. This was in contrast to the inner city European universities which did not suffer to same the extent since they served a largely urban population with a traditions of good public transportation.

Earlier in this chapter the large structure at MIT was described as emphasising connections between the various parts of the building and providing generic accommodation which was able to respond to changing needs over time. These issues of connectivity and generic space types, together with other campus concerns such as growth, change and planning structures, were major characteristics of the postwar universities, examined in the next chapter.

CHAPTER SIX

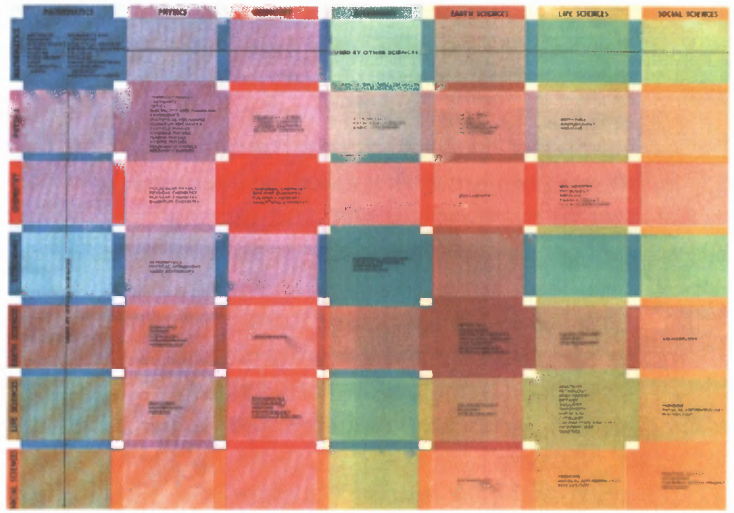
The Postwar Universities

6.1 Overview and Background to the Postwar Universities

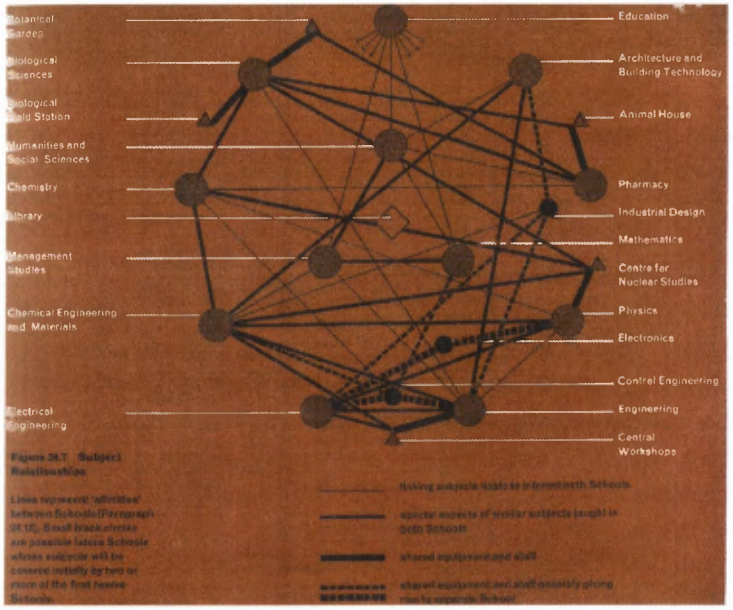
Joseph Rykwert identified the university as the archetypical building of the modern era: "Historical epochs might also be classified by the type of building which is the archetype or paradigm - depending on which way you are looking - to all that gets built in the age. That is what the temple was in ancient Greece, ... the baths alone to imperial Rome, the cathedral to the Middle Ages, the palace to the 17C and so on until you come to the block of flats in the period 1920-1940. And for us now it is the university" [Rykwert, Zodiac 18]. In a similar vein the Architectural Review claimed in an editorial review that "the great new university movement afoot in Britain [is] somewhat similar to, and perhaps as exciting as, the cathedral building movement of the early twelfth century" [Architectural Review, July 1964].

This new university planning movement arose out of changing quantitative and qualitative social, educational, political and technological forces. In the 1960's, there were a great number of students coming through the secondary school system as a result of the postwar baby boom. Not only did the numbers increase but the proportion electing to proceed to tertiary education institutions also grew. For instance, the 3.5 million students in the United States in 1959 doubled to 7 million in 1969, when 50% of those qualifying from secondary schools entered places of higher learning. In 1900 only 4% of those eligible had enrolled in post secondary colleges in the States. In 2003, 65% were enrolled and planners envisage a time later in the century when this will approach 100%.

The 1950's were a period of recovery, rebuilding and consolidating after the war. However, during the decade of 1960 to 1970 the number of university students in Britain more than doubled from 100 000 to 220 000 students. In 2003 about 18% of the population in Britain held university degrees compared with about 27% in the United States, 20% in Canada, 19% in Japan and Australia, 13% in Germany and 12% in France [Newsweek September 15, 2003].



6.2 Science Chart
Chart showing how the seven sciences blended with the phenomenal growth of interdisciplinary studies
[Margenau, H. & D. Bergamini, 1966]



6.3 New Map of Learning
Chart showing strength of course affinities at the University of Bath in the 'New Map of Learning'
[Matthew R. Johnson-Marshall & Partners, 1965]

The amount of university building that took place in the 20 year period from 1960 to 1980 exceeded everything that had been built in the previous 600 years. The massive costs of providing this education led administrators and taxpayers to demand that the greatest advantage accrue from these investments. Largely for these reasons, the 1960's saw the introduction of audio, video and computer aided instruction as well as the application of the sophisticated tools of operations research and systems analysis to the management and planning of universities. Techniques for the management of space in universities were pioneered in California in 1948. These techniques have been developed continuously since then into comprehensive descriptive and predictive models, which feed into current space management and planning procedures.

In the sixties, university teaching was regarded as a key profession in a world increasingly dominated by the professional expert. Similarly, architects commissioned to design the new universities regarded them as key buildings. Therefore they received extremely serious attention, not only as isolated buildings, but as prototypes which could demonstrate solutions to current architectural and planning problems.

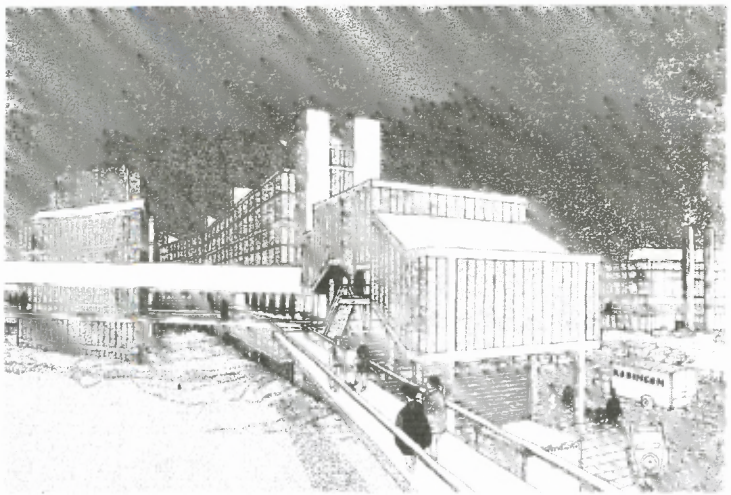
The re-assessment of ideas about university programmes and their spatial implications started as soon as the idea of the first new universities had taken root with publication of the Robbins Report in Britain [Robbins, 1963]. Three aspects of this re-assessment were critical. The first had to do with academic planning: the report proposed broad grounding courses in general studies before specialisation, promoting the idea of schools of study with the hybridisation and splitting of traditional subject fields and opportunities for customising curricula across the old departmental boundaries [Figs 6.2-3].

This fundamentally changed the structural nature of academic activity from a vertical stratification of departmental compartments to a lattice structure with a horizontal weave forming a web-like configuration operating both within and across traditional boundaries. This lattice structure, described as 'the new map of learning' was a fundamental generator of most of the spatial planning for the new British and European universities.

The second aspect was the spatial preoccupation with the implications of uncertainty with regard to size, funding, the nature of academic programmes, teaching methods and technologies. Although relatively small, the significance of this 'new university planning movement' was important in addressing urban planning and architectural issues, including the use of the motor car, growth and change, industrialised building methods and appropriate forms of enclosure for non-predictable change.

It was this focusing of attention on problems within what is, seemingly a manageable unit, which gave the university programme an architectural and planning importance beyond its obvious primary function. Most of the spatial concepts which spilled over from urban planning, had to do with notions of compactness being equally beneficial in terms of social mixing and the new educational structures, through encouraging formal and informal contact. Other ideas had to do with the articulation of different modes of traffic and the creation of pedestrian precincts through variations of the Radburn plan, with traffic *cul de sacs* feeding into pedestrian areas or by means of sectional differentiation with pedestrian areas above vehicular and service areas [Fig 6.4].

Most importantly, plans were concerned with evolving a general structural organisation which could provide for growth and change within a coherent spatial framework. The planning solutions range from the interconnected nodal systems to various linear structures and to surface and spatial networks. It has become increasingly clear that, like Alexander's city, the university is not a tree, but a semi-lattice of overlapping sets of curricula and opportunities for random associations across the disciplinary boundaries. For this reason, postwar university planning can perhaps best be understood in terms of its relative connectivity.



6.4 Movement at Sheffield University
Competition entry for extensions to Sheffield University. Peter and Alison Smithson 1953. Entrance from street to high level student circulation routes
[Lewis, 1967]

6.5 The Shakespearean Seven
The seven postwar English universities [not to same scale] [Birks, 1972]

6.2 British, German, Swiss and Scandinavian Universities

6.2.1 British Universities

Lord Robbins was commissioned in the early 1960's to examine higher education in the UK. He predicted a massive increase in higher education students to over half a million by 1980, 300 000 of whom would be in universities. It proposed that seven new universities be founded, existing universities expanded and the elevation of five colleges of advanced technology to university status. These were Bath, Brunel, Surrey, Loughborough and Bradford [Robbins, 1963].

Although most of the development of the new universities, known as the Shakespearean Seven [Sussex, York, East Anglia, Essex, Kent, Warwick and Lancaster] responded to similar social, educational and technological forces, the spatial results were very different [Fig 6.5]. These differences were not cosmetic, but had to do with the search by planners for structuring devices capable of accommodating increases in size and some measure of change. The absence of a structuring device was seen as the prime weakness of earlier university plans.

It is important to understand the seven new universities as part of historical university development in the UK. Like the Scottish universities and later, the civic redbrick universities, the new universities were not only meant to cope with increases in numbers but also to offer alternate social values and patterns of life.The task of developing these universities was given to the University Grants Committee, a national authority which granted funds according to certain guidelines and standards.

The new universities were planned to be big by English standards. They were located outside comparatively small towns in non-industrial, arcadian settings. Sussex was outside Brighton, Kent outside Canterbury, Essex outside Colchester, East Anglia outside Norwich, Warwick outside Coventry, with Bath, Lancaster and York outside, or on the edges, of their respective towns. These peripheral locations were both because of a perceived national need to stimulate underdeveloped and declining regions economically and because, in terms of the dominant model, universities required sites of about 200 acres for their academic, non academic and residential facilities. The

possibility of planning universities in some of the new towns was only realised in the case of the Open University in Milton Keynes. Thus, opportunities for university and city to grow together was lost with the results interpreted as a form of 'ivory towerism' separating the world of academia from every day life.

By contrast, the Leeds Plan [Chamberlin, Powell and Bon, 1960] was a comprehensive review and extension of an existing university. Its planning emphasised two points. One was the importance in spatial planning of recognising the 10 minute cross over period between lectures: the origin of the' ten minute university' which was to become a feature of most of the new universities. The other was a concern with providing generic, flexible teaching space in the form of simple loft space, rather than specifically designed facilities. A case was thus made for compactness with the pedestrian route as the key to architectural organisation of the buildings, similar to the proposal by Alison and Peter Smithson in their Sheffield University competition entry [Fig 6.4].

Three of the seven new universities, York, Lancaster and Canterbury, were based on the collegiate system, with students residing in colleges, forming a community of scholars living in a 'house unit' of about 12 and a secondary 'college unit' of about 240. Sussex had a mix of traditional residences and a student 'village', while Essex and East Anglia had self-catering student flats clustered around living/dining spaces for 12 or 16 students. A number of these universities will now be discussed in greater detail.

University of Sussex

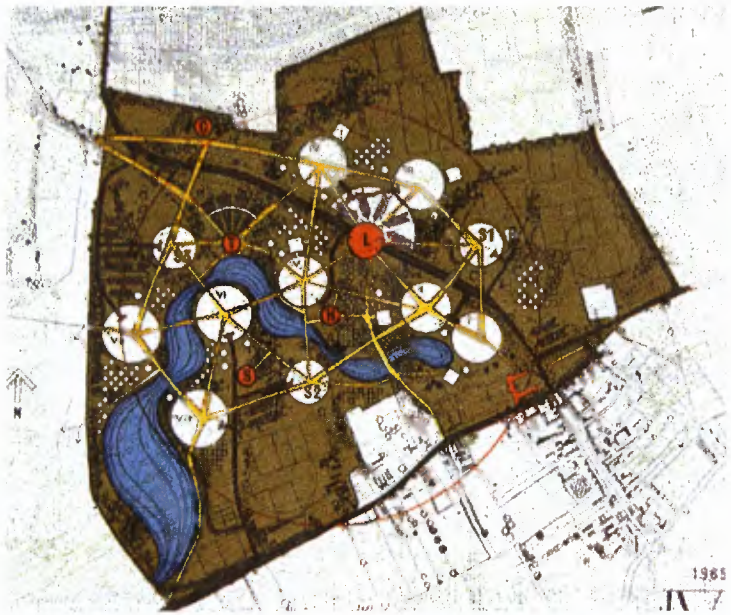
The architect for the University of Sussex, Sir Basil Spence was appointed in January 1959 and the first buildings were completed on a 209 acre site 4,5 miles from Brighton in October, 1962. Planned for 3 000 students, it enrolled 6 862 full time students in 2001. It was highly regarded academically with flexible and broadly based courses. At a housing level, it was able to make use of the annual tourist cycle in Brighton which catered for holiday makers in the summer and was able to offer students lodging during term time. One third of the students were accommodated on site.

Sussex

6.6 Sussex University
Plan of University
[Birks, 1972]

York

6.7 York University
Plan of University
[Birks, 1972]



6.8 York University
Plan showing nodal system
[Matthew R. Johnson-Marshall & Partners, 1962]

6.9 York University
View across lake of Langwith College showing CLASP system of construction
[Muthesius, 2000]

The plan was a traditional campus type with individual pavilions arranged in precincts and set in parkland, a spatial plan which did not reflect the lattice like connectivity of its 'new map of learning'. Growth, according to the architect, was by 'frogs spawn proliferating in the spaces between the trees'. Development took place from a firmly established core building, Falmer House, which was the social centre of the University and which accommodated student, staff and food services. It, therefore, grew by accretion in a semi circle from Falmer House as a centre point, with new buildings further and further away from the 'centre' [Fig 6.6].

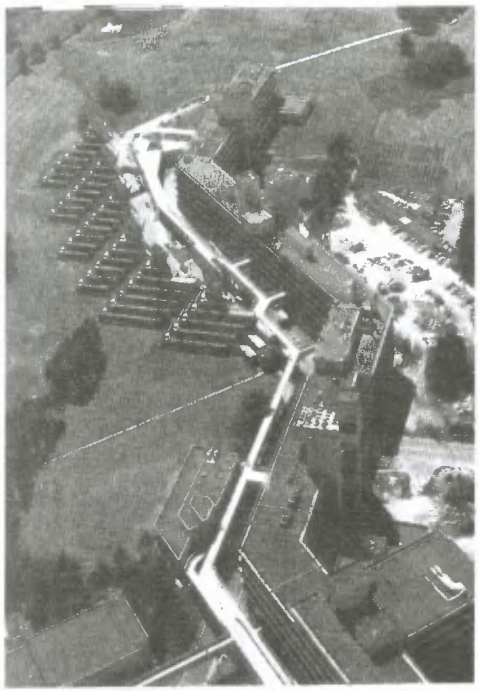
The architectural quality and environmental character of the site has been highly regarded by many, with fine buildings set in a gently undulating landscape with many fine old trees.However, initial plans for the horizontal segregation of traffic had to be modified because of increases in student numbers and car usership and parking loads were under estimated with the inevitable transformation of green landscape into grey tarmac.

University of York

York was founded in 1960 and a year later the architect, Andrew Derbyshire of Robert Matthew, Johnson-Marshall and Partners, was appointed to design a university based on the college system on a 190 acre site. It was planned for 3 000 students and currently has nearly 10 000.

The plan was based on a nodal system with colleges linked to specialised nodes for central science, library, assembly and recreational facilities. The colleges accommodated social modules of about 250 students and were planned in pairs, sharing a common dining hall module for about 500 [Fig 6.7].

In the collegiate system, most staff and all students were members of colleges. All first year undergraduates and overseas students were guaranteed accommodation in one of the eight colleges, or in University residences within walking distance of the colleges. Most departments were located in specific colleges. The bulk of the university was housed in three and four storey colleges, each one containing both teaching and living accommodation developed, as the architect stated, in a 'memorable



6.12 **University of East Anglia**
Aerial view showing teaching wall on right of linear walkway with student housing on the left
[Muthesius, 2000]

6.13 **University of East Anglia**
Central buildings around square linked to walkway by a series of platforms

6.15 **University of East Anglia**
Western end of walkway now terminated by 'high tech' building housing Sainsbury Collection

6.14 **University of East Anglia**
Walkway with teaching wall on left, opposite the student housing ziggurats

Besides linking the various academic and residential buildings, the elevated walkway also acted as a horizontal duct on its underside. The teaching wall was a five and six storey building system comprising a continuum of neutral academic accommodation without boundaries and with a constant ceiling height of 3,25 m. This allowed mechanical and electrical services to be provided at any point. The teaching wall formed a background to foreground buildings housing library, administrative, food and student services. These were planned around a series of central open spaces and linked to the spinal walkway by an arrangement of platforms and decks [Figs 6.13-14].

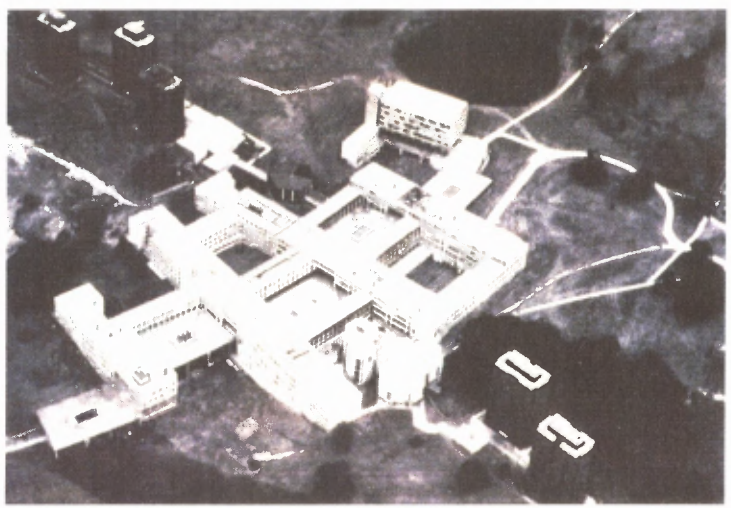
The characteristic pyramidal student housing on the lower edge of elevated walkway, together with the snaking teaching wall, resulted in an image which Reyner Banham described as the UEA 'zigzaggurat'. This chain of student housing was organised in clusters of 12 study bedrooms, sharing a communal 'farmhouse kitchen', a living and dining area for the self catering housing units.

Cars entered from the high ground on the north, with a large parking area connecting to the various pedestrian routes. Some of these entered the teaching wall from the upper [north] side providing entrances at intermediate levels. Others accessed the elevated pedestrian spine providing access from the south to the teaching areas at a lower level and to the student housing ziggurats at an upper level. This spine provided separation between pedestrians and service traffic to the teaching wall and housing at grade. The scheme, therefore, provided for both horizontal and vertical separation of pedestrians and cars.

The plan was a terraced linear scheme with the potential for expansion at both ends or by construction of additional terraces. The resultant form of the background teaching wall, the foreground 'central' buildings and the stepped student housing was a convincing example of campus design which was both open and compact. It had a quality of design that was matched by few other postwar universities.

Essex

6.16 Essex University
Plan with central buildings in east, adjacent to lake. Linear spine winds down the valley to the west
[Birks, 1972]



6.17 Essex University
Aerial view showing 'head and tail' growth from library at the top down the five stepped squares. Lecture theatres are in the interspaces on either side of the spine & students housed in dark brick tower blocks further out

In the early eighties, the Centre for Visual Arts was constructed at the western end, effectively blocking expansion at that end. The building was an uncompromising Hi-tech building by Norman Foster, in marked contrast to the late modern palette of materials used by Lasdun [Fig 6.15].

University of Essex

Planning for Essex University commenced in 1962 and the first buildings were occupied in 1965. The site was 204 acres in a valley 2,5 miles from Colchester and a 45 minute train ride from London. The first Vice Chancellor, Dr. Albert Sloman, gave the 1965 Reith Lectures which were subsequently turned into "The making of a New University", published by the BBC.

Sloman was one of the few Vice Chancellors at the time who believed that size was important. Essex was planned for between 10 000 and 20 000 students, in the belief that departments needed to be big in order to build up effective research teams to cover all necessary branches of a particular subject and to justify the resources and, frequently, expensive equipment. He believed that it was only through a broad undergraduate base, that the post graduate research tip to the pyramid could be achieved. Further, he argued that this research activity would attract the best staff who, in turn, would attract the best students. These large departments were to be grouped in schools to discourage isolationism. This interaction between departments and schools was to be reflected in the physical plan. In 2003 Essex had 9 100 students.

The architect, Kenneth Capon of the Architects Co-Partnership, planned a very concentrated scheme in the valley, with a walking distance of 5 minutes between academic buildings. This was achieved by using the bottom of the valley as a service road giving access to all plant, workshops, storage, deliveries and some parking. Above this he built a 'giants causeway' in the form of stepped decks with access to academic and student services buildings. Pedestrian movement was up and down these decks with inter linked squares of teaching buildings, weaving across the spine forming urban squares. Five squares were planned, staggered in a mild zigzag, stepping down the alignment of the old river. There were two changes of level, each of about 3,6m. between Squares 2 and 3 and 3 and 4 [Figs 6.16-18].

6.18 Essex University
Aerial view from west with library at the top, 'entrance' to complex at bottom & student housing in brick tower blocks on either side
[Muthesius, 2000]

6.19 Essex University
Stairs connecting squares over service spine

6.20 Essex University
Main square

6.21 Essex University
Residential towers with academic buildings in foreground

6.22 Essex University
Residential towers with academic buildings in foreground

Essex, like East Anglia, adopted the Leeds proposal for continuity of teaching space. This allowed for some degree of change in use and user, in a spatial configuration which was flexible and offered a high degree of connectivity between departments. Special buildings, such as the larger lecture theatres, which did not readily fit into this flat floor continuum were located in the gaps between the teaching buildings on the outside of the spine.

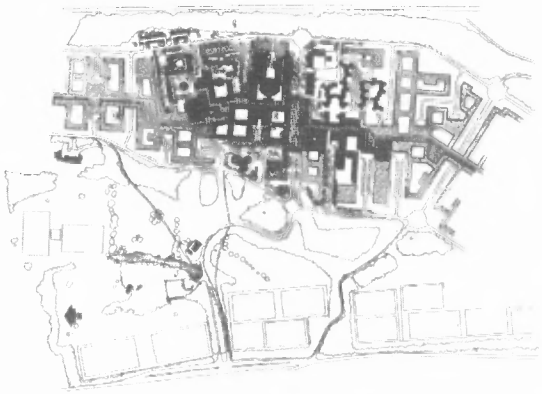
The visitor arrived by being dropped off in the undercroft and coming up in Square 3, the central square. It contained the restaurant, coffee shop, bar, campus shops and student administrative, social and cultural services. It had bright lights and neon and was intended to have the atmosphere of the Latin Quarter in Paris or Soho in London [Figs 6.19-20].

The idea of colleges or halls of residence was rejected, as the university wanted to give the students as much freedom as possible and as much responsibility outside of an institutional framework. Flats were, therefore, constructed, with groups of a dozen or so students sharing communal living, kitchen and bathroom facilities. Study rooms were also provided in each flat for those students who had lodgings in town but who needed a home base on campus for study and a sense of belonging to a small social group. The flats were fourteen storey residential towers, built in dark load bearing brickwork, in contrast to the prefabricated concrete system for the teaching buildings. These were planned on secondary movement routes, at right angles to the spine, close to the teaching buildings [Figs 6.21-22].

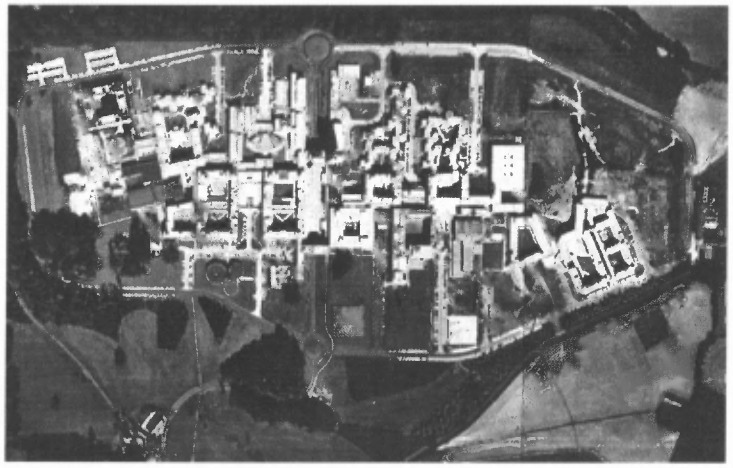
As noted, the main service and public transport road was below the pedestrian spine. This vertical separation was complemented by a ring road, which fed traffic into parking areas on the periphery.

Essex was a compact scheme with a high degree of connectivity. It was structured on a line with a Library and main square as its head, and with growth taking place at the other end. Facilities were thus constructed further and further away from the head. This was a common problem with the 'head and tail' or unipolar linear schemes.

Lancaster



6.23 Lancaster University
Plan of University
[Birks, 1972]



6.24 Lancaster University
Aerial view of University
[University of Cambridge Aerial Photography]

University of Lancaster

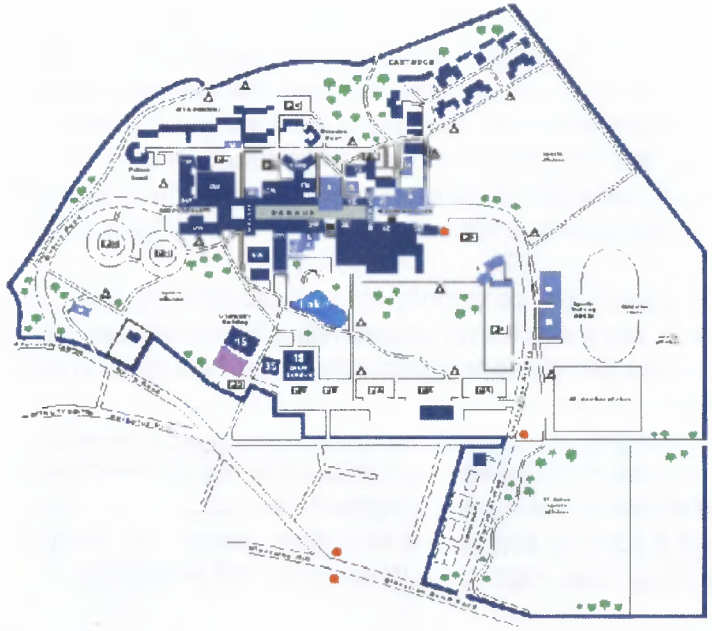
The University of Lancaster had a similar density, but differed from Essex in that it was a bipolar linear scheme with its central facilities in the middle, growing in two directions from the centre.

It was the last of the Shakespearian Seven to be built, moving onto its site in 1966. The 200 acre site was 3 miles from the town of Lancaster. Planned to grow to 3 000 students in 10 years, it had 1 850 full time students by 1970: by 2003 it had 12 217.

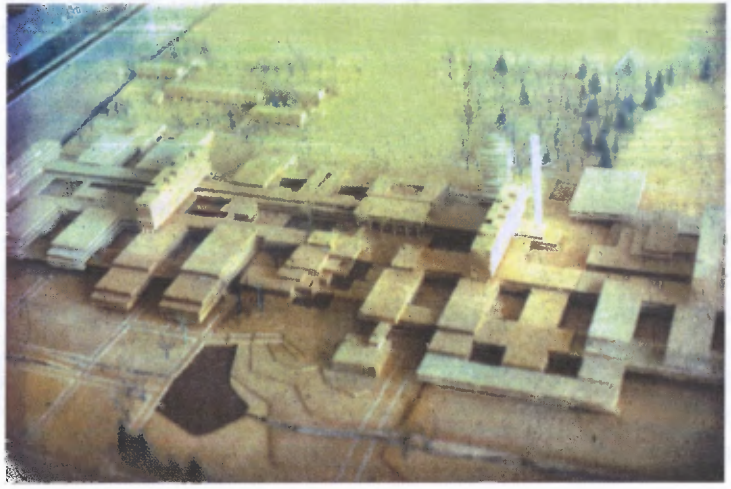
Gabriel Epstein of Shepheard and Epstein developed a plan which was relatively simple and easy to understand. It was based on a number of concerns: a strong pedestrian focus; the need for the university to appear complete at any stage in its growth; cars needed to be out of the way but able to provide an adequate service, and the ability to cope with unforeseen growth and change.

Accepting the need to integrate buildings, to mix social, residential and teaching activities and to separate vehicular and pedestrian traffic, a 'vertebrate' plan was developed. It had a pedestrian spine in the form of a meandering street running north-south. The spine widened into squares at a number of points, with a covered way along the whole of its length and around all squares, with the result that people could walk to any point under cover. This was the main structure [spine] with secondary movement routes [ribs] at right angles to the central spine [Figs 6.23-24].

The institutional structure was based on the college system but here it was given far less physical definition than at York or Kent. The density and pattern of connected courts was similar to Oxbridge. Each college had a membership of 500, half of whom lived in college, with the others living in town but having membership of the college and use of its facilities. There was no students union but all 'lively' facilities used by students faced the spine walkway. These included restaurants, common rooms, a dance hall, pubs, shops, banks and launderettes.



6.25 Bath University
Plan of University



6.26 Bath University
Model of University

Wheeled and foot traffic was separated horizontally, with cars feeding into small landscaped parking areas for 1 250 cars in a series of culs de sac on the periphery. These perimeter roads, however, were linked by an east west underpass under the central Alexandra Square. A module of 10,6m. wide buildings and 30m. wide quadrangles was adopted. The buildings, which attached to the spine, were planned with interstitial spaces of the same 30m. This dimension provided 'breathing space' and allowed cars to come to within 15m. of the spine.

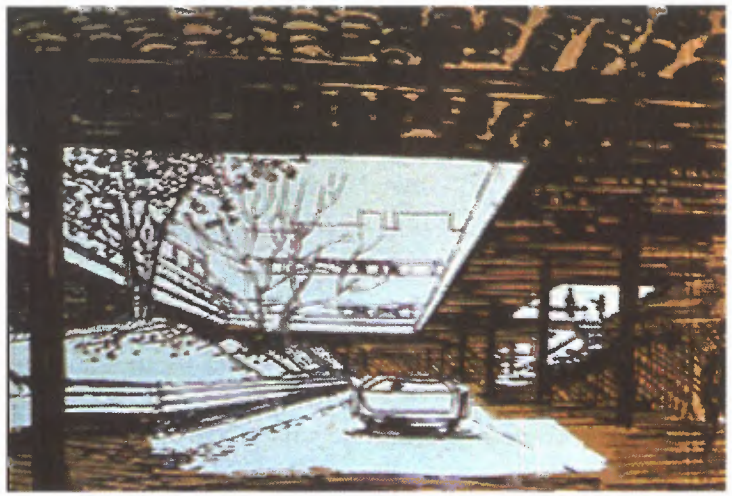
Lancaster is a livable, down to earth bipolar linear scheme, double banked with teaching and residential facilities. It was planned to allow a number of architects to contribute to it's building within this framework, as long as there was respect for the established grain, the small scale and the almost casual mix of activities.

University of Bath

Bath was another bipolar linear scheme double banked with teaching facilities. It was a College of Advanced Technology, which became a university in 1966. Planned for a growth of 3 600 students within 10 years, with a maximum of 5 000, it had a full time enrolment of 8 614 in 2002.

The architect, Hugh Morris of Matthew, Johnson Marshall and Partners, had already been appointed in 1962 and construction started in 1964 on a 190 acre site, about 11 miles outside Bath. The plan established a series of principles of growth and zoning, rather than a definite statement of building forms. It was a guide to action, rather than a blueprint for the future. It set out the balance between buildings, landscaped open space and car parking and it established zones for academic, social and residential buildings. Within the academic zone, it established areas for science, engineering and humanities as well as student housing.

Morris planned a compact scheme, with development stepping down the site in storey high terraces cut into the hillside. One of these steps contained the service road, with delivery bays, plant and storage space. Above this was the pedestrian deck known as the Parade to evoke memories of the *genius*



6.27 Bath University
Sketch of lower service road with the Parade above
[Matthew R. Johnson-Marshall & Partners, 1965]

6.28 Bath University
View of Parade with service road below

loci of Georgian Bath. The layout was based on a linear pattern of growth, with primary expansion occurring at both ends and secondary expansion at right angles to the long central spine. This was a pattern which allowed the various parts to grow independently of one another. Construction started in the centre, with the first phase academic facilities, the inter school lecture theatres, general institutional and supporting services and the residential slab. Each linear end was thus free to grow in future phases to meet unknown demands within the planning principles. Similar principles guided the secondary lateral growth at right angles to the Parade [Figs 6.25-28].

The focus of academic and community life was provided by the central pedestrian Parade, along which were ranged main administrative and social buildings, library and teaching rooms used collectively. Also opening off the Parade were the nuclei for the Schools of Study, a grouping of reception, common rooms, meeting rooms and the coffee and snack bar. Lateral growth behind the nuclei was stratified into horizontal zones for general teaching spaces and other non-science spaces related to the nucleus and Parade. Behind this was a zone for bench type laboratory spaces and, lastly, the heavily loaded, large span engineering laboratories and workshops.

In this way, although Schools had individual identities and clearly demonstrated the University's academic structure, they did not dominate the architectural form as separate buildings. Restaurants, as well as social and academic support facilities, were sited to create points of activity along the length of the Parade.

An informal pattern for housing students was adopted. Some flats and study bedrooms were planned in tall buildings over the Parade, others in 3 storey buildings to the north and some in Bath itself. It had been decided to make the twelve academic Schools of Study the primary focus of social life and it was hoped that staff and students would meet in the nuclei of common rooms provided in each teaching building. These were seen as the points of entry into the wider pattern of community life which would develop in its clubs and societies, students union, sports centre, theatre and shops, as well as the several restaurants and bars distributed along the Parade.

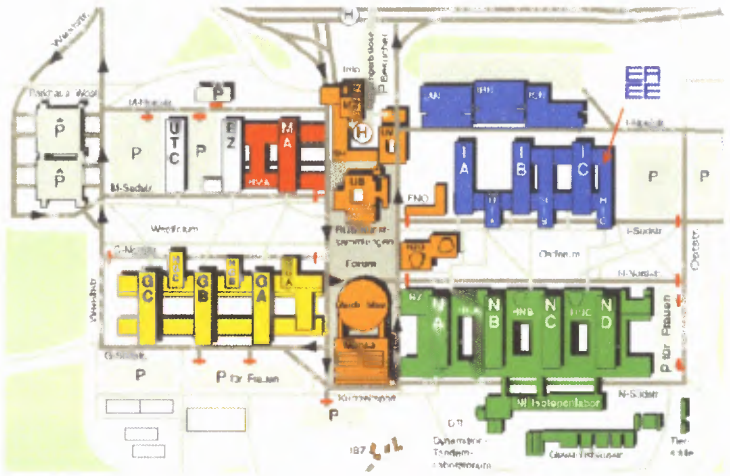
Although the architecture was undistinguished, the plan for Bath probably best reflected the academic and spatial planning forces at work in the postwar British universities, such as the high degree of connectivity predicated by the 'new map of learning'; the need to respond to growth and change, as well as separation of cars and pedestrians.

6.2.2 German Universities

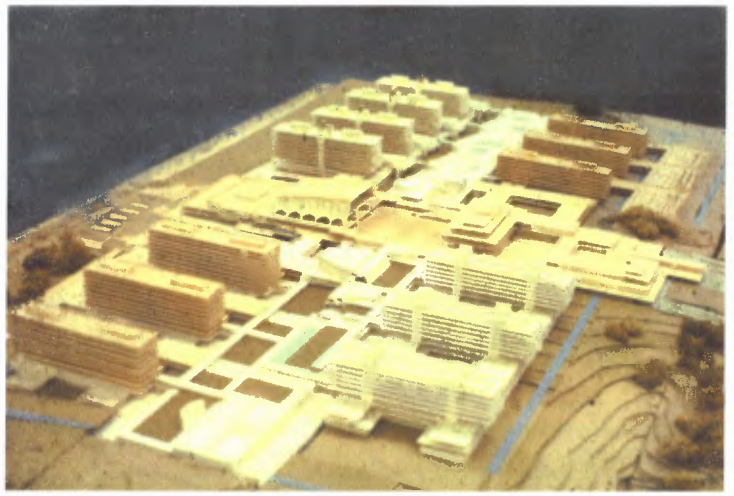
The postwar German universities came about for much the same demographic reasons as the British. However, they were descended from very different historical traditions, both with regard to teaching methods and approaches to student housing. University matters were a state concern and there was no national authority such as the University Grants Committee in Britain. They also had a smaller percentage of students entering tertiary education than in Britain which, as discussed, was very low compared to the United States.

By the late 1950's in Germany, university extensions on a large scale were planned in many places. In law, states had the final say on the planning of universities. In practice, however, this authority was delegated to the special building offices set up in individual universities. These were well resourced and, generally, well staffed, with highly skilled teams who shared their expertise with universities in other states and who had access to various university research centres. These, in turn, disseminated reams of information on every aspect of university planning.

In the State of Baden-Württemberg, for example, the vast programme of university building was entirely directed by the Staatliche Bauverwaltung in Stuttgart. From 1957 to 1972 its leader was Horst Linde who also occupied the chair of town planning at the Technische Hochschule Stuttgart, which he changed into the chair of Design for Higher Education. Here Linde developed a research institute and led a school of designers. In addition, he edited a massive four volume work on all aspects of modern university planning and architecture. He also set up the Zentralarchive für Hochshulbau which produced and housed a considerable amount of material on all aspects of university planning [Muthesius, 2000].



6.29 Bochum University
Plan of University
Red: Medicine
Yellow: Humanities
Blue: Engineering Sciences
Green: Natural Sciences
[Muthesius, 2000]



6.30 Bochum University
Early model of University

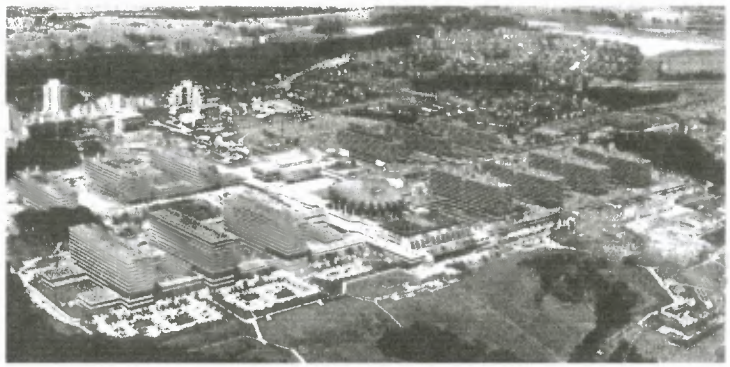
By the mid 1960's, the states began to insist on rigorous standardisation resulting in the pooling of experience and the development of the characteristic three band building based on the 7,2m. grid. At the same time the Stuttgart researchers, particularly Peter Jokusch, stressed the importance of the social dimension of university life. It was pointed out that in the British new universities, one third of the costs went on 'social' buildings. Initially German planners rejected this level of expenditure on non-core activities but eventually increased the provision of social programmes [Muthesius, 2000].

As in Britain, the German universities were generally planned outside or on the edges of cities on large sites of about 150 hectares or 370 acres. Land of this size was simply not available in the cities. The planning was to be compact, with everything within the 10 minute walking distance of the centre. By 1965 the Lancaster architect, Gabriel Epstein, had formed connections with the Stuttgart group and later he succeeded Linde in the chair for the Design for Higher Education programmes. English universities with their novel low rise, high density plans became the model for the new German universities [Muthesius, 2000].

Bochum University

Bochum is in North-Rhine Wesphalia, the most populous state in Germany. The University is sited on 540ha. in the centre of the Ruhr, close to the point where the dominantly industrial land changes to the picturesque valley of the river Ruhr, about 5km. from the centre of Bochum. While the university served a generally working class area, the attractive site helped alleviate the severe image of a sooty region, an improved image badly needed at a time when the erosion of the traditional economic base, coal and steel, had already begun [Muthesius, 2000].

An international ideas competition for the design of the University was won by Hentrich, Petschnigg and Partners who subsequently worked together with the State Building Authority on the project. During 1963 the plans were developed and construction started in 1964: by mid 1965 it accommodated 2 000 students. It was planned for 15 000 students. By 1970, there were 10 000 students and currently it has over 35 000.



6.31 Bochum University
Aerial view of University
[Muthesius, 2000]

6.32 Bochum University
Student Centre with 'Jumbo' Blocks in background

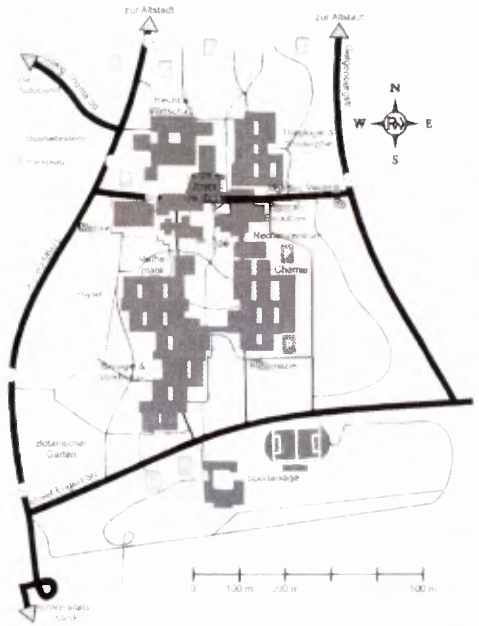
6.33 Bochum University
View from valley to the south

The University plan was a large bipolar linear scheme about 900m. long and 400m. wide, double banked with 13 virtually identical teaching buildings. At the centre was the Forum, an area of 120m. by 400m., comprising the foreground buildings: the Aula Maxima [assembly hall] seating 2 400; Mensa [refectory]; and the Library. It was on a raised deck covering 3 levels of parking. It was a formal, almost simplistic, plan structured by an open space spine which accommodated some of the larger central lecture theatres. It was bordered by a continuous two storey podium, connecting the teaching slabs which rise 7 or 8 storeys above the podium [Figs 6.29-30].

The University was served by four roads off the main highway. Two of these were on either side of the forum with access to structured parking and to the backs of the teaching slabs. The two other roads were at the east and west ends of the precinct. Pedestrian movement from the edges to the Forum took 7 to 8 minutes. Since the time between lectures was 15 minutes, the large central lecture theatres were accessible from all parts of the campus. Throughout the university, there was either horizontal or vertical separation of pedestrians and cars [Figs 6.31-33].

The teaching buildings, 'jumbo' slabs, were planned on a 7,5m. structural grid. They were 3 bays wide, a layout which could be used in various ways. Normally, one of the outer bands was for staff accommodation and the other for students. The central band was then used for small classrooms, departmental facilities, storage and plant. An alternate layout was for office type accommodation on the outer band with the other two bands used as wide accommodation for studios and laboratories. The 7,5 grid accommodated three parking bays and small offices 2,5m. wide. Each floor was 2 577sqm. and they were served by two cores.

Housing for 30% of the students was considered but this was not implemented. Instead, a township [Unicentre] was developed immediately to the north, containing a variety of housing types and related shops, markets, restaurants, a coffee bar and various types of entertainment.



6.35 Regensburg University
Plan of University [Regensburg Universitätsbauamtes, 1977]

6.34 Regensburg University
Aerial view from the south [Regensburg Universitätsbauamtes, 1977]

Bochum University was a solution which reflected the academic plan. It was structured by a strong, large and compact linear spine, with separation of traffic routes. It used current building techniques and reflected the image of late modern architecture which, because of its size had been difficult to soften with planting. It was an heroic effort which has been justly criticised as being too big, too uniform, monotonous, utilitarian and inhuman. However, it remains the prototypical postwar German university.

Regensburg University

Regensburg is a city of 130,000 inhabitants and is the seat of the district government of the Upper Palatinate, an eastern part of Bavaria which used to be close to the Iron Curtain. The site was chosen in attempt to alleviated congestion in the capital, Munich, and also to stimulate development in the under-developed region. The medieval town centre has remained intact and the labyrinth of narrow streets and squares makes Regensburg's Old Town one of the most picturesque in Germany.

University facilities were located on a 150 ha. site at the southern edge of the city, about 15 minutes by foot or 5 minutes by bus from the central train station. It was thus one of the few postwar universities which, although on the edge of town, was able to integrate with the life of the town.

The University opened in 1967 with 670 students, having been planned for 8 000. By 1996 it had a total of 16 682 students. Planning was undertaken by the University Building Office under Helmut Gebhardt in 1964, with competitions being held for individual buildings. Regensburg was noted for its hard and soft landscapes which unified the complex and created surface continuity, thereby softening and bringing together the often very well designed buildings by different architects.

The plan was a bipolar linear scheme. It was a relatively loose, medium density scheme which also managed to be compact. The human scaled plaza was placed close to the city end of the linear spine, with limited growth in the northern direction. Major growth took place to the south and at right angles to the spine [Figs 6.34-35].

6.36 Regensburg University
Distant view of University centre

6.37 Regensburg University
View of University centre

The centre was flanked by the Aula Maxima, the Mensa, Library, Administration and large lecture theatres. Like Bochum, Regensburg made use of slope to construct 3 layers of parking under the central plaza. Avoiding large concrete complexes, the architecture on campus harmonized with the landscape. Cross east-west traffic was channelled underneath the university, allowing for wide open areas which were landscaped, creating a campus with a park-like atmosphere [Figs 6.36-37].

Regensburg has a central library and several specialist departmental libraries. The central library is in the form of a linear library which serves three of the major teaching buildings adjacent to the 'plaza' in a spatial continuum. As at Bochum, students live in University housing off campus, but close enough to make use of, and thus, enliven, the central food and recreational services.

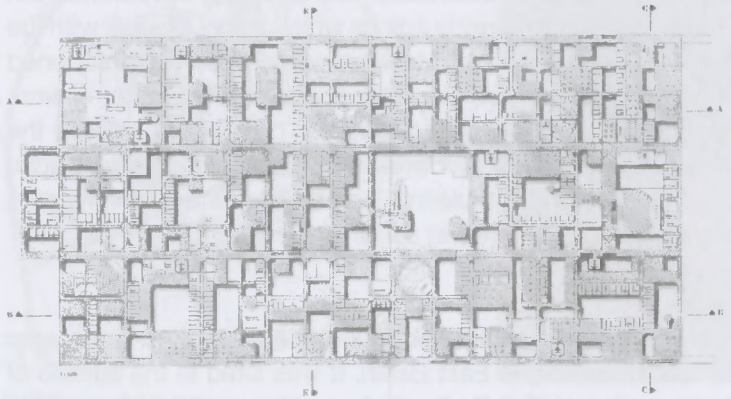
Regensburg was one of the most successful new university environments in Germany. It had two and three storey buildings which, although built with the ubiquitous off shutter or precast concrete, were well designed and softened by the excellent landscaping. It was a direct expression of the forces at work in the postwar universities and shows that it was possible to achieve the academic and campus planning objectives in a manner which was livable, environmentally attractive and stimulating. It was however a relatively small and low density scheme, compared to some of the others.

Berlin Free University

The Free University of Berlin was founded in 1948 by emigré professors from the Humboldt University in East Berlin. It was sited in the suburb of Dahlem in what was then, West Berlin. Today, with over 60 000 students on all campuses, it is the largest university in Berlin.

In September 1963 an international competition was held for an extension to the Arts and Science Faculties for 3 600 students on 14ha. It was to be planned within the existing campus, which already had teaching buildings, a central library, an assembly building and administrative and service facilities.

6.38 Berlin Free University
Plan of context with Arts & Science Faculties in left hand corner [www.fu-berlin]

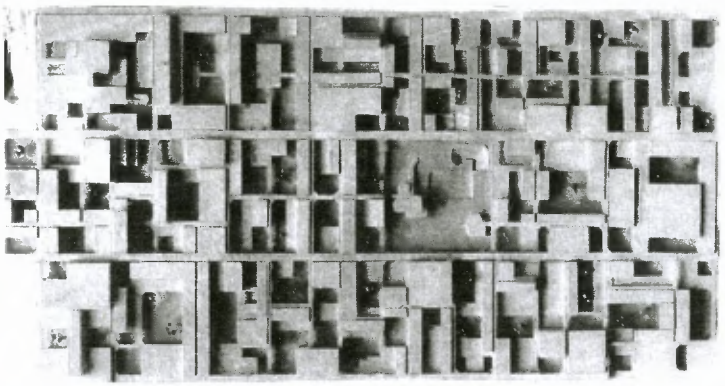


6.39 Berlin Free University
Plan of Arts & Science Faculties [Field, 1999]

The competition was won by Candilis, Josic and Woods, a firm that had previously been a runner up in the Bochum competition. Both Candilis and Woods had worked for Le Corbusier and Woods, in particular, was an active member of Team 10, an important group of architects who did much to advance planning and architectural theory in the late 1950's and 1960's.

Designed in 1963, the first buildings were completed in 1973. It was the most celebrated of the postwar university plans amongst architect and planners. Accordingly, it is appropriate to quote directly from the architect, Shadrach Woods on the competition project:

> "The scheme is an attempt to discover structuring principles which might be applicable to the organisation of the physical environment. The University is considered a place and a tool. Many of its functions are known, others are not. We supposed that its principal function is to encourage exchange between people in different disciplines with a view to enlarging the field of human knowledge. Our intention then, in this scheme, is to provide.....the maximum possibilities for contact and exchange in the community 'university', while ensuring privacy for each specific function. In order to facilitate intercommunication between various disciplines we felt it necessary to go further than the analysis of different faculties in different buildings; we tried to imagine a synthesis where all faculties would be associated rather then dissociated and where the psychological barriers which separate one from another would not be reinforced by physical barriers such as entrance doors and building walls or by the physical identity of the parts at the expense of the whole.
>
> The system adopted is one in which a series of parallel ways is established following the principle direction of the University.....These main stems run NE-SW and are 70m. apart. They contain and serve all those functions which would benefit from easy contact with the rest of the University, including auditoria, exhibition space, lounges, libraries, lecture halls, cafes etc.



6.40 Berlin Free University
Model of Arts & Science Faculties [Field, 1999]

6.41 Berlin Free University
Exterior views of Phase 1

> The main stems are connected at convenient intervals by secondary ways. Those places and functions which require privacy and tranquillity are located on these secondary connectors. This web of primary and secondary circulation.....is then, not a megastructure but a structuring device which exists only when required.
>
> The University..... has three levels; a lower service and storage floor [under part of the building], the ground floor which contains most of the activities and an upper floor [over part of the building] with offices and small classrooms. It is hoped to add a fourth level with some housing if this seems desirable. All roofs are accessible as public or private terraces.
>
> No one of the main stems has been given greater importance than the others either in dimension or intensification of activity planned along it. It is felt that the plan.....should remain as open [non-centric] as possible so that it may become, through use, poly-centric" [Woods, 1964] [Figs 6.38-40].

Candilis, Josic and Woods had designed many housing schemes in North Africa and were familiar with the dense, interwoven fabric of dwelling, court and street. They had also developed housing projects in France, particularly in Toulouse-Le Mirail on a linear stem structure. Their Bochum competition entry was a low rise, high density scheme based on a stem structure. The antecedent to the Berlin project was their unsuccessful 1962 competition entry for a central city redevelopment in Frankfurt. Here, Woods had introduced the idea of linear stems together with a series of cross strands forming a grid, web or mat. In the Frankfurt scheme this web correlated with the grain of the city and was integrated into its fabric. A year later, this web structure was the basis for the Berlin scheme, with its matrix of corridors, rooms and courtyards.

The main organising structure for these projects was the street, which was seen as the primary realm of social interaction. The planning diagrams stressed the exchange of ideas, association of disciplines and use of a minimum structuring system within which individuals and groups may

6.42 Berlin Free University
Interior view of main lecture theatre, divsible into two smaller auditoria

6.43 Berlin Free University
Interior view of common room

6.44 Berlin Free University
Interior view of side 'street'

determine desirable relationships. They also stressed that buildings were designed not as 'monuments' but as 'instruments'; instruments that the users themselves must learn to use [Figs 6.41-46].

Manfred Schiedhelm who had been part of the original competition team in Paris and job architect in Berlin, took over the project in 1973 when Woods died at age 50 and stayed with it for over 20 years. He describes this experience as follows.

> "We were fascinated by three phenomena; Mediterranean architecture with its beauty and high degree of flexibility, the Cartesian clarity of the American city and the experience of living and working in Paris in the 1960's with its vibrant liveliness [of the street scene] and important art scene. Seen from an urbanistic point of view, these three urban structures were guided by the street as a feeder for all activities which make up a city. The street as a linear centre around which the city could grow. The street as a void which allows the flow of goods and facilities. The street as the only permanent element of the city. As long as the void was kept clear, the rest could be adapted to changing needs."
>
> He added that"....once we had found this web-like scheme of organisation, the adaptation of programmes became an easy task.....A street pattern of permanent main streets and adaptable side streets laid the basis for a free and changeable use of the space in between which was divided into built and non-built zones" [Field et al, 1999].

Woods asserted that "planning [urbanism] is the correlating of human activities; architecture is the housing of these activities. The building exists, then, both as university and as a shard of the ideal city" [Woods, Perspecta 12]. The Berlin scheme, however, was not integrated into the city fabric in the same way as the Frankfurt plan. It was a fragment of the city set apart as a building in a suburban field without recognisable entrances. It was planned on a neutral grid which led to problems of orientation, both internally and externally.

6.45 Berlin Free University
Interior view of ramped 'street'

6.46 Berlin Free University
Interior view of ramped 'street'

The metal curtain walling, designed with Jean Prouvé, consisted of framed panels in Cor Ten steel, which had self-protecting corrosive qualities. However, from the beginning, the thin sections started rusting and the facade began to decay [Fig 6.41]. By the 1990's, this had become extensive. As part of a comprehensive process of renovation, the steel panels and framing have subsequently been replaced with patinated bronze elements.

The rusty panels have led to much criticism, as has the fact that the plan was designed as part of the city but lacks urban intensity although, in the long run, the two may coalesce, as can be seen from recent campus plans. It has not been popular with the users, perhaps because it is an 'instrument' which they do not understand how to use. In this context Manfred Schiedhelm commented:

> "What remains today of a thirty five year old idea? Students and staff have taken over the building. Many [amateurish] alterations have been made without the help of the architects. For psychological reasons, the staff want separate, overseeable, units such as houses with doorbells. But our urban scheme should be able to match this task. Despite all these difficulties, the building is booming like a railway station of information. Students have made certain areas into places of their own. Makeshift cafes and bookstores have been established in different places. During the warmer months courtyards have become extensions of seminar rooms, over and beyond their recreational function. The complex has become an adaptable tool for the realisation of university life. The future will have to judge its value" [Field et al, 1999].

It is useful to note that the Berlin plan preceded Le Corbusier's Venice Hospital project by 2 years. In this context Gabriel Field notes that Woods' Berlin scheme and Corbusier's Venice Hospital "took on the challenge of reintroducing the elements of traditional city life in redefining streets, even entire urban fabrics. These are difficult projects which attempt to reconcile the mechanisms of modern architecture with the recovery of the street as a form of organisation and a realm for social interaction" [Field et al, 1999].

6.47 Konstanz University
Plan of University
[Muthesius, 2000]

6.48 Konstanz University
Aerial view of University
[Muthesius, 2000]

Konstanz University

Konstanz is in the state of Baden-Württemberg, which has two of the oldest German universities in Heidelberg and Tübingen. The site overlooks the beautiful Bodensee and the famous island of Mainau. The University was originally planned for 3,500 students. After 10 years it had 5 000 students. Since then this figure has doubled to over 10 000.

The move to the green fields site outside Konstanz took place in 1972. The university was planned as a living and working environment, where new forms of teaching and research were to be reflected in its design. The plan was influenced by the Stuttgart Institute, although it was implemented with strong design input by a team led by Wenzeslaus von Mann and Wilhelm von Wolf of the University Building Office.

It was effectively one building of 350m. by 350m., eight storeys high. Architecturally, it was based on the standard 7,2m. grid, stepped toward the view, creating high level platforms for the foreground buildings, with their complex polychrome shapes contrasting to the regularity of the high rise concrete background teaching building [Fig 6.47-48].

It is difficult to determine the planning structure of this intricate building complex. Some planners talk about it as a scheme with a linear spine, others talk about a 'cranked spine' [Muthesius, 2000]. The square building form shows no evidence of one dimensional linearity. It has more of the characteristics of the two and three dimensional web structures, a kind of three dimensional Berlin. For the purpose of this thesis, it is taken as a 'high rise' or multi level web structure although it lacks a very legible horizontal and vertical circulation system. In addition, it can be classified as a megastructure, as will be seen in a later section, with all the attendant problems of the large structure, of dealing with growth and change [Fig 6.48].

What is widely agreed is that it was a very big and complex building which had the feel a large passenger liner. The compact scheme allowed ready access to all facilities, including the library and social facilities, but it was

6.49 Konstanz University
Aerial view of major open space [Humpert, K]

6.50 Konstanz University
Water as an Art Project

6.51 Konstanz University
Art & Building Project

6.52 Konstanz University
Distant view of complex

overpowering and confusing. The designers were very conscious of this and did much to emphasise social dimensions and the need for an hierarchy of space identification in their planning. For instance, students had their own work station, with desk, chair and cupboard, while each department had its own small resting spaces called common, recreation and refreshment rooms. At the next level, there were the large food services and recreational facilities for the university as a whole. A further example of this social concern was the avoidance of large lecture theatres in favour of a many seminar rooms, which promoted work in small groups. In addition, the University sponsored 'Art and Building' projects which attempted to vitalise what could have become a dull concrete jungle, by integrating large art works and supergraphics into the fabric of the building [Figs 6.49-52].

The compact nature of the plan allowed the development of the library at its very centre, which had much of the feel of the engine room of a ship. This large multi-storey facility had one entrance which was never very far from the users and yet it had many secure exits in departmental areas, to add to the users convenience.

The University of Konstanz was a high density network offering good connectivity. It was an interesting example of the difficulties associated with constructing a large multi-functional structure and of the ways in which a talented group of architects tried to offset an oppressive environment by the use of large scale art works, creating legibility, variety and opportunity for individuals to create their own space identities within the large frame. However, it brings with it all the doubts and questions surrounding these large structures, which will be explored in a later section of this work.

6.49 Konstanz University
Aerial view of major open space [Humpert, K]

6.50 Konstanz University
Water as an Art Project

6.51 Konstanz University
Art & Building Project

6.52 Konstanz University
Distant view of complex

overpowering and confusing. The designers were very conscious of this and did much to emphasise social dimensions and the need for an hierarchy of space identification in their planning. For instance, students had their own work station, with desk, chair and cupboard, while each department had its own small resting spaces called common, recreation and refreshment rooms. At the next level, there were the large food services and recreational facilities for the university as a whole. A further example of this social concern was the avoidance of large lecture theatres in favour of a many seminar rooms, which promoted work in small groups. In addition, the University sponsored 'Art and Building' projects which attempted to vitalise what could have become a dull concrete jungle, by integrating large art works and supergraphics into the fabric of the building [Figs 6.49-52].

The compact nature of the plan allowed the development of the library at its very centre, which had much of the feel of the engine room of a ship. This large multi-storey facility had one entrance which was never very far from the users and yet it had many secure exits in departmental areas, to add to the users convenience.

The University of Konstanz was a high density network offering good connectivity. It was an interesting example of the difficulties associated with constructing a large multi-functional structure and of the ways in which a talented group of architects tried to offset an oppressive environment by the use of large scale art works, creating legibility, variety and opportunity for individuals to create their own space identities within the large frame. However, it brings with it all the doubts and questions surrounding these large structures, which will be explored in a later section of this work.

6.53 Lausanne Institute of Technology
Model of first project [Zweifel, 1997]

6.2.3 Swiss and Scandinavian Universities

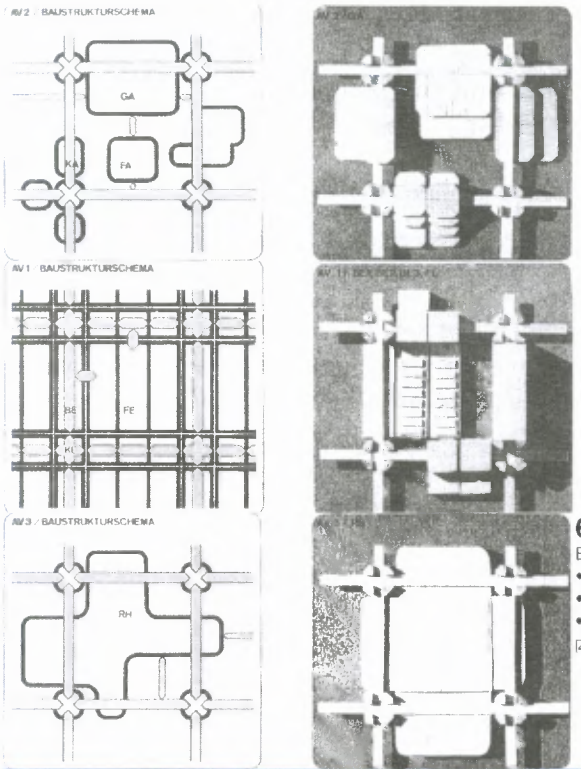
There were many other university developments in Europe at the time. Most of these were in Germany but some, such as Liége and Louvain-la-Neuve were in Belgium, while others were in France where new campuses were created for the Universities of Paris, Nanterre and Orléans. In Italy there were schemes by the celebrated Italian architects Gian Carlo de Carlo at Urbino and Pavia and by Vittorio Gregotti at Calabria, Palermo and Florence. Several new universities were also constructed in Scandinavia, as well as extensions to existing universities, many of them very fine individual works of architecture. Three built schemes and one project, however, made substantial contributions to postwar university planning.

Federal Institute of Technology, Lausanne

The site of the Institute is west of the city of Lausanne, close to the University of Lausanne. A loose brief was supplied to the architects, J Zweifel and H Strickler of Zurich, allowing freedom of interpretation. During the initial planning, which began in 1970, particular attention was paid to possible changes in teaching and research, the composition of the users, and a possible future fusion with the University of Lausanne.

A planning structure was devised which did not establish built form but determined a movement system, development axes, zones for different building types, development of central areas and a proposed green open space system [Fig 6.53]. These were elaborated as follows:

- the Institute was to be open to the surrounding communities;
- the complex was not to be seen an agglomeration of single buildings but as an integrated diversified structure;
- notwithstanding the continuous neutral planning grid of 86.4m. square, the hiearchical organisation of the site was to be established by central zones of various importance;
- motor and pedestrian traffic were, to a large extent, separated;
- close communication between teaching and research was required;
- the option of growth was ensured in all departments, in terms of both quality and quantity [Zweifel, 1996].



6.54 Lausanne Institute of Technology
Building structure; from the top:
- 'Knot' strucutures;
- 'Band' structures, &
- 'Field' structures

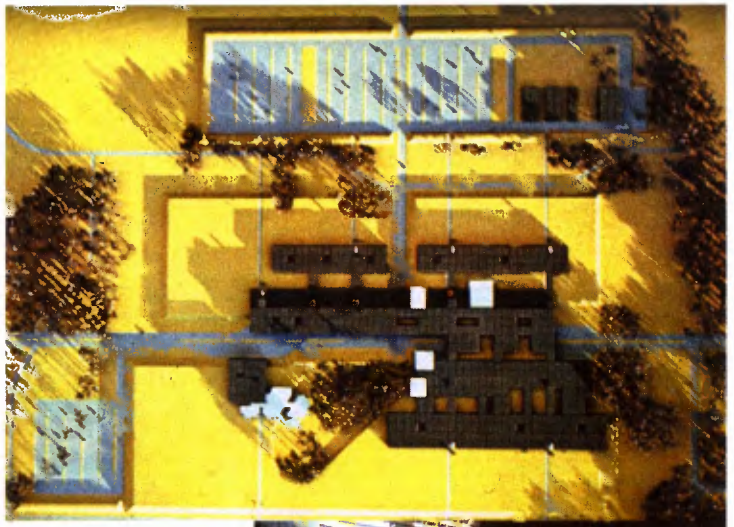
[Zweifel, 1997]

6.55 Lausanne Institute of Technology
Exterior view
[Zweifel, 1997]

The planning methodology involved a system of 'ordering' and 'freedom', preventing chaos while not predetermining the outcomes. This resulted in a very clear time scale, with fixed short term planning but flexible medium term goals and distant strategies within the ordering system. The consequence was a differentiation between 'planning structure' [order] and 'building structure' [freedom] in which planning structure was seen as a spatial ordering system, consisting of a set of minimal 'rules', established to safeguard the long term functional and physical development of the Institute. 'Building structure' was then the sum of the constructional steps required to implement the short term requirements, which were changeable within the planning parameters [Bauen+Wohnen, July 1971].

Some of the rules which ordered the planning structure were:
- central zones of three types for use of the whole college, the various schools and the departments;
- zones which determined public accessibility;
- a macro planning grid of 86,4m. square which limited the spread of development;
- a building grid of 21,6m. wide, with three 7,2m. structural bands and a micro module of 1,2m.;
- three green belts in a north-south, and two in an east-west direction;
- zones for development of various uses, building types, heights and densities;
- routes for external pedestrian circulation and a three dimensional definition of internal routes, which are mainly at two levels above ground;
- spatial corridors for vehicular traffic, service deliveries, the provision of parking garages, facilities for public transportation for buses and a future monorail;
- several rules which governed the provision and location of service [utility] runs relating to ring and network systems, site ducts, tunnels, cable canals, internal plant rooms, and vertical and horizontal ducts.

Some rules which ordered the building structure were:
- a catalogue of building elements of relatively anonymous character which allowed easy adaptation to different use;



6.56 Odense University
Model of first phase of development

6.57 Odense University
Photograph of activity concourse

- three types of building structure: 'knot' structures or cores which occurred at nodal points; 'band' structures which accommodate small to medium width rooms in stackable floors, and 'field' structures for those large auditoria and halls which were not easy to stack;
- other rules related to communications structures, permanent and less permanent structures and 'shell' structures with a high degree of adaptability [Fig 6.54-55].

The original project for the Institute was based on a complex network structure with a high degree of connectivity. The space typology established by the building structure 'rules' was a serious attempt to differentiate university spaces, both in terms of their physical attributes and also in terms of their assembly. Unfortunately the scheme, as built, lost much of its two dimensional connectivity and became a linear plan interrupted by a major access road.

Odense University

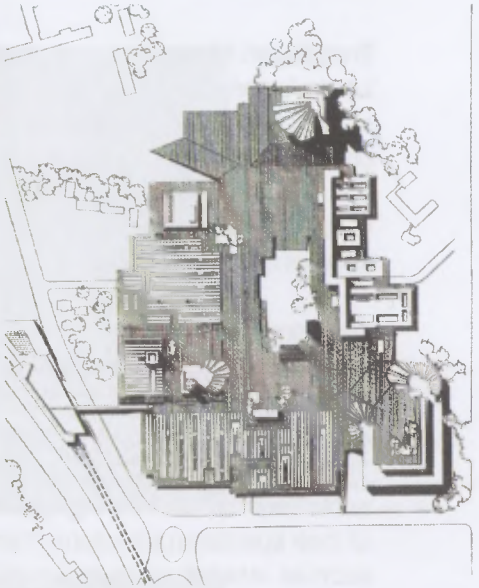
The commission for the plan for the University of Odense in Denmark was won in competition by Holscher, in association with Krohn, Hartvig and Rasmussen in 1967. While not significantly advancing university planning theory, it was an important building complex which consolidated and refined much of the thinking which preceded it.

Work started on the 473ha. site in 1971 and the first buildings were completed in 1975. The original plan was a compact bipolar linear scheme, structured by a pedestrian mall above a spine north-south service road. Lateral east-west routes fed departmental areas from the mall. The scheme as built, however, had two major north-south malls with secondary passageways at right angles every 100m., serving the various academic departments and institutes. Thus the linear scheme evolved into a small web structure [Fig 6.56].

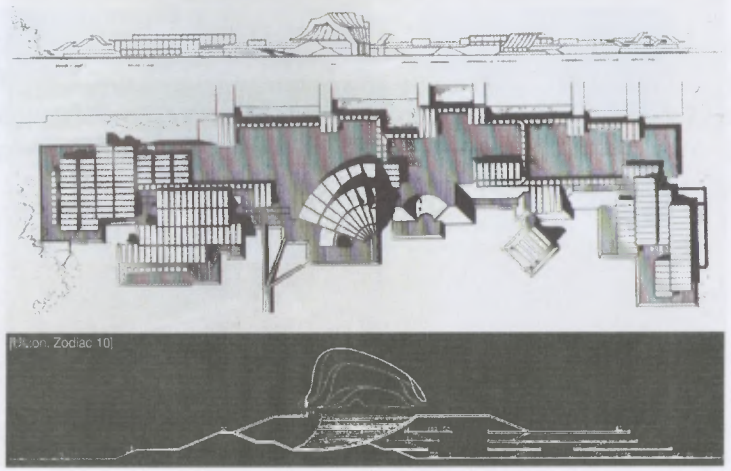
Both the malls and 100m. passageways were 7,2m. wide and served as communication spaces, lounges, exhibition and recreation spaces, as well as accommodating stairs, lifts, plant and duct space. In some places, these activity routes were double volume, giving a sense of space and legibility.

6.58 Odense University
Exterior view

6.59 Stockholm University
1961 Plan of cometition winning scheme [Larsen, Arkitektur 4 1980]



Frampton, 1996



[Utzon, Zodiac 10]

6.60 Jørn Utzon
Utzon's 1967 competition entry for Odense University with typical 'plateau' project below

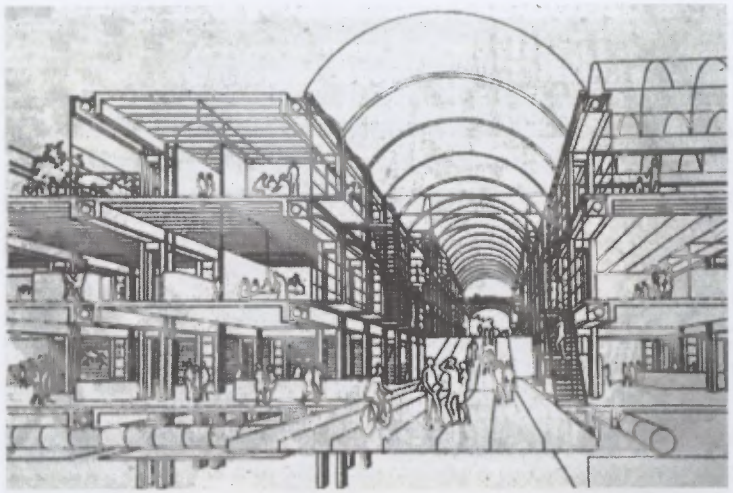
Library space was an integrated system which was planned along the activity spaces relating to the institutes they served. It was a continuum which could expand with academic growth [Figs 6.57]. The building was a constant height having a lower basement level with two storeys above which sometimes became double volumes. Construction was reinforced concrete with a curtain wall façade of Cor Ten, with very crisp detailing [Fig 6.58].

Stockholm University

Another very accomplished Danish architect who has contributed to university planning and design is Henning Larsen. In 1961 an architectural competition was held for the central complex of the new Stockholm University campus at Frescati. Of the 45 entries submitted, Henning Larsen's scheme was awarded first prize. Unfortunately, however, the commission to produce the overall plan was awarded to Swedish architect David Helldén.

Larsen's plan, which predated most of the new universities, was remarkable in that it anticipated many developments which emerged later in the 1960's. In addition, it achieved something very few of the other new universities were able to: a strong and coherent campus design. While many of the postwar universities discussed so far have contributed to campus planning and university building theory, very few have emphasised the role of campus design, which was so strong in the prototypical American campus.

In Larsen's scheme, the University was raised on a podium or 'plateau', some of it above parking and service facilities. The background teaching buildings provided the wall and the plateau formed the floor to the foreground buildings for assembly, auditoria, library and administration, which were sited at key points on the plateau [Fig 6.59]. The design language used by Larsen reflects much of what was current in Scandinavia at the time, particularly the Finnish work of Alvar Aalto and Danish architect Jørn Utzon's exploration of cloudlike-like forms hovering over very strong platforms, as reflected in the Sydney Opera House and other schemes of that time. This was much to the annoyance of the architect, Utzon, who wrote a letter to an architectural journal noting that his own plateau explorations, were based on visits to China and Mexico and concluded by noting that "I have been here before" [Utzon, circa 1965] [Fig 6.60].



6.61 Trondheim University
Section through main structuring gallery [Larsen, Arkitektur ?]

6.62 Trondheim University
View of glass roofed gallery from office

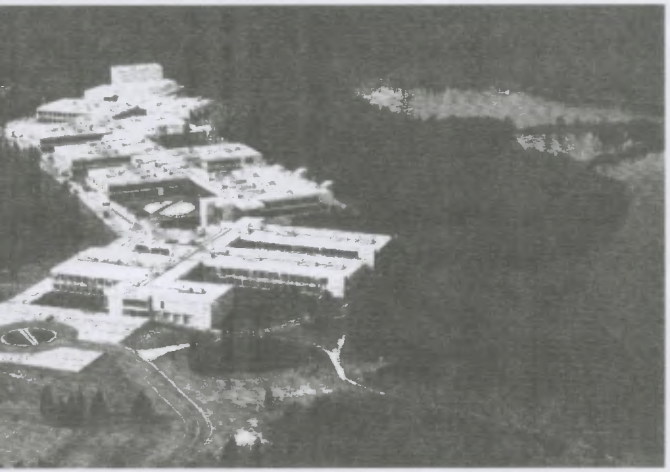
In 1964 Larsen received second prize in the Berlin Free University competition. He also received a commission, part of which has been built. It was a simple scheme of alternate bands of accommodation and open space courtyards. Larsen's Trondheim scheme, won in competition in 1970 was an extension of this Berlin scheme.

Trondheim University

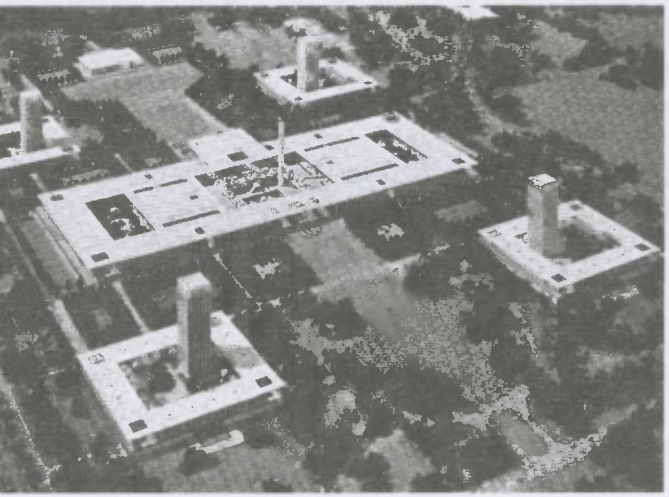
Larsen's competition scheme for the University of Trondheim has a perimeter of 450x900m., comparable to the central portion of Oxford University. The project was structured on a planning grid of about 90x90m., within which the buildings were placed like blocks in a town. Pedestrian streets were glass roofed galleries and functioned as contact zones between different sectors of the university.

The community functions such as shops, travel bureau, information offices and auditoria, lecture theatres and large classrooms were at ground level. Above were the departmental areas, seminar rooms, libraries and general offices. On the top level were administrative offices and research facilities. The glass roofed galleries gave a unique character, partly because of their social function as meeting spaces for staff and students and partly because of their special architectural character, which lent themselves to many uses, such as street theatre and parties [Figs 6.61-62].

The complex was designed on a 7,2x7,2m. structural module with a 1,2m. strip grid which carried services horizontally and vertically in a cluster of four columns. The street façades had timber windows with yellow awnings and perforated aluminium panels. The galleries were paved in red brown ceramic tiles and the external panels were of white Transite 10mm. thick.



6.63 Stockton State College
Cranked linear scheme by Bob Geddes [Turner, 1984]



6.64 State University of New York
Albany campus by Ed Stone [Turner, 1984]

6.3 North American Universities

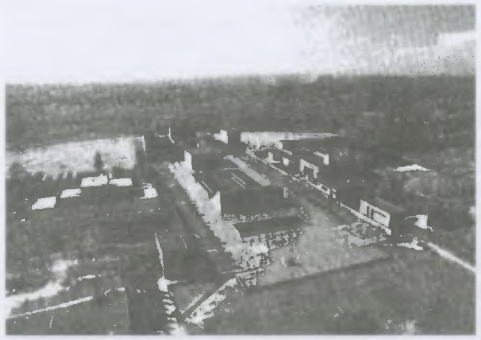
6.3.1 Universities in the United States

The important university developments of the sixties were of two types: on the one hand there were the project orientated European contributions exploring appropriate planning structures for the new educational programmes; on the other, there were the method orientated North American contributions to research and development into planning systems and processes. These methods included space management and planning techniques, which were pioneered in the 1950's at Berkeley by Donovan Smith, the first 'university space man'. They also included the sophisticated modelling of planning systems operating on vast data banks, which were, theoretically, able to predict outcomes for any given set of variables.

These electronic systems were largely based on experience gained by the military in the cold war and by space scientists. They did not fit comfortably into a university context, which was arguably less mechanistic than sending a man into space. Eventually, they gave way to processes of strategic, tactical and operational planning supported by inputs from the academic planners, the many university communities, educational technologists, information scientists, demographers and facilities managers. These institutional processes have been in a continuous state of evolution and have made major contributions to institutional planning.

This was not the case in spatial planning on the American Campus where, with a few exceptions, the general standard of postwar development has been mediocre. Much of this development took place at existing universities which, in the process, became megaversities. Often these additions resulted in outstanding individual buildings or groups of buildings by very good architects, some of which will be analysed in a later section. However, their contribution to postwar university planning was questionable.

On the east coast, Bob Geddes' Stockton State College stands out as a small, but very convincing, cranked linear scheme, with academic facilities arranged on either side of the linear gallery Fig 6.63]. In contrast, Ed



6.65 State University of New York
Purchase campus by Edward Larrabee Barnes [Turner, 1984]

6.66 University of Illinois
Chicago [Circle] campus bt Walter Netche [Turner, 1984]

6.67 Santa Cruz
Plan of site showing land form [http://maps.ucsc.edu]

6.68 Santa Cruz
Plan of campus with 20 minute Template

Stone's State University of New York at Albany is, in this author's opinion, a devastatingly banal scheme, with a central grouping of academic facilities surrounded by quadrangular dormitory complexes at each corner, with 22 storey towers at their centre [Fig 6.64]. Edward Larrabee Barnes' plan for the State University of New York at Purchase is a thoughtful scheme, with main buildings arranged along a mall accommodating central buildings with teaching buildings on either side, connected by colonnades [Fig 6.65].

Walter Netche's new University of Illinois at Chicago [Circle] was a scheme with a powerful central grouping of assembly and lecture facilities, accessed by an elevated walkway surrounded by individual buildings set in a car dominated environment [Fig 6.66]. New universities in California were at Irvine, Davis, Santa Barbara, San Diego and Santa Cruz which, spatially, is one that deserves special study.

University of Santa Cruz

The master plan for Santa Cruz was prepared by a team of architects headed by John Carl Warnecke in 1963. It was located on a 800 ha. site in a spectacular mountainous context covered by a redwood forest, about 2 miles from Santa Cruz city at the northern end of the picturesque Monterey Bay.

The plan anticipated 7 500 students by 1975, with an ultimate student population of 27 500 by 1990. Today it has just over 14 000 students. It's academic plan was based on a college method of education, with a number of sub campus [college] units which were self-sufficient in residential and general teaching facilities . "The intention was to combine the advantages of a small college with the facilities of a great university. Because of its location, it was necessary to provide more than the usual amount of residential space. Here then, the opportunity seems great to make use of new methods of instruction, study and communications" [Warnecke, 1963].

"The key element in the academic organisation of the campus is to be the residential college. Ultimately 15 to 20 are planned with the number of students in each varying from 250 to 1 000. In the first college .... 600 students are planned for, 400 of whom will live on campus with 200 commuting. The residential college is the academic unit of administration,

6.69 University of Santa Cruz
Views of the Colleges, Central Buildings & cycle way.
[http://www.ucsc.edu/about/]

providing for not less than half the students instruction and, further, it is the centre of his academic life, a place where he lives, dines, leads most of his social life and centres his athletic and recreational activities" [ibid]. [Figs 6.67-68].

There were to be differences between the colleges in terms of subject orientation. "This might range from Comparative Literature to Life Sciences always with a common devotion to liberal education. Cutting across the college boundaries there will be campus-wide academic units based on specific disciplines, grouped broadly under the Humanities, Social Sciences and Natural Sciences" [ibid].

In addition to the residential colleges there were to be professional schools for specialised academic fields such as Engineering, Business, Natural Resources and Landscape Architecture. The University Library was to be centralised, but each college was expected to have 10 000 to 15 000 reference works. Science disciplines were also integrated across college boundaries and they were to have their own science centre with all the necessary specialised facilities.

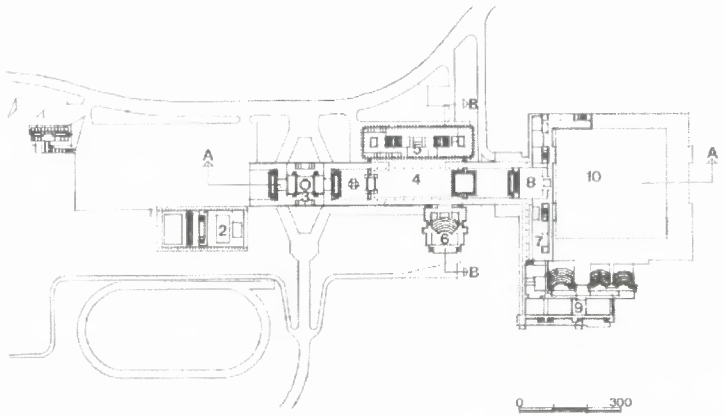
The campus was planned on a nodal structure, in which the residential units were built in one operation, except for minor future changes and expansion. Growth was by proliferation of nodes. As at York University in England, the great attraction of these nodal schemes has been the ability to complete building operations in one site, complete the landscaping and move on to constructing the next node without disrupting activities.

Each college grouping was designed by a different architect. The first, Cowell College, was by Wurster in 1966. It had three storied residential blocks grouped around communal facilities and green courts. Subsequent colleges were Stevenson College by Esherick, Crown by Kump and the widely published Kresge College by Charles Moore, a complex and livable design in the form of a small polychrome hill town. Each college varied in character and, because of the wooded nature of the site, they were visually screened from each other.

As noted, specialised nodes were provided for central science, library, assembly and recreational facilities. These were located on a linkage system which included paths, bicycle ways and roads. It is doubtful whether these nodal systems can provide the necessary connectivity without mechanised movement systems, for distances at Santa Cruz were considerable and students could be faced with a fifteen minute walk to the central library or science labs. Bicycle routes in the mountainous terrain are also problematic. It must be concluded, therefore, that the long distances involved would encourage movement by cars, with a consequent negative impact on the very special wooded environment [Fig 6.69].

6.3.2 Canadian Universities

Unlike the United States, Canada did not have a large stock of existing universities which they could expand to cope with the postwar baby boom. Consequently, they developed several new universities, including Trent near Peterborough in Ontario, Simon Fraser and Lethbridge in British Columbia, Brock on the Niagra peninsula, Scarborough College and York University in Toronto, in addition to major extensions to Alberta, Guelph and MacMaster Universities . Two of these, Simon Fraser University and Scarborough College are described here since they are part of the postwar mainstream. Both were designed by two young, talented, but very different, architects.



6.70 Simon Fraser University
Plan of campus
Architectural Review ca. 1965

6.71 Simon Fraser University
View of academic quadrangle

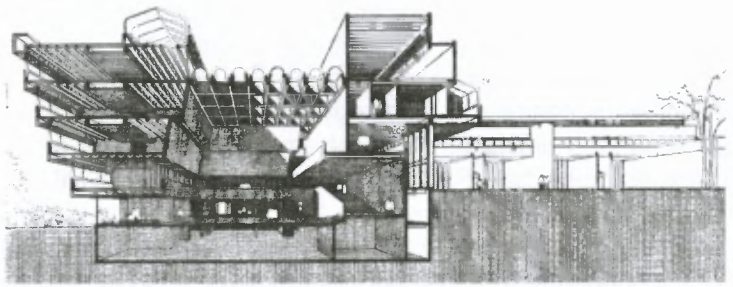
6.72 Simon Fraser University
View of Convocation Mall

Simon Fraser University

Simon Fraser University was won in competition by the firm of Ericson Massey in 1963 and the first buildings were occupied in 1965. It was built on a spectacular wooded site of 1 200 acres on the slopes of Burnaby Mountain overlooking Vancouver. It was planned for 2 500 students initially, growing to between 15 000 and 17 500. Currently, it has more than 25 000 students on its three campuses.

The plan was a compact unipolar linear system, headed by a large academic quadrangle with general teaching buildings on the northern mountain side and specialised science buildings on the south. The administration building overlooked the quadrangle on the east and, to the west, was the Convocation Mall, a large glass-roofed concourse which related to the library on its northern edge and to the theatre and student services centre opposite [Figs 6.70-72].

6.73 Scarborough College
Plan of campus
Architectural Review ca. 1965



6.74 Scarborough College
Section through central meeting place
Architectural Review ca. 1965

6.75 Scarborough College
View of central meeting place

6.76 Scarborough College
View of pedestrian spine

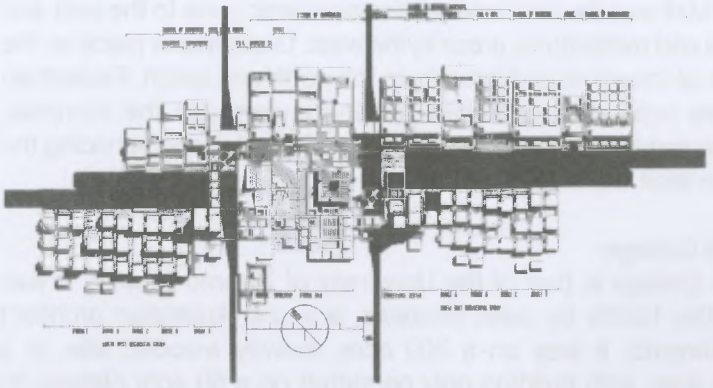
Convocation Mall was the link between the academic zone to the east and the residential and recreational areas to the west. Growth took place on the western edge of the spine and laterally to the north and south. Pedestrian and cars were separated, with cars moving underneath the complex, passing a Transportation Centre on the edge of the Mall and servicing the buildings from their backs.

Scarborough College

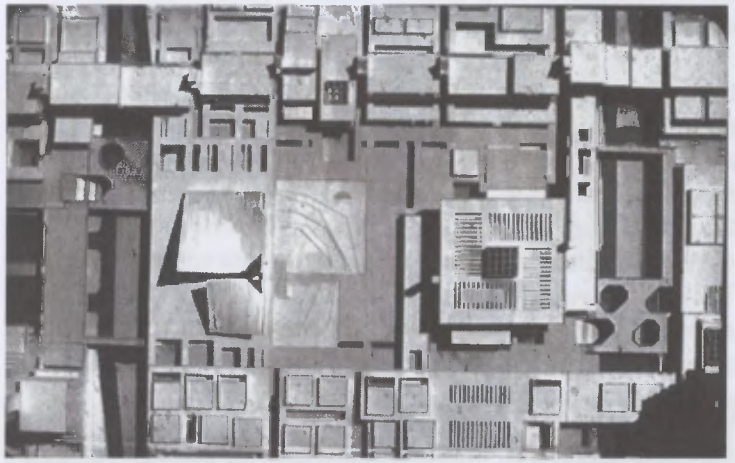
Scarborough College is part of the University of Toronto system. It was designed in the 1960's by John Andrews, a young Australian architect working in Toronto. It was on a 200 acre, heavily wooded site, in a conservation area, with building only permitted on a 50 acre plateau on the north side. It was planned to accommodate 6 000 students in 1972 and today has about 7 200 students.

Scarborough was essentially a small 'head and tail' [unipolar] linear scheme with a difference, in that it has two linear stems. At the head was a central meeting place, cafeteria, administrative offices and a monumental boiler room, with its splayed concrete wall and triple chimney stack becoming a major architectonic feature. Two wings stemmed from this centre, the six storey east wing for humanities and five storey west wing for sciences [Fig 6.80]. The wings were double banked along a meandering, skylit pedestrian spine. The science wing stepped back to form skylights for the deep laboratories on the north edge. Conversely, the humanities wing stepped outward on the south edge, thus providing shade to the offices. In all cases lecture theatres were used as 'knuckles', allowing the wings to change directions and follow the meander pattern.

Scarborough was an architectonic 'tour de force' which, architecturally, became one of the late modern icons, with a mixture of both 'futurist and 'brutalist' imagery complete with off shutter concrete. It had great architectural influence at the time but contributed little to the mainstream thinking about the spatial development of universities [Figs 6.73-76].



6.77 Zambia University
Plan of University for 5 000 students



6.78 Zambia University
Central Forum with assembly hall & library

6.79 Zambia University
Assembly hall with teaching buildings on left; residential on right

6.4 Two Universities in Africa

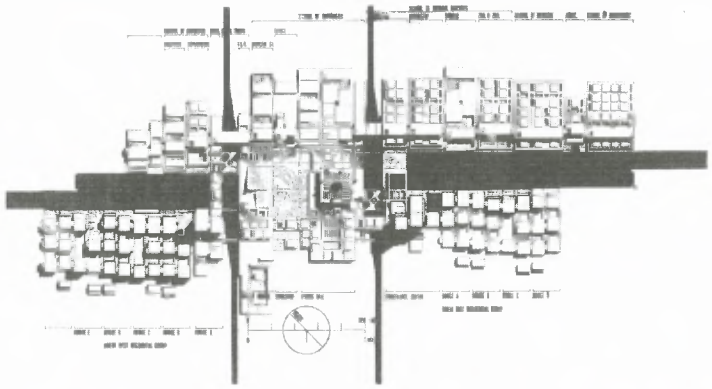
These two postwar universities, constructed in the 1960's and 1970's, are included here because they are interesting variations of the linear planning structures examined previously and illustrate the international transferability of ideas as well as showing the importance of regional differences.

University of Zambia : Lusaka

The University of Zambia was an example of the university not only serving the educational needs of a newly independent country but also, together with a new parliament building, becoming a symbolic statement of nationhood. It was planned in 1965 on a 660 acre site two miles from central Lusaka, for an initial enrolment of 2 500 growing to 5 000 students. Anthony Chitty, an architect planner from England, coordinated the planning with Julian Elliott as design leader. The first buildings were occupied in mid 1967.

The scheme adopted some of the mainstream ideas of the new university planning movement. It was generated by an academic programme based on schools of study. It had a compact plan, with the articulation of wheeled and foot traffic routes and reflected a concern with the growth process. It had a strong linear spine centred on the Forum, an open air amphitheatre planned for use separately or together with the assembly hall on its north-eastern edge. The assembly hall, Forum and library on the south-eastern edge were the heart of the campus. This heart, together with the two major parking areas, formed the spatial spine of the campus. To the north-east of this spine were the academic buildings and, to the south-west, the social and residential facilities. The intention was that as academic growth took place, similar growth could occur in residential facilities and also in the parking areas. Secondary growth was structured by lateral communications and servicing routes [Figs 6.77-79].

The University of Zambia was a bipolar, double banked, linear scheme with academic buildings on one side of the spine and social buildings on the other. Consequently, it suffered the problems generally associated with a single line of teaching buildings with low connectivity limiting the range of curricular affinities. At the same time, the Administration building was part of the range of academic buildings which further fragmented the connections.



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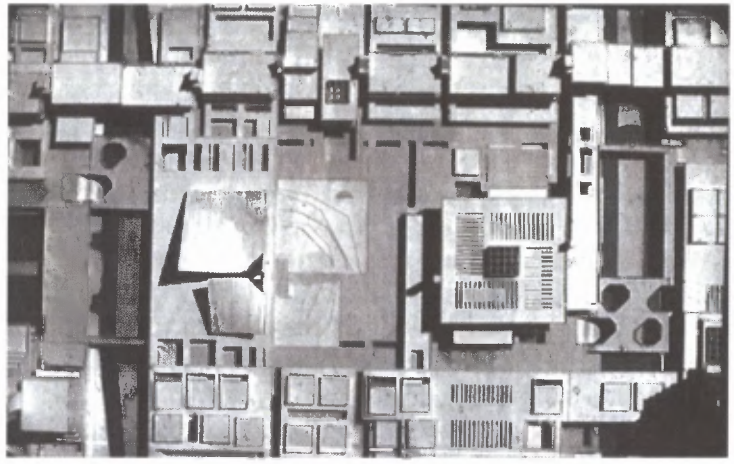
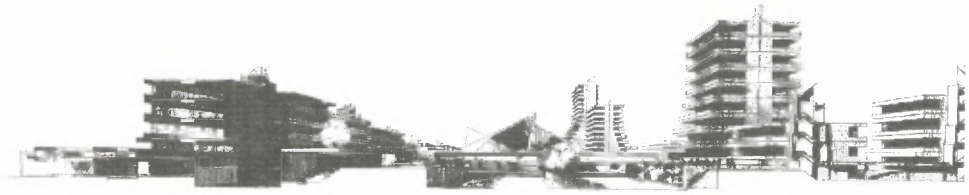


6.78 Zambia University
Central Forum with assembly hall & library



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Assembly hall with teaching buildings on left; residential on right

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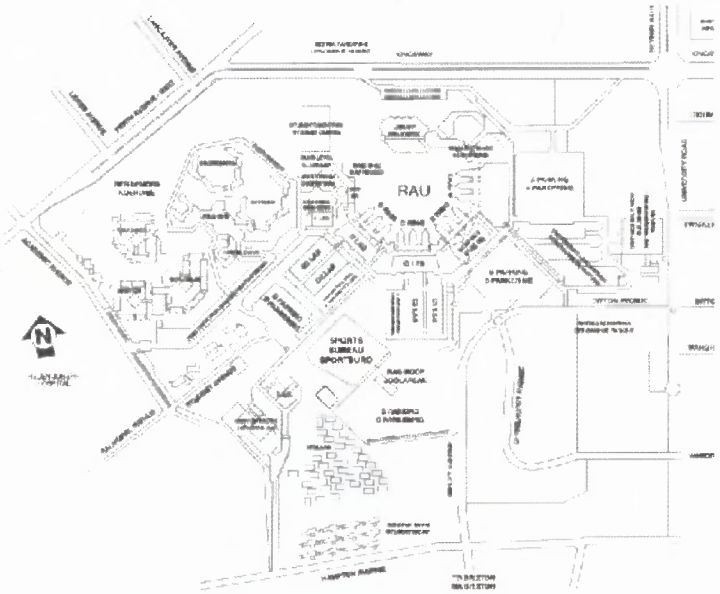
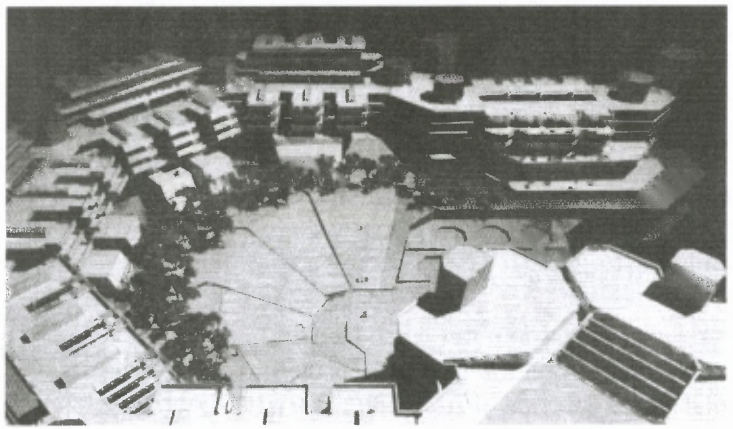
The scheme adopted some of the mainstream ideas of the new university planning movement. It was generated by an academic programme based on schools of study. It had a compact plan, with the articulation of wheeled and foot traffic routes and reflected a concern with the growth process. It had a strong linear spine centred on the Forum, an open air amphitheatre planned for use separately or together with the assembly hall on its north-eastern edge. The assembly hall, Forum and library on the south-eastern edge were the heart of the campus. This heart, together with the two major parking areas, formed the spatial spine of the campus. To the north-east of this spine were the academic buildings and, to the south-west, the social and residential facilities. The intention was that as academic growth took place, similar growth could occur in residential facilities and also in the parking areas. Secondary growth was structured by lateral communications and servicing routes [Figs 6.77-79].

The University of Zambia was a bipolar, double banked, linear scheme with academic buildings on one side of the spine and social buildings on the other. Consequently, it suffered the problems generally associated with a single line of teaching buildings with low connectivity limiting the range of curricular affinities. At the same time, the Administration building was part of the range of academic buildings which further fragmented the connections.



6.80 Rand Afrikaans University.
Plan of University
www.rau.ac.za



6.81 Rand Afrikaans University
Model showing octagonal development
[Linde, 1970]

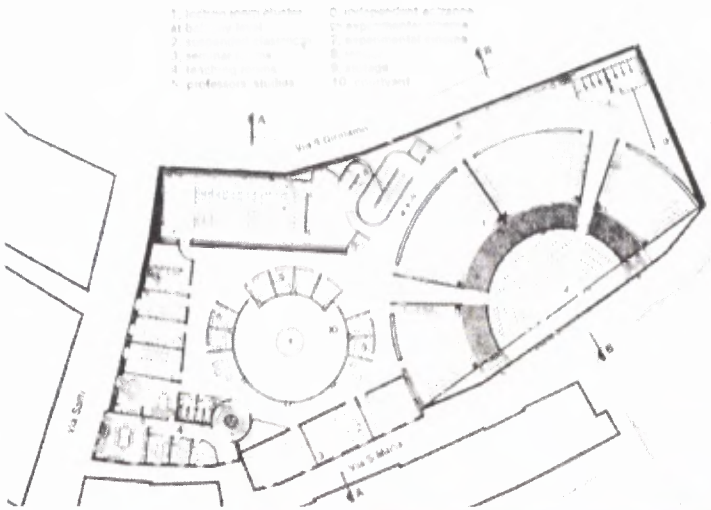
Rand Afrikaans University : Johannesburg

In September 1967, a planning committee was formed to create a new University complex and campus in Auckland Park, four kilometres from the central business district of Johannesburg. It was motivated by the aspiration of the Afrikaans community in the Witwatersrand to establish its own university, one that would specifically meet the educational needs of the fast-increasing Afrikaans speaking population of the Witwatersrand.

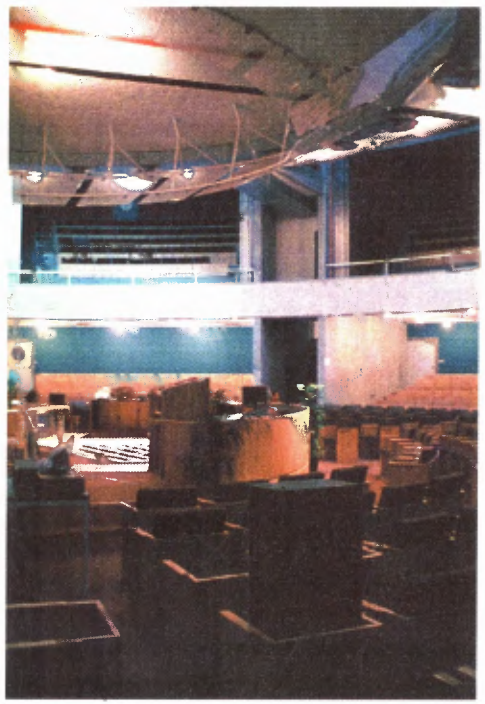
The planning directive was to create a modern university, where students and lecturers could form a close-knit community and where there would be opportunity to establish interfaculty and interdepartmental liaison. Architects Meyer and van Wyk were appointed in 1968 and produced a compact, multifunctional complex on an octagonal structure.

It was a finite linear scheme, with the library as its head in the first segment of the octagon. The ceremonial entrance and administration was in the second segment, with teaching buildings in the next four segments. The seventh segment accommodated the student services and assembly hall, which terminated the planning structure. The final segment was left open, as part of a landscaped internal open space with a decorative water feature [Figs 6.80-81]. The whole of the octagon was structured by a multi-level, Piranesi-like, concourse. Academic offices and small teaching spaces were planned in the inner portion of the octagon, with the large lecture rooms and auditoria on the outer edge. Behind these were the specialist laboratories, parking areas and service roads.

It was a massive closed megastructure, built in a continuous process, funded over a period of about 10 years. It was an architectonic work of great competence, but it had uneasy overtones of an authoritarian regime, a flagship project for the apartheid regime, which one wit in Austraila dubbed, 'Vorster's Laager' [John Vorster, the draconian apartheid Prime Minister at the time and Fosters Lager].



6.82 University of Urbino
Plan of Giancarlo de Carlo's lecture theatre complex for Faculty of Law
[Zucchi, 1992]



6.83 University of Urbino
View of 2 level sub divisible lecture theatres with viewing arc of 180°

6.5 Relationship to Conceptual Framework

In the first sections of this chapter nineteen selected university plans from Europe, North America and Africa were described and discussed. Obviously, in detail, there were significant differences between many of these. In total, however, they represent the mainstream university planning ideas of the period. This section seeks to summarise the main tendencies and to reflect on the range of differences through the space, building and planning structures which make up the conceptual framework.

6.5.1 Space Structure

In the postwar period, university buildings emerged as amongst the most complex buildings in the architectural spectrum. They had to accommodate the whole array of specialised educational facilities such as auditoria, dry and wet laboratories, factory laboratories, libraries, herbaria, vivaria and planetaria, as well as the normal range of office, commercial, cultural, recreational and housing facilities. University architects have, therefore, increasingly grappled with the fundamental space particles of buildings, or their granularity, and ways in which this disparate range of facilities can be assembled into appropriate building forms.

- **Classrooms**
  The postwar experience in classroom design has been erratic, ranging from the 'goodbye to the classroom' movement of the middle 1960's, to the need for very large lecture theatres, to an emphasis on small, personal teaching groups and methods. The early programmed learning technology which allowed students to study audio visual material at their own pace, was not successful, largely because of the paucity of material and the lack of face to face interaction between teacher and student. Some colleges, which were planned with a limited range of classrooms, have had to re-think how to convert auto-tutorial space into conventional classrooms at a later stage.

  Most universities built in this period, however, had a mix of small to medium flat floor classrooms with up to 100 stations, able to be stacked within normal structural grids of 7m. to 8m. There has been considerable

6.84 Berlin Free University
View of sub divisible lecture theatre with viewing arc

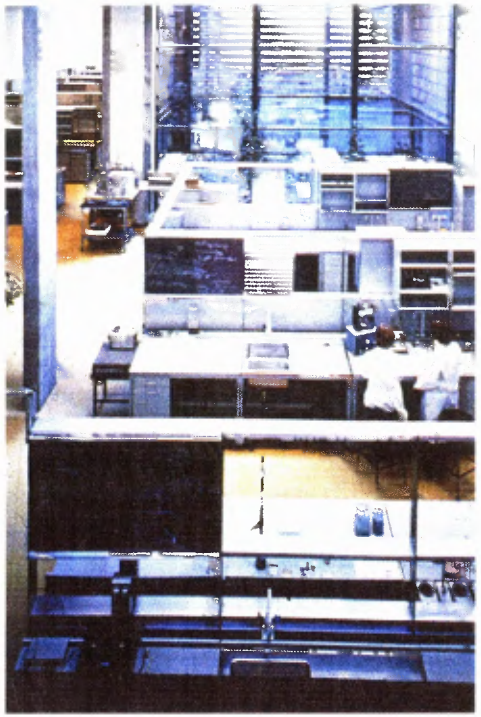
6.85 University of Cape Town
View of lecture theatre with viewing arc of 90°

innovation in the design of larger lecture theatres with upwards of 120 stations. Some of these were on the conventional rectangular 'shoe box' plan. Others explored the 'pizza box' plan, widening the viewing arc to 90° and some even up to 180° for situations which did not require use of audio visual equipment. Arguments in favour of this wider arc were, firstly, that the shorter distance between lecturer and student improved communication in terms of eye contact, hearing and, in the case of the 90° degree arc, viewing the visual material on screen. Secondly, it was argued that, ideally, a university lecture was not a one way process of a lecturer ramming information down students throats, but an interactive one with an element of debate and that the wider arc facilitated this two, and even three, way interaction [Figs 6.82-85].

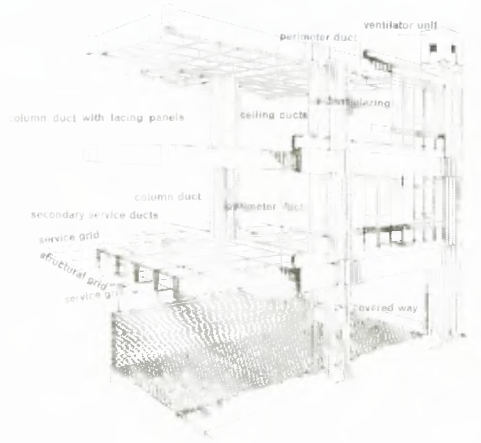
The postwar period saw the development of very large lecture theatres, to cope with increasing course enrolment in a cost-effective manner. Chalk and epidiascope have given way to white boards, flip charts, 35mm. slide projection, digital projection and a multiplicity of audio visual equipment, including television, with more and more educational resources available in digital format. All this has had an impact on size and shape of facilities, as well as the electrical and mechanical service provision.

The great change in the latter half of the 20C was the coming of age of the computer and the development of the idea of the 'smart classroom', which introduced an increasing number of technologies into the teaching process. This included the convergence of television and computing, with an emphasis on widespread use of the internet and intranet with high band width connectivity. This has, once again, raised the idea of a-spatial learning, but this time through an interactive system which allows a degree of interaction between student and lecturer.

At the very least, a lecture theatre now requires a computer work station integrated with a podium and a computer connected video projector to supplement the old blackboard and slide projectors. The podium is no longer merely a place for reading from a book or lecturing from written notes but a spot for directing an array of multi-media technologies.



6.86 Odense University
Bench laboratories with wall & floor services (Arkitektur, 8/1976)



6.87 Birmingham University
Laboratories with continuous vertical & horizontal network of services (Dowson P., RIBAJ ca. 1967)

- **Laboratories**
  The architecture of the postwar laboratory has been dominated by finding ways of servicing the, often very complex, research activities in a flexible manner, since much research technology has a very short life expectancy. The life expectancy of the body of knowledge in small particle physics, for instance, is estimated to be four years. The model rate of revision for all science activity is now probably about 15 years which is considerably shorter than the life of university buildings [Guedes, 1979].

  Methods of servicing laboratories in this period varied from ducts along external walls feeding benches at right angles, to those which combined the vertical wall ducts with horizontal branches. Some architects ran services in linear ducts in cross walls with horizontal runs to any point on large floor areas. Others used a system of turrets feeding a grouping of stations. Still others sought to integrate both vertical and horizontal service runs within structural systems, often dramatising the system architectonically. Finally, there have been schemes which have done exactly the opposite, hanging a suspended service system totally free from structure and, in the case of the Charles Darwin Building at the Bristol Polytechnic, feeding a system of mobile laboratory equipment and furniture.

  In the 1960's in Britain, the idea of regular grids within which functions would be defined and served by vertical and horizontal ducts on a modular system formed by a cluster of columns and beams on a strip or 'tartan' grid, were developed by Arup Associates in the schemes at Birmingham University, Loughborough University of Technology and the Addenbrooks Biological Sciences Building. At the Metallurgy, Mining and Mineral Engineering Department at Birmingham University, the bays were 6m. square with the a 0,9m. strip grid. At Birmingham, a system of 'packaged services' was developed with a planning discipline of services network and construction. Rather than thinking of ducts, the aim was to ensure a continuous vertical and horizontal network of spaces, a network of structural discontinuity, so that services could absorb changes of programme, without either invalidating the basic concepts or becoming prematurely obsolete [Fig 6.87].

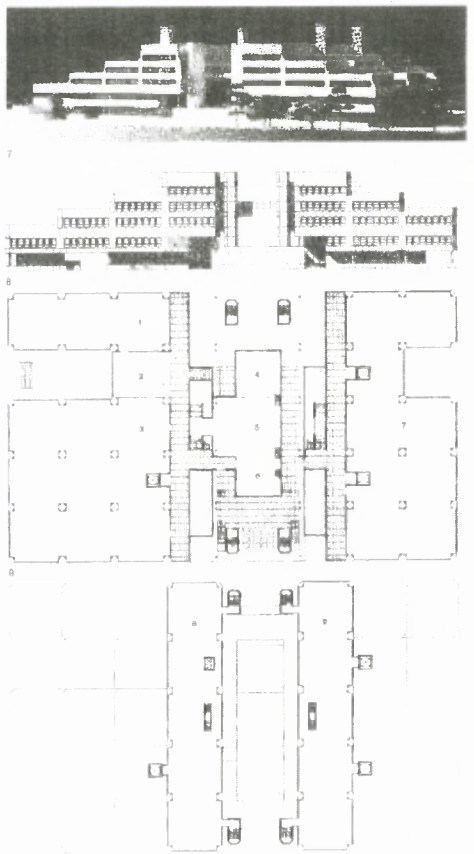
6.88 University of Pennsylvania
Richards laboratories with monumental architectonic duct elements

6.89 Bristol Polytechnic
Science laboratories in the Charles Darwin Building with flexible floor & ceiling services

Architects in the USA were less attracted to theories of service distribution. Taking the use of air conditioning for granted, they went directly to solutions which achieved ease of servicing, often at the expense of user comfort. Saarinen's IBM and Bell Telephone Laboratories collected services into large linear vertical cores, feeding laboratories on either side. These laboratories had no windows, although rest areas with windows were provided. Louis Kahn's well known Richards Memorial Research Centre at the University of Pennsylvania celebrated the vertical ducts as monumental architectonic elements, while failing to make the same provision for horizontal service runs [Fig 6.88]. On the other hand, his Salk Institute provides an interstitial loft space 75m.x 20m. in a Vierendeel truss structure, providing services to any point on the floor below. [Guedes, 1979]

In 1970, the Academic Building Office for the University of California developed a system of laboratory requirements for science and engineering laboratories. Some elements of the system such as structure, main ducts and ceiling grid were treated as permanent, while lighting, partitions and secondary services were designed for ease of alteration. A key feature was the strict zoning of the distribution of services in the ceiling space, with all services pre-coordinated: no two component systems share the same space, in contrast to the complex integration of structure and service of earlier design approaches [Guedes, 1979].

A modest variation on this theme was developed for the Charles Darwin Building at the Bristol Polytechnic. The building was designed on a 600m. x 600m. planning grid with a 8.0m.x 8.4m. structural grid. Both furniture and its associated services were designed for maximum flexibility. The mobility of the furniture was linked with the provision of an overhead distribution system, incorporated into the metal ceiling. The ceiling grid was matched by a grid of drainage points in the floor, to which waste from furniture and equipment is flexibly connected [Fig 6.89]. Developed in parallel with the service system was a range of loose furniture and fittings comprising 1200mm.x 600mm. tables related to 2400mm.x 150mm. spine units containing services outlets and drainage, flexibly connected



6.90 Oxford University
Science laboratories integrating various space types with set backs in plan & section providing daylight to deep laboratory spaces [Martin, 1983]

6.91 Oxford University
Science laboratories with set backs in plan & section

to the overhead services distribution and floor drainage grid [Laboratories Investigation Unit, circa 1975].

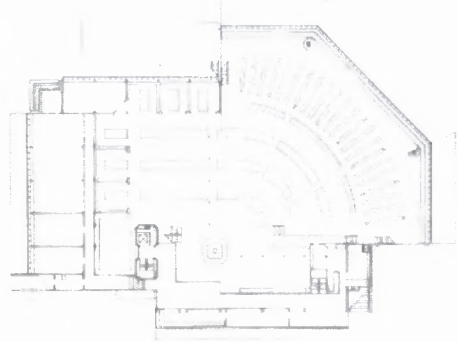
Besides developments in complex, bench type laboratories, new space types were needed for many special plant installations in civil, mechanical and electrical engineering requiring high tension laboratories, electron microscopes and the many 'factory laboratories' for, inter alia, structural and hydraulics experiments. These brought new requirements with regard to floor loadings, column spacing, ceiling heights, top lighting and vehicle access.

Sir Leslie Martin's Oxford laboratories showed how all aspects of science departments could be integrated with service spaces at the lower levels, classrooms and libraries at the 'street' level, with teaching laboratories on either side and research laboratories and offices above. It was constructed out of 30ft. square 'tables', with 5 ft. strip grids for circulation and services. It incorporated set backs in plan and section, providing daylight to deep laboratory spaces [Figs 6.90-91].

- **Libraries and Learning Resource Centres**
  "It is impossible to imagine a university without books. They are essential to teaching and research in every subject. The character and efficiency of a university may be gauged by the treatment of its central organ - the library. We regard the fullest provision for library maintenance as the primary and most vital need in the equipment of a university. An adequate library is not only the basis of all teaching and study; it is the essential condition of research without which additions cannot be made to the sum of human knowledge" - thus wrote the authors of the first report of the UK University Grants Committee in 1921.

  There are those who think that a university needs nothing more than a good library. A library is many things to many people. There is, for instance, the perception of the 'administrators' library, which requires centralisation, a single entrance, easy access for the book trolley and a spatial configuration which enables the maximum degree of surveillance.

6.92 Oxford University
Leslie Martin's Law & Colin St John Wilson's Library with plan based on supervision from one control point
[Martin, 1983]



6.93 Cambridge University
Stirling's History Library with plan based on the Martin/ Wilson Oxford Law Library with supervision from one control point [Stirling, 1996]

6.94 Toronto University
Main library known as 'Fort Book'

There is also the ideal of the 'users' library, which requires primary information as close as possible to his/her home base and also requires the opportunity to browse for secondary material across subject field boundaries. This requires a spatial configuration arranged in a legible system, organised according to the book classification system. The issue of surveillance is seen as problematic, since library study is a private act of communication between the reader and his material and this can be disturbed by strict supervision [Figs 6.92-93].

This perennial conflict has been approached in many ways, ranging from the very centralised high rise library, such as the high rise 'Fort Book' at Toronto University [Fig 6.94], to the library continuum at Bielefeld University and to those universities that can still afford a multiple library system, with many discrete departmental libraries. Significantly, the new map of learning of the 1960's, with its emphasis on Schools of Study and inter-subject activity, militated against isolated pools of library material.

Generally, a conventional central library format has been adopted by most postwar universities, with large flat floors stacked one above the other. The new library at Edinburgh University [Sir Basil Spence and Partners], for instance, had seven floors, each of which is 50m.x 74m., a total area of 3 700m^2 or about two thirds the area of a football field. Five and a half floors are given over to various combination of readers and book material. A search for a particular book could result in a reader not finding a book at one end of a floor and having to go to opposite end of the upper floor to pick up his search sequence.

This particular problem was addressed in the library for the University of Zambia in 1966, where continuity in the classification system was achieved by a ramping system rising 800mm. between floor plates, which were also linked by small companion ways. Thus the classification sequence was maintained, with no break in floor level being greater than 0,9m. with all levels accessible by the book trolley [Figs 6.96-97]. A similar system was used by the same architects for the new library at the University of the Western Cape, completed in 1987 [Fig 6.98].

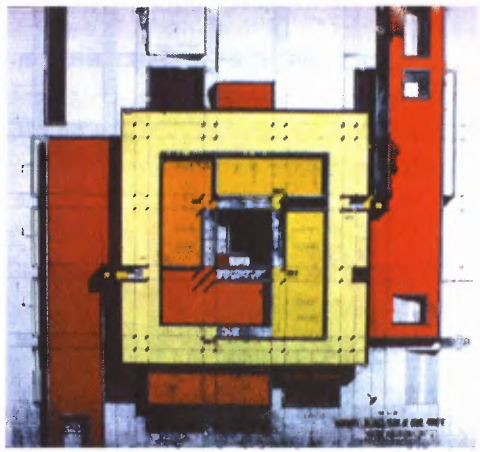
6.95 Stockholm University
Main library by Ralph Erskine showing quality of reader spaces in very large library

A library which satisfied both the needs for continuity of the classification system and departmental libraries, was planned at Bielefeld University. This otherwise undistinguished plan, has a 'Bibliothekskontinuum,' which brings together components of the central library with departmental libraries. The whole of this 'library continuum' was above the concourse on the second floor of the very large complex. It was accessible from all departments which were housed in tall blocks, each of which had an entrance to the Library and access to book material used by that subject field [Fig 6.99].

A similar scheme was proposed for the new University of Ulster by architects Robert Matthew, Johnson-Marshall and Partners. The university plan was a linear scheme which was structured by the library. This new plan has, unfortunately, not been constructed. Other libraries which tended towards the continuum concept were Regensburg and Konstanz Universities in Germany and Odense in Denmark, as discussed previously.

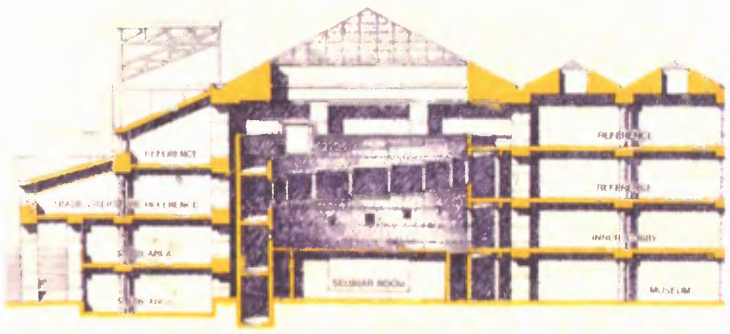
Historically, the library was a facility that dealt essentially with book material, stored in open and closed access conditions with a variety of reader stations, open for perhaps 12 hours a day and less over weekends and holidays. In the postwar period, with book material changing to tapes and CD ROM's, with the increasing use of the computer for accessing local, national and international information and with user demands for all hours access to both information and study facilities, a re-think of the traditional role is being forced on library administrators.

Sometimes these changes took place within the existing library, with 24 hour study facilities accessed from outside the security cordon and with special computer facilities in the form of electronic 'knowledge commons'. More often they are taking place in specially designed 'Learning Resource Centres': electronic media centres which offer access on a 24/7 basis to all types of information, usually on CD ROM in a rapidly expanding computer based learning environment.

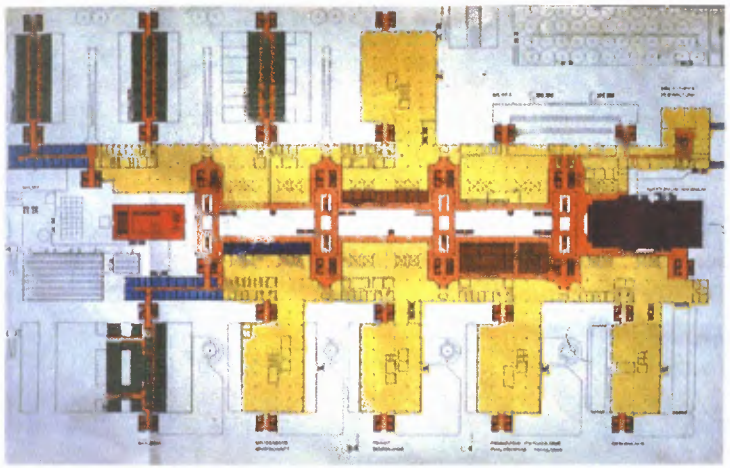


6.96 University of Zambia
Spatial continuum with floors at 800mm. intervals

6.97 University of Zambia
Interior view showing ramped access to floors at 800mm. intervals



6.98 University of the Western Cape
Spatial continuum with floors at 1200mm. intervals



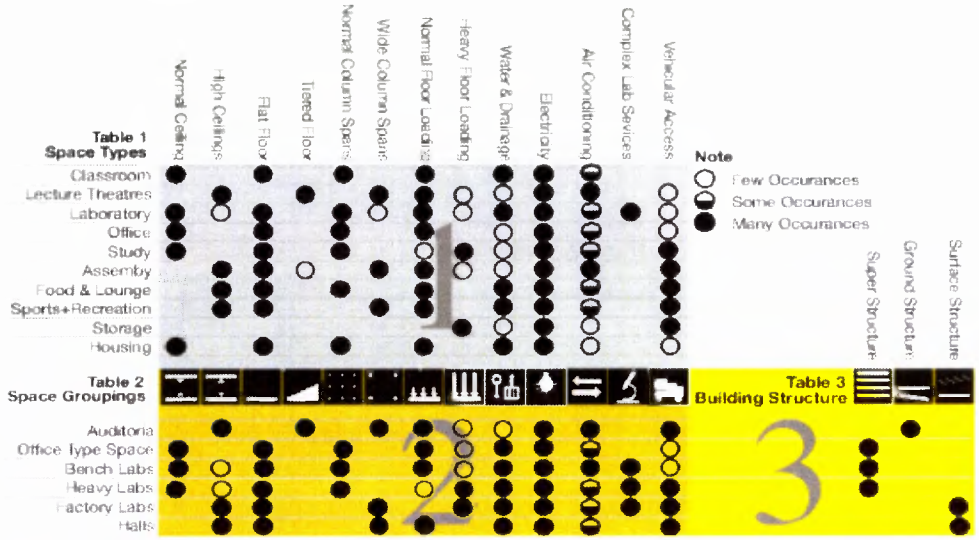
6.99 Bielefeld University
'Bibliothekscontinuum' linking all faculties in spatial continuum
(Herzog et al. Development Report)

The widespread use of IT systems in academic libraries has encouraged the emergence of the library as a training centre for computer skills. The modern library is not only a place where information is accessed but part of the training environment of the university. As a consequence, there are often seminar rooms and lecture theatres adjacent to computer suites, where students can be trained to use equipment and encouraged to develop computer skills [Edwards, 2000].

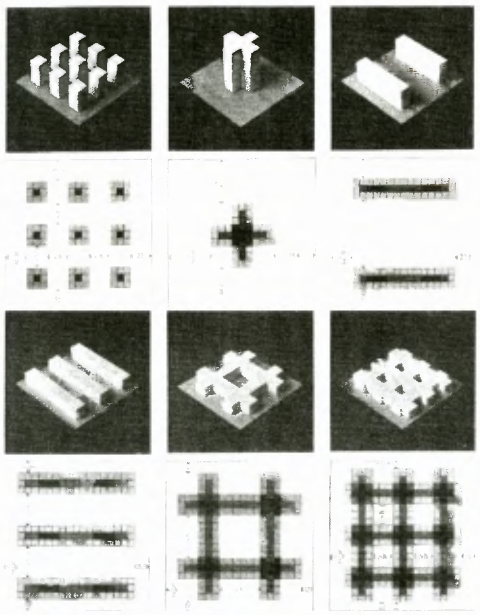
This variety and complexity led to development of new building types in which the various space types were assembled in a very different manner. It did not necessarily mean that there were radically new space types, but the way they were assembled into building types started to change in this period, as shown in Tables 1, 2 and 3 in Figure 6.100.

- **Other Facilities**
  Other facilities have not changed as dramatically as classrooms, laboratories and libraries. Assembly halls followed much the same pattern as in previous periods, although they were much larger. Food service facilities were also on a much larger scale and subject to economy measures which influenced the size of the catering module and the various ways in which food could be processed from delivery to table. Proportionately, more recreational facilities were being provided at universities, with indoor sports requiring large span spaces. Residential facilities ranged from the traditional colleges and halls of residence to hotel type accommodation, flats and more general housing types as discussed in the previous sections on individual universities.

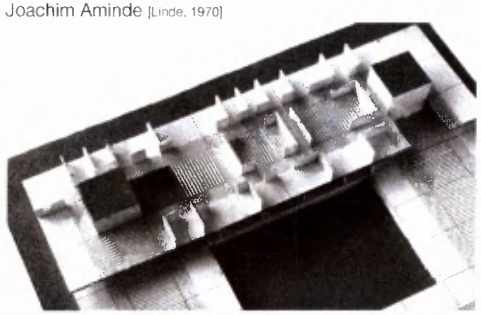
One major change in this period which was very difficult for universities to come to terms with was the increasing use of the motor car, with many facilities requiring access for deliveries and maintenance, not to mention the need for parking. The implications of this will be described in the section on planning structure.



6.100 Postwar Universities: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**



6.101 Three Band Buildings
Studies of various three band building forms each accommodating the same amount of space by Hans-Joachim Aminde [Linde, 1970]



6.102 Three Band Building
Three band building at University of Cape Town showing penetration of inner band by double volumes & courtyards

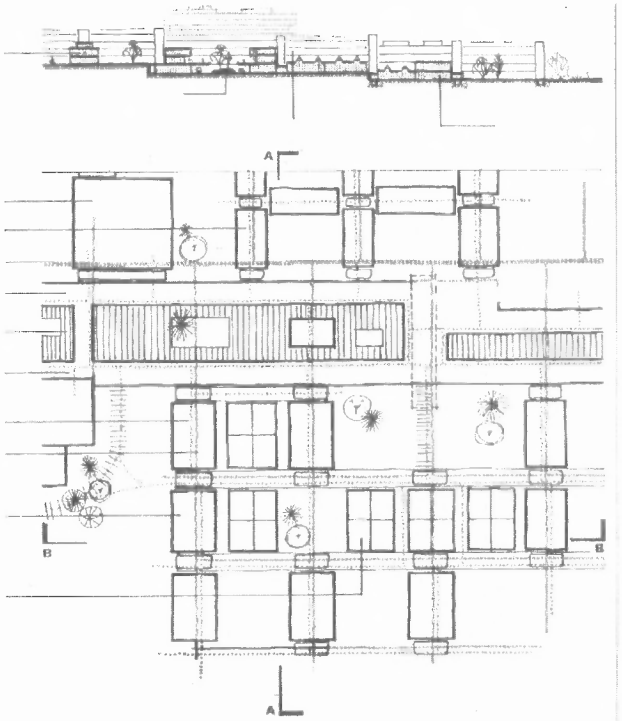
6.5.2 Building Structure

Generally during the postwar period, there has been a distinction made between foreground and background buildings. Those buildings, such as the central assembly hall, library and sometimes, the students union and university administration building, were regarded as key buildings which were differentiated from background buildings, both in terms of siting and configuration. The bulk of university accommodation, however, fell into the category of background buildings, where space types with different physical attributes had to be assembled together into coherent building form.

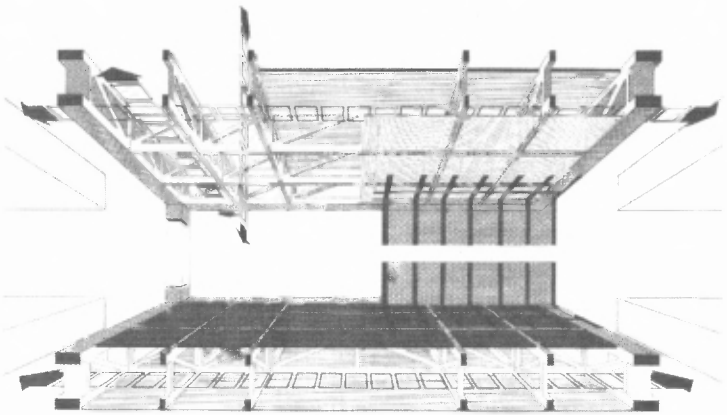
There have been different approaches to this problem. Some architects have just 'muddled through', forcing disparate spaces into conventional building frames. Others have explored various ways in which the vast array of university activities could be accommodated in flexible and adaptable spaces, or in long life, loose fit, low energy spaces. Together with this complexity, university buildings, more than most building types, have had to adapt to change, sometimes spasmodic and sometimes rapid. This dynamic has been caused by paradigm shifts in conceptualisation of university activities, by innovative programmes and by new technological processes.

The ubiquitous 3 band building based on the 7,2m. module has been discussed in the section on German universities [Fig 6.101]. These usually provided two outer bands for small accommodation and a circulation passage with a central band 7,2m. wide for wider accommodation. There were, however, variations on this plan, as can be seen from a large three band building at the University of Cape Town with small atria and courtyards [Fig 6.102].

Attempts to categorise families of space and bring them together into generic buildings for humanities type buildings and the more complex engineering and science types, have also been discussed. Others designers have developed universal, multi-strategy spaces, capable of accommodating anything from a small office to an engineering factory laboratory.



6.103 University of Bath
The Bath studies with a gradation of space from office type to bench labs to heavy factory labs
[Matthew R. Johnson-Marshall & Partners, 1965]



SECTION THROUGH SPACE UNIT

6.104 Loughborough University
The Loughborough studies for the large span 'space unit' which provide for a large range of different space types [Dowson P, RIBAJ

The issue of space types was approached in an interesting way at the University of Bath, where lateral growth was stratified into horizontal zones for general teaching spaces, a second zone created for bench type laboratory spaces and a third for heavily loaded, large span engineering laboratories and workshops. Similarly at Lausanne, three types of building structure were identified: 'knot' structures or cores which occur at nodal points; 'band' structures which accommodate small to medium width rooms in stackable floors; and 'field' structures for those large auditoria and halls which are not easy to stack [Fig 6.103].

A completely different approach was adopted by Arup Associates in the proposals for Loughborough University in 1964. In his research, architect Peter Foggo broke down university space into three types: factory type workshops and heavy laboratories; specialist teaching rooms and research laboratories; and less specialised class, lecture, seminar and tutorial rooms.

His research led to the development of large span 'space units'; which provided a wide range of different spaces and servicing possibilities. These attempted to answer problems which lie at the heart of the university planning challenge. A dimensional system was devised consisting of 15m. square structural units separated by 4,5m. strip grids, which contain all the vertical services. Precast concrete vierendeel trusses 1,5m. deep acted as crawlways and precast concrete ceiling panels acted as a floor for services which were integrated into the structure of the interstitial floors. The panels could also be removed to provide extra height to the 3m. ceilings when required. Heavy workshops requiring extra height were planned at ground level. These space units were capable of being stacked into 6 floors, although 4 was the preferred height. Within the space unit, a rigorous dimensional system was devised which allowed brick partitions to be placed on a modular pattern, providing a large variety of room and corridor configurations [Fig 6.104].

Building systems which sought to provide adaptable accommodation were also explored in California, with the well known School Construction Systems Development [SCSD] team, headed up by Ezra Ehrenkranz. This exploration of system building was later developed into the Academic Building Systems [ABS] and University Residential Building Systems [URBS] projects.

6.105 McMaster Health Sciences Building

6.106 McMaster Health Sciences
Reception area

6.107 McMaster Health Sciences
Two interior views

The McMaster Health Sciences Centre at Hamilton in Canada was an extension of this approach. The hospital occupied about 60 percent of the building, with the remaining 40% used by the Faculty of Health Sciences. The building, completed in 1972, was designed by Eberhard Zeidler of the Toronto architecture firm Craig, Zeidler and Strong [Figs 6.105-107].

It was an attempt to 'future proof' a medical hospital by planning a structure with a shell which could accommodate the changing activities of a teaching hospital during its various life cycles. The building was divided into primary unchanging elements and secondary elements which changed when space was altered. In the McMaster scheme, about 60% of the building elements would remain constant investments in the life cycle costs of the building. The maximum retention factor in a conventional building would be 10% or less. The two major elements which helped to create such retention were the interstitial truss and the unitised air handling system [Zeidler, 1983].

At McMaster about 15% of building cost went into the structural system which had a floor supported by trusses spanning of 22,5m. This provided planning freedom and a deep interstitial space between floor and ceiling for service runs, small plant and maintenance. The result was a common building shell that contained a variety of uses ranging from animal quarters, manufacturing areas, residential and office use [Zeidler, 1983].

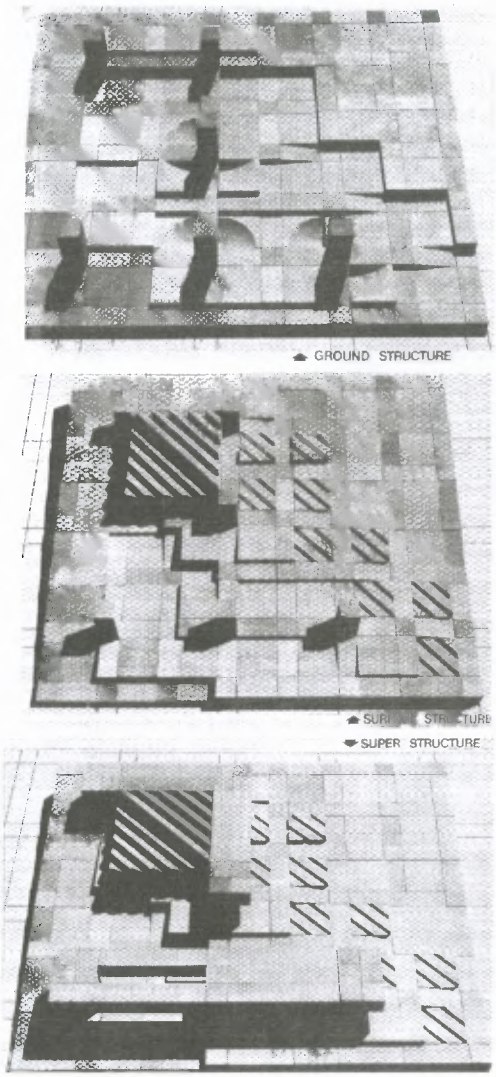
Seminal work was undertaken by Professor Horst Linde and his team in Stuttgart on university planning, including detailed analysis of space types and their physical attributes. They concluded that all university facilities could be grouped together in 6 families of space;

F1 auditoria with sloping floors, high ceilings, wide column spacing, normal floor loading and air handling;

F2 office type spaces with normal ceiling height, column spacing, floor loading and natural light;

F3 bench laboratories which are similar to offices but require heavy service installations;

F4 heavy laboratories which are similar to bench laboratories but require heavy floor loading;



Ground Structure

Surface Structure

Superstructure

6.108 University of Cape Town
Studies of 3 basic space groupings: Ground Structure; Surface Structure &, Superstructure
[UCT Planning Unit Report 3.2, 1976]

F5 factory laboratories with high ceiling heights, flat floors, heavy loading including point loads, servicing and vehicle access;
F6 large halls with high ceilings, flat floors, wide column spacing, heavy loads, air conditioning and vehicle access [Linde, 1970].

Working on the basis of the Linde analysis of grouping facility types into space families , the University of Cape Town Planning Unit, in 1976, translated the 6 categories into 3 basic building structures [Fig 6.108]:

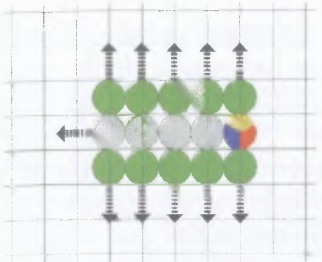
1 Super Structure or stackable floors with normal column spacing and ceiling height for office type facilities with varying degrees of servicing and floor loadings;
2 Surface Structure or large open spaces with top lighting for factory laboratories and large halls;
3 Ground Structure for large lecture theatres and auditoria.

It is this analysis which has formed the basis for the conceptual framework set up to analyse space and building structure in this thesis.

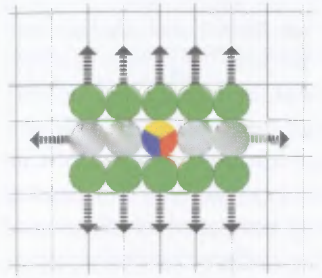
6.5.3 Planning Structure

Educational theory in the sixties was primarily concerned with breaking down the vertical stratification of departments and weaving a lattice of interconnecting horizontal threads across traditional boundaries, emphasising formal and informal connections. This was expressed spatially in most of the postwar universities by comprehensive and compact planning, often in the form of megastructures, a preoccupation with growth structures, the significance of the cell and node and by the separation of car and pedestrian. The universities were generally sited in green field sites, in less developed regions.

This had a parallel to city planning theory which, at that time was also concerned with compact city centre plans and social interaction in a traffic free pedestrian environment. The major difference, however, was that city plans were scaled to the motor car while universities, although having to deal with the car, were scaled to a predominantly pedestrian environment although, later, they were to experience all the problems associated with increasing car usership.



6.113 Unipolar Linear Structure



6.115 Bipolar Linear Structure

6.114 Essex University
Plan in 750m. Template

6.116 Lancaster University
Plan in 750m. Template

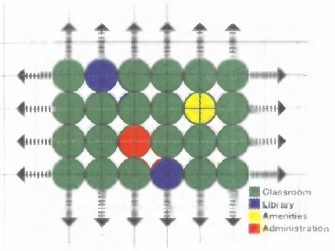
6.117 Bochum University
Plan in 750m. Template

- **Linear Structures**
  Linearity characterised most of the new universities of the postwar period. The primary line was usually structured by the main means of movement, with secondary development taking place at right angles to it. It came in a number of sub types: unipolar schemes with a fixed end and an open end [Fig 6.113]; bipolar schemes with two open ends [Fig 6.115], and 'no-polar' schemes with two fixed ends. In addition to polarity, linear schemes could be double or single banked with academic facilities.

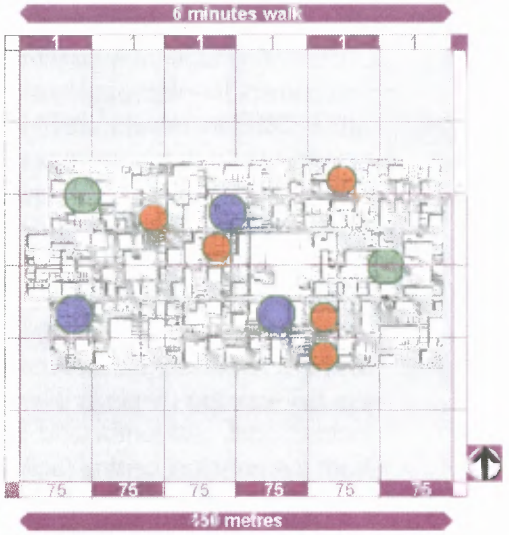
  Examples of unipolar or 'head and tail' linear structures were Essex [Fig 6.114] and the Zurich University proposals by Ziegler in 1966. At Essex, the tail was the dynamic element where expansion took place, so that instructional, residential and social facilities were always moving away from the principal central facilities in the head. In trying to overcome this problem, the Rand Afrikaans University folded the dynamic tail around a central precinct so that the instructional facilities remained reasonably close to library and administration. The growth pattern was, however, interrupted by locating the main assembly hall and student centre at the end of the tail, thus blocking future development.

  The bulk of linear schemes were bipolar schemes, with expansion taking place in both directions. Schemes were double banked with instructional facilities in the case of the universities of Lancaster [Fig 6.116], Bath, Ulster, Odense, Oulu, Bochum [Fig 6.117], Bremen, Regensburg, Dortmund and Bielefeld, Simon Fraser, Lethbridge and Scarborough College. They were single banked in the case of Surrey, Rissho [Japan] and Zambia. In Zambia, the major linear spine was banked on one side by academic buildings with residences on the other. Residential growth, therefore, could occur together with academic growth, but with a consequent loss of flexibility and connectivity in the academic bank.

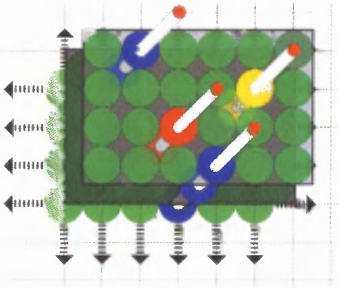
  Although these schemes solved many of the problems of the smaller universities, they were elementary structures which could not easily meet the needs of the large institutions, because growth in a single line eventually became unwieldy. They were all building dominated schemes with area factors greater than 1.



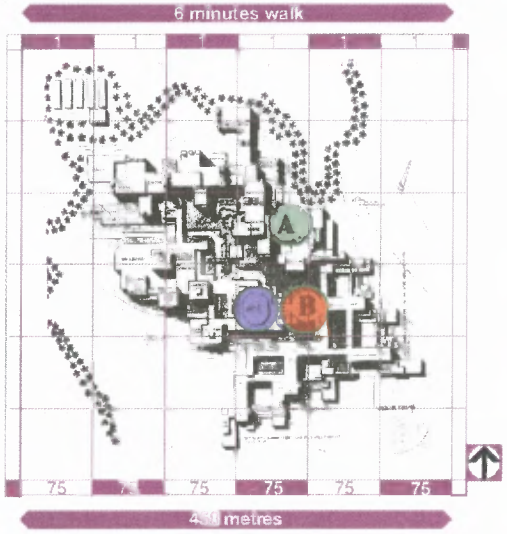
6.118 Web Structure



6.119 Berlin Free University
Plan in 450m. Template



6.120 Multi-Level Space Structure

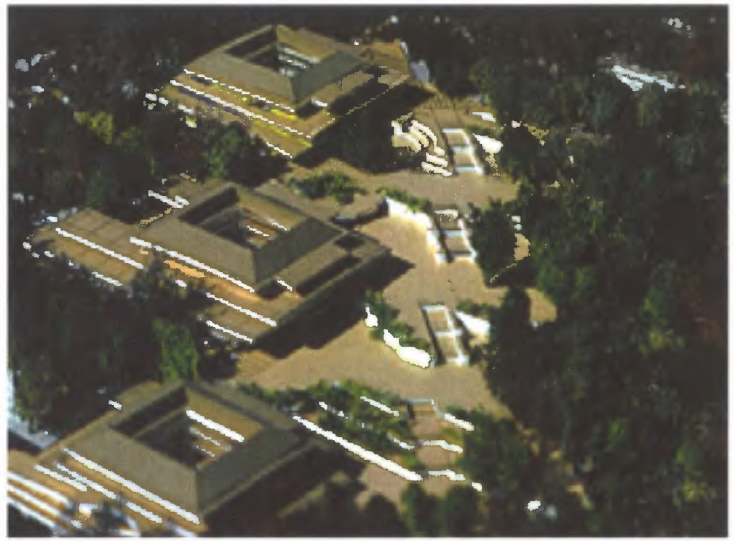


6.121 Konstanz University
Plan in 450m. Template

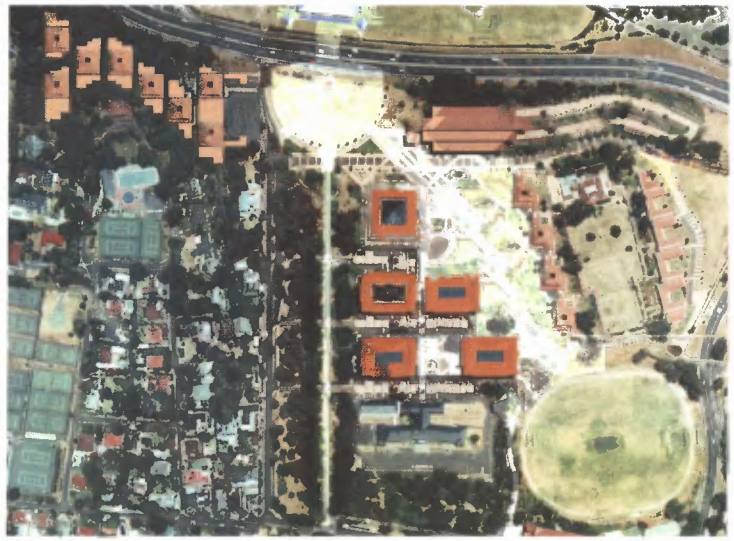
- **Web or Network Structures**
  Web structures evolved directly from linear schemes as they grew in size and complexity. Typically a web structure had two or more major movement routes linked by minor routes at right angles, offering planning flexibility with good connectivity [Fig 6.118]. The Free University of Berlin [Fig 6.119] project was planned on a web network of primary and secondary communications linkages, with similar networks proposed by the same architects for the Zurich University competition and also the Toulouse Faculty of Arts. These medium density schemes were compact, offered relatively high connectivity and provided comfortable working environments with a balance of building to open space and area factors which were about 1, similar to the Oxbridge colleges. They were planned on a neutral, egalitarian framework, with carefully distributed activity nodes making the scheme poly-centric. In these three network schemes, the communications system was the dominant structuring element with facilities being of secondary importance. The opposite was the case at Loughborough and, to a lesser extent at Marburg, both of which developed dominant space units which were linked by a secondary communications network. These were relatively low density web structures which, in the case of Loughborough and Marburg were fairly spread out.

Two dimensional web structures were sometimes developed into three dimensional, high density structures in order to improve connectivity and acessibility or because of site limitations. They were structured by nodes carrying the vertical infra-structure rising out of the web [Fig 6.120]. The University of Konstanz was an example of a high density network which offered very good connectivity. It was also an example of the difficulties associated with constructing a large megastructure and is an example of ways in which a potentially oppressive environment could be mitigated by the use of environmental art [Fig 6.121].

Other examples of high rise network structures were the University of Ulm, [Germany] the postwar buildings for the University of Paris and the McMaster Health Sciences Centre in Canada, as well as the compact high rise space network of the Hentrich and Petschnig competition entry for Zurich University and the early plans for the Lausanne Institute of Technology.



6.126 University of Cape Town
Model of new Middle Campus



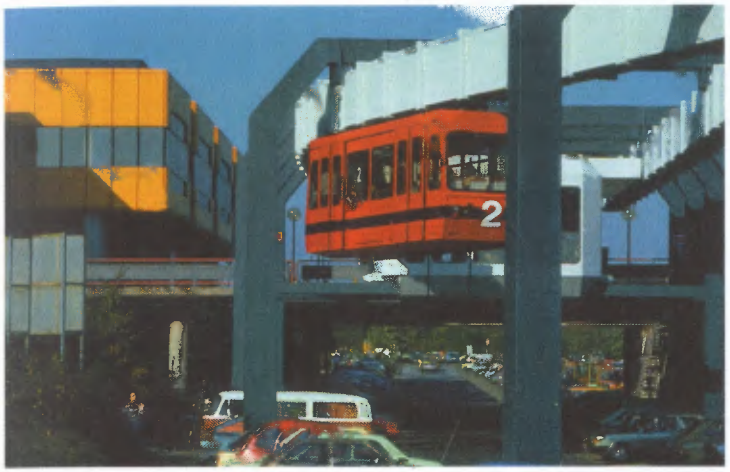
6.127 University of Cape Town
Plan of new Middle Campus

prolonged periods. If this was not the case, they frequently became truncated schemes like incomplete freeways. They also presented serious problems in terms of personalised environments. In spite of their many problems, these macro-structural projects were attempts to come to grips with the programmatic requirements of a new academic world, within the context of current architectural and city planning theory. They tried to answer problems which the simplistic idea of isolated pavilions in a field could not do.

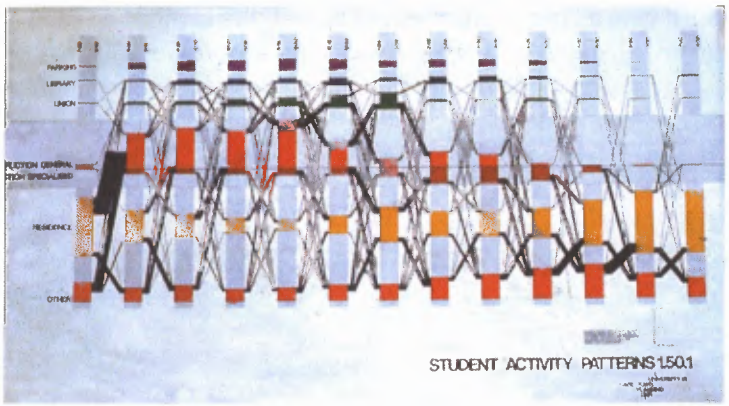
An attempt to create a planning framework which brought together some megastructural benefits within an open system was made for the University of Cape Town's Middle Campus. The plan, set within the context of a strong existing structure, indicated a loose arrangement of discrete buildings linked by arcades and ground structure, which provided a compact organic framework based on five principles. Firstly, it could be built in a piecemeal manner. Secondly, each planning block was physically self sufficient in terms of landscaped open space, entrances and parking.Thirdly, each block was as operationally independent as was economically feasible. Fourthly, each building was territorially identifiable and finally, at every stage, there was to be a sense of completeness.

A development framework was constructed on this basis which resulted in a strong spatial connection to the existing structure, reinforced by major pedestrian routes on terraces covering ground structures which accommodated lecture theatres and a library continuum, linking three terraces of academic buildings. Vehicular access was to be from the back with open and structured parking for each terrace. Each terrace, therefore, was identifiable with its own parking and had lecture theatres and library, which were also shared with other terraces [Figs 6.126-127].

Christopher Alexander's master plan for the University of Oregon at Eugene, USA, was an attempt to find deeper meanings in the physical patterns and structures of universities. It was summarised in the well known six principles: organic order, participation, piecemeal growth, patterns, diagnosis and co-ordination [Alexander; 1975]. Most readers will quarrel with some of these



6.128 Dortmund University
Intra-campus transportation system



6.129 Student Activity Patterns
Diagram showing relation of activity patterns through the day. Central band is activity in general and special teaching facilities which is governed by the timetable & drives all other activities [UCT Planning Unit Report 1, 1971]

principles and some will quarrel with all. The principle of participation, for instance, with all planning decisions in the hands of the users, is particularly problematic, since university buildings are renowned for their high turnover of users. The example cited by Alexander is a case in point, where the Professor and key staff members of the Faculty of Music virtually designed their new building but left before it was completed. Similarly, many of his patterns were based on past experience, often romantic and sometimes naive, which precluded the search for an evolving timeless way of building. Nevertheless, this work offered a theoretical framework which identified and addressed some of the major issues in university planning today.

One very important impact on the postwar university has been the widespread use of the motor car. This was a major problem in North America from the beginning, with its affluence and widespread use of the car. Initially, this was less of a problem in Europe which has a much lower car usership and a long tradition of public transport. However, this was to change with increasing affluence, although universities housing large numbers of students on campus were less affected than commuter campuses.

Many different solutions have been adopted in trying to solve the parking problem. These included managerial alternatives such as a 'hand in glove' approach of restricting parking to certain users, charging high prices while offering alternate modes such as [often free] campus bus services, 'park and ride' systems and in some cases, light rail systems [Fig 6.128]. They also included complex systems of manipulating the timetable in order to even out loads on classrooms, laboratories and services, including parking [Fig 6.129]. On the other hand there were those planners who tried to meet the ever increasing demand by providing additional parking at high environmental cost, 'solving' the problem through congestion.

Generally, many of the new universities adopted plans with pedestrian cores and peripheral parking although some, such as Bochum and Regensburg and, to a limited extent Bath, Essex and East Anglia provided structured parking at the core.

6.130 Student Demonstrations
Student demonstrations in Harvard Yard, 1968

6.131 Zurich University
Master planning. Zurich University Competition

6.5.4 Conclusion

As noted previously, the postwar universities were built during an heroic and confident period. It was a period when young people around the world rejected authoritarianism. The universities were in the centre of this crucible with student activism and public demonstrations denouncing an unpopular war and demanding more and more say in not only the governance of universities but also the relevance of what was taught, who taught it and how it was taught [Fig 6.130].

Similarly, it was also an heroic period for the architects and planners, physical and academic, charged with bringing an unprecedented number of new universities into being. The number of new projects realised between 1960 and 1980 was also unprecedented and it is difficult to see how, short of another major cataclysm, a similar situation will arise in the future.

Reflectively, the response of planners was remarkable, both at the academic and spatial level. It was a time of great stimulus, with the synthesis of ideas from the academic, planning and architectural spheres. It was defined by great clarity in academic planning, urban planning theory largely aimed at overcoming the degradation of central cities caused by the unbridled use of the motor car and by an architectural community which sought to bring together societal needs with tectonic honesty. It was a time of cooperation between architect and planners, attempting to rationalise a changed world and working on the basis of an often collective belief system.

In spite of all the theory, the enthusiasm and opportunities, the results of this great wave of university building has produced academic environments which are often disappointing, sometimes banal and even hostile. So what went wrong? A number of reasons for this can be identified.

Master Planning

The first factor was Master Planning. Proposals for the new universities were seldom called Master Plans: they were Development Plans; Strategic Plans; Structure Plans, or Guide Plans. One was even called a Servant Plan. Most were names for products with a prescribed mode of growth, rather

6.132 Leicester University
Leicester Engineering Building. Example of a building expressing highly specific clients brief

6.133 Essex University
Example of an aborted megastructure expressing unfulfilled expectations of brief

than a process that could establish frameworks subject to continuous review. In fact, however, most were Master Plans which, while sensitive to the needs of growth, were incapable of interruption when difficulties arose, funds ran out or changes occurred in institutional priorities. This meant that, frequently, large building complexes were constructed without the benefit of performance evaluation, before commencing the next stage of development. More seriously, structures that were planned to be big, often had to be prematurely aborted and, without the benefit of size and complexity, did not work as intended.

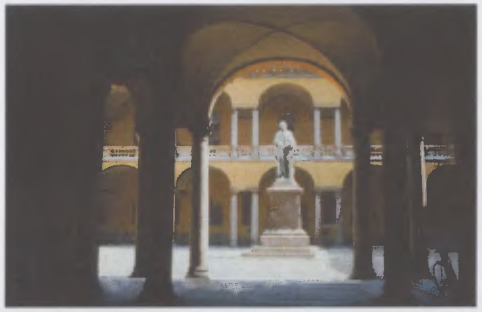
Where funding was continuous for a sufficient length of time, the original intentions often have been realised, but where there was incremental growth, because of lack of funds or exaggerated growth expectations, the results have shown up the inflexibility of the so called 'development plans'. This has given rise to disillusionment on the part of the institution, often with new plans being grafted onto those which were still-born.

The Nature of the Brief

The second reason was the nature of the brief. What was taken for granted was Sir John Summerson's thesis that the roots of modern architecture rest in the definition of the programme [Summerson, 1957]. By extension, therefore, no design process could be started until an academic structure existed. While this encouraged dialogue between the academic and spatial planners, it is doubtful whether the perceived requirements of one generation of academic planners would suit the needs of future academics, or to put it paradoxically, there may be times when the essence of a brief is the absence of a detailed programme [Brawne, 1970].

There was a common perception that a design solution lay in final clarification of the brief, a belief which led to several unfortunate situations where a brilliant professor's every wish would be interpreted architectonically by the eager architect, only for the professor to be attracted to a better post before the building was completed, leaving an idiosyncratic plan which others found difficult to operate [Fig 6.132].

6.134 Cambridge University
Timeless ways of building at Cambridge



6.135 Pavia University
Timeless way of building at Pavia

6.136 University of Virginia
Timeless way of building at Virginia

6.137 Regensburg University
"Spray the Grey" at Regensburg

Growth

A third reason was the prevailing attitude towards growth. This resulted in a search for structures which could adapt to different rates of growth. This often assumed that the academic framework would remain more or less the same, except for increases in size. In fact, a university of 2 000 students could require a radically different structure from one of 10 000. This is a real issue, since nearly all postwar universities have many more students than the maximum for which they were planned. Conversely Essex, which wanted to be large with 15 000 to 20 000 students, today has just over 9 000 students. This has resulted in some of the infrastructure having the abandoned feel of an incomplete freeway. This case demonstrates clearly the problem of the megastructure as a large complex which cannot be modularised and which expresses the unfulfilled expectations of the brief [Fig 6.133].

Design

A fourth reason relates to design. The postwar universities were designed in the language of late modern architecture, bringing with them all the aesthetic values and stylistic baggage of the time. It was the period of the 'New Brutalism' with its emphasis on the use of fairface concrete [Fig 6.171] and a search for non-traditional imagery. To exacerbate the situation, this was a period of the rapid growth of technology, with a strong belief in systems building and the engineered environment. Plans were evaluated for their compactness, efficiency, degree of connectivity, cost and speed of construction.

Unlike the concerns with campus planning, campus design was seldom discussed and there was little evidence, surprisingly, that architects and planners were aware of the design potential of campuses on large green-field sites with opportunities for unconstrained development, as had happened in the previous century with Jefferson's iconic campus at Charlottesville in Virginia. There was also little evidence of the rich American and European history of university architecture, with its roots in the timeless heritage of the ancient world from which so much could be learned. Nor was there any suggestion that architects were aware of the university environment as a 'hidden curriculum', a subliminal situation which in the case of the best universities, leaves no one untouched by its civilising experiences and memories [Figs 6.134-137].

6.138 Massachusets Institute of Technology
Architecture Department at MIT, 1968

6.139 Massachusets Institute of Technology
Madison Avenue gloss at MIT, 1968

6.140 Massachusets Institute of Technology
'Doc' Edgerton's stroboscopic photos at MIT, 1968

6.141 Massachusets Institute of Technology
Art gallery in the foyer at MIT, 1968

Generalist versus Specialist

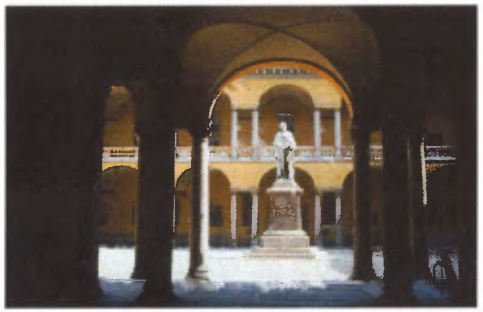
A fifth reason relates to the inherent tension between generalist and specialist approaches. The argument of this thesis is that universities have become distinctive space, building and planning types. If this is accepted, it follows that university architecture and planning have become specialist skills. While many of the architect/planners responsible for the postwar universities have subsequently, with experience, become specialist 'campus planners', very few, at the time, had designed a university before.

This inexperience manifested itself in a lack of understanding of the underlying structures and dynamics of university development. Except in one or two cases, there was little awareness of the vast array of university space types, how they could be grouped into families of generic space structures, and how these could, in turn, be assembled into basic building structures, each with its own characteristic 'footprint'.

In spite of these negatives, many valuable lessons can be learned from these disappointing outcomes. Firstly, they have brought home the reality of 'shooting at a moving target', whereby there could be no certainty about the rate of change or the nature of future development and the underlying need to think about planning as a process which is under constant review.

Secondly, within many universities, there had been a realisation that the need for comprehensive planning should be seen together with the desires of users for spatial self determination. On the one hand, because of patterns of association and connectivity, there was the development of megastructures. On the other hand, users were demanding the freedom to shape their own settings in new, and sometimes alien, environments. These aspects of personal and collective authority predicated orders of determinacy in planning. An interesting example of this was in the 'Big Building' at MIT where, during the late sixties, architectural students customised their environment with objects found on building sites. This occurred alongside other departments with slick Madison Avenue styled reception areas and yet others displaying scientific breakthroughs such as the pioneering work of Harold "Doc" Edgerton in high speed photography.

6.134 Cambridge University
Timeless ways of building at Cambridge



6.135 Pavia University
Timeless way of building at Pavia

6.136 University of Virginia
Timeless way of building at Virginia

6.137 Regensburg University
"Spray the Grey" at Regensburg

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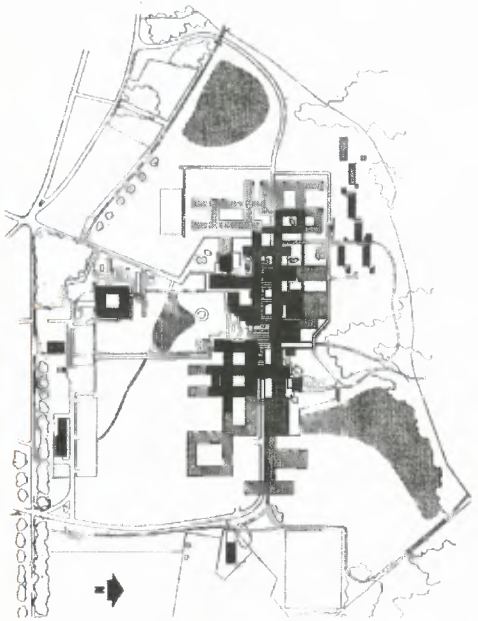
6.142 Hook New Town
Plan of Hook New Town [London County Council, 1961]



6.143 Bath University
Plan of Bath University by same architect/planner as Hook
[Matthew R, Johnson-Marshall & Partners, 1965]

6.144 Hook New Town
Sketch of urban deck at Hook [London County Council, 1961]

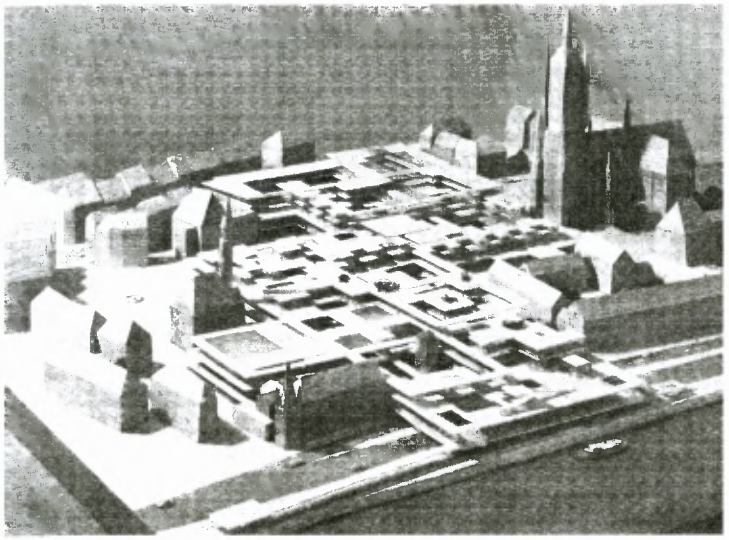
6.145 Bath University
View of Parade & service road at Bath University

All of this was experienced together with informal art exhibits showing how a big building can be dominated if it is used as a tool by creative users [Figs 6.138-141].

Thirdly, because the postwar universities were consciously micro-urban units which were under single land ownership and could be developed in a relatively short time, they frequently became research projects for exploring new planning theories, in ways which were not possible for city planners. Michael Brawne writing in the Architects Journal noted that "a good deal of the fascination which these projects [the new universities] have exerted has been due to the fact that university plans have to solve very many of the problems inherent in town planning, that they have to tackle in miniature the whole range of urban questions and have to make very much the same decisions [Brawne, 1965].

He went on to note that in the case of the University of Bath, Hugh Morris, the architect/planner who was one of three people most concerned with planning Hook new town, argued: "Bath shares with Hook the idea of a linear centre, able to grow but at some stage finite. In both cases the centre is raised off the ground so as to disentangle cars and pedestrians and in both instances this is made easier by existing ground levels. At Hook the main paths to the residential areas went off at right angles to the centre. At Bath each school has its main internal route of movement going off at right angles. Again, in both projects certain of the main buildings stand free within the wide street-like space of the linear centre. Yet in neither case does the plan suggest a preconceived or highly determined sense of order" [Brawne, 1965] [Figs 6.150-153].

Differing from the city scale, universities were conceived from the outside-in as micro urban units, as well as from the inside-out, as extensions of architecture. Berlin Free University perhaps offers up a seminal architectural and urban idea from its period; the building as city. "Our contemporary physical environment is increasingly characterised by projects that introduce extraordinary disruptions in the fabric of the



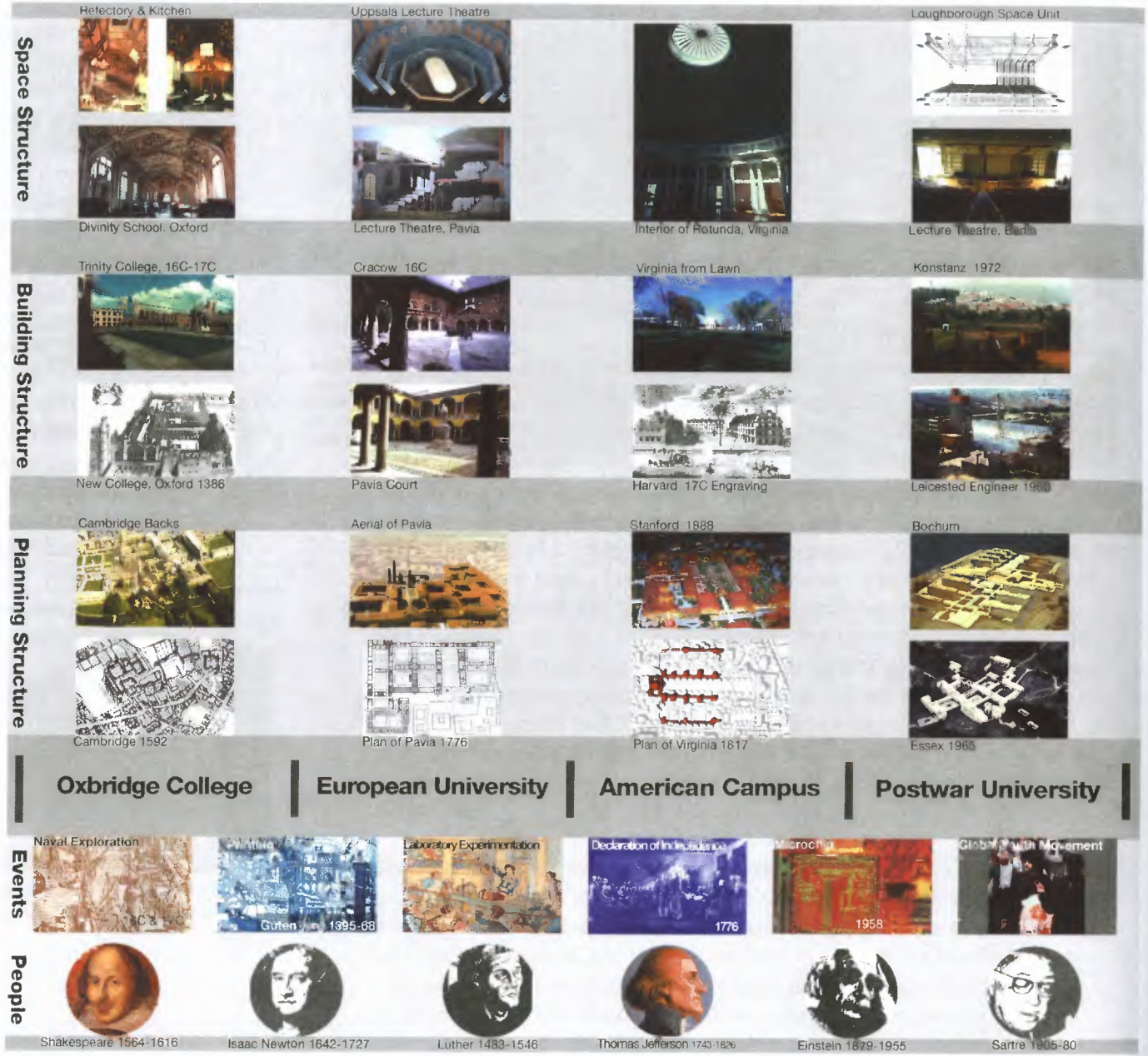
6.146 Frankfurt City Centre
Competition proposal by Candilis, Josic & Woods. Multi-level grid of pedestrin circulation precursor to Berlin Free University [Field, 1999]

city. Without traces of nostalgia, Shadrach Woods attempted to maintain the cultural continuity of the city while addressing those new emerging scales of operation. Despite all its contradictions, or perhaps because of them, the Berlin Free University may hold clues to the challenges of our contemporary environment" [Field et al, 1999].

Many valuable university planning lessons have, therefore, been learned from these disappointing outcomes. These can be summarised as an awareness of the importance of:

- granularity, which is the smallest module or fundamental space particle from which generic space structures can be assembled;
- interruptibilty, which is the ability to assemble space structures into building structures, which in turn can be built in small modular increments without prejudicing the organic growth of the whole;
- open architecture, which is the ability to manipulate these modules to create larger complexes, each with its own characteristic 'footprint';
- connectivity, which is the need for the building modules to interact within an efficient circulation network, offering the maximum amount of contact;
- a useable past, which is an awareness that, in designing the new academic environments, there is an historical, collective environmental heritage which is as rich and meaningful today as the academic heritage which it accommodates.

CHAPTER SEVEN
Conclusion



CHAPTER SEVEN

Synthesis and Conclusion

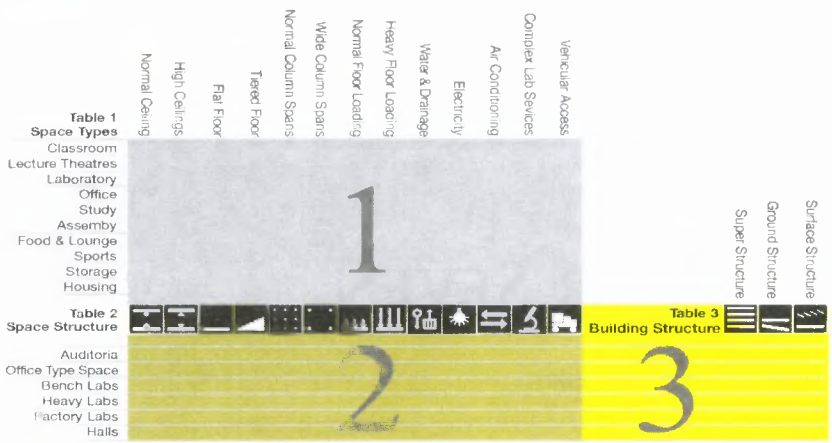
7 From Bologna to Berlin

The hypothesis which has been investigated in this thesis is that there is a correlation between the university as a distinctive evolving space type and shifts in social, economic, political and educational circumstances.

This chapter seeks to prove this through a comparative review of the changing space, building and planning structures of the four university types which have been identified. It then surveys the social, economic, political and educational circumstances which gave rise to these changes. Finally, it weaves the spatial and social threads together, demonstrating how the changing spatial types are in direct response to shifts in the prevailing contextual environment. The chapter is divided into three sections:

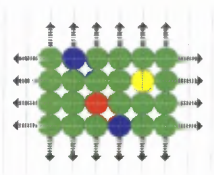
- a comparison of the spatial characteristics of all four university types within the conceptual framework of the thesis, at the scale of space, building and planning structures;
- an overview of the major university types and their socio-political contexts;
- two concluding sections which synthesise the major arguments to demonstrate that, throughout their history, universities have evolved as a result of shifts in social circumstances and, in so doing, became distinctive and, often, archetypal spaces.

7.1 Navigator Image
The Navigator Image presents an overview of Chapter 7
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document.
The lower bands illustrate some of the social milestones of each period, in terms of significant individuals and events which took place, sometimes influencing the spatial development of universities.

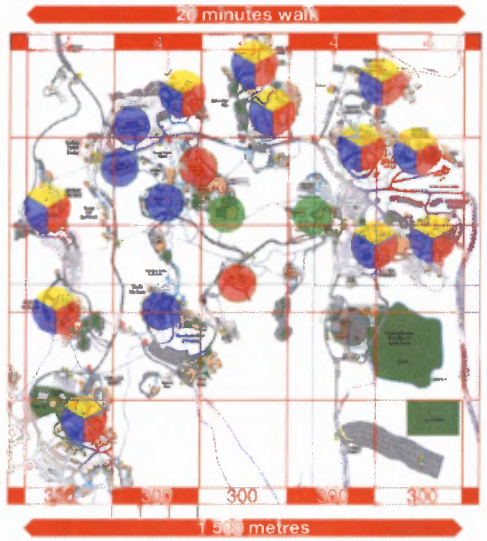


7.2 Framework for Building & Space Structure

Table 1 shows room or **Space Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in **Table 2**. **Table 3** goes a step further & shows how these can be accommodated in 3 types of **Building Structure,** super-structure or stackable 'office' type accommodation; ground-structure for large lecture theatres with sloping floors & surface-structure with large column free spaces and often, top lighting



7.3 Growth Structure
Template showing growth structures & zoning of key facilities



7.4 Spatial Ordering & Scale
Template used to show spatial ordering & scale of plan

7.1 Relationship to Conceptual Framework

This section analyses the space, building and planning structures of all four university types on a comparative basis. University campuses are the result of assembling a range of space or room types into building forms which proceed, through precinctual designs, to spatial development frameworks on the land.

Space Structure

The framework used to analyse the various space or room types in terms of their physical attributes is shown in Table 1 [Fig 7.2]. These are translated into six generic space groupings, as shown in Table 2. Note that space types and space groupings taken together are referred to as space structure.

Building Structure

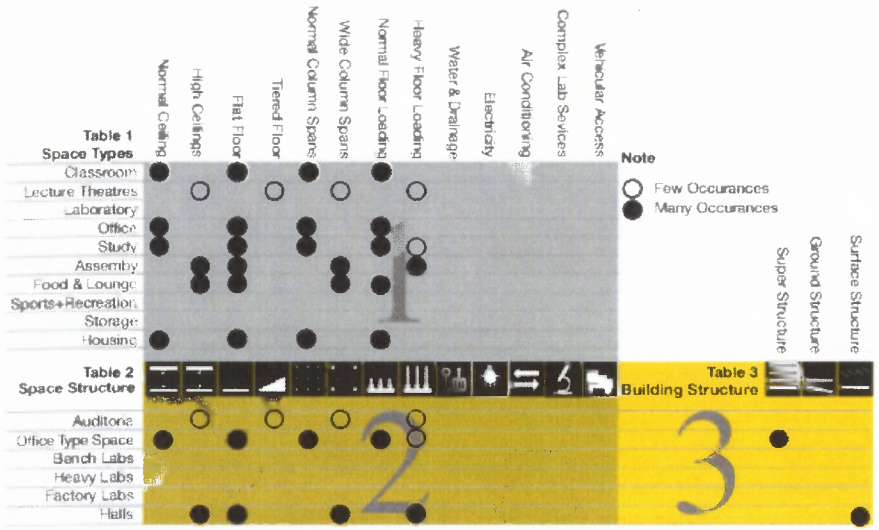
The term 'building structure' is used to describe the three dimensional assembly of space types into building form. It is argued that space groupings can be accommodated in three generic families of building structure:

- super structure or stackable 'office' type accommodation which, with varying degrees of floor loading and mechanical servicing, can accommodate most space types;
- ground structure, for large lecture theatres with sloping floors which do not fit comfortably within stackable office accommodation, and
- surface structure, with large column free spaces and, possibly, top lighting for large halls and factory laboratories [Fig 7.2, Table 3].

Planning Structure

Planning structure is seen as the three dimensional matrix within which building structure locates, according to spatial design criteria, growth patterns, scale , policy, site determinants and the contextual environment. Two different types of templates are used:

- a diagrammatic template, which indicates growth structures and zoning of key facilities [Fig 7.3];
- a second template which shows spatial ordering, with scales varying from 75m. [1 minute walk] to 1 500m. [20 minute walk] [Fig 7.4].



7.5 Medieval Colleges: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

7.1.1 Space and Building Structure

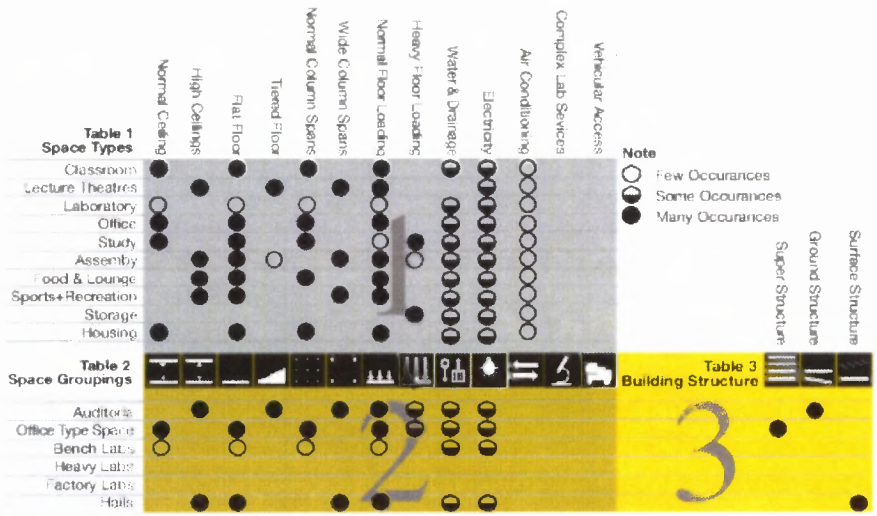
The Medieval Colleges of Oxford and Cambridge

The analysis of space categories for each of the four university types is shown in Table 1 [Figs 7.5-8]. The first type, Oxbridge from the 14C to the 17C, comprised a small range of rooms with fairly standard attributes. High ceilings were provided for chapels and refectories, most rooms had flat floors although, at the end of the period in 1699, Christopher Wren's Sheldonian Theatre was built at Oxford. This was a large facility with a tiered floor. Floor loading became problematic, particularly with libraries on the upper level: many of the timber floors showed signs of 'bounciness' and deflection occurred under excessive book loading. Trinity Library [1695], also by Wren, had a concrete floor on the upper level and had comparatively large spans of 11.3m. There were virtually no services, although there were some references to leaden ablution facilities with cesspit soakaways. Some of the major rooms were heated by fireplaces, cooking was on wood stoves and lighting was provided by lamp and candle. Vehicular access was limited to service points for horse and cart and barges on the river. Auditoria were only beginning to appear and there were no laboratories. As can be seen in Table 2 [Fig 7.5] these individual space categories can be grouped into two of the six generic space types.

Table 3 indicates how these groupings of generic space types were assembled into building structures. In the Oxbridge period, there were really only two types of building structure: stackable office type accommodation for small classrooms, libraries and student accommodation [super structure in Table 3]; and the halls or large refectories and chapels [surface structure]. These were assembled horizontally, simply by butting the larger spaces up against the smaller spaces, stacked into two or three storeys.

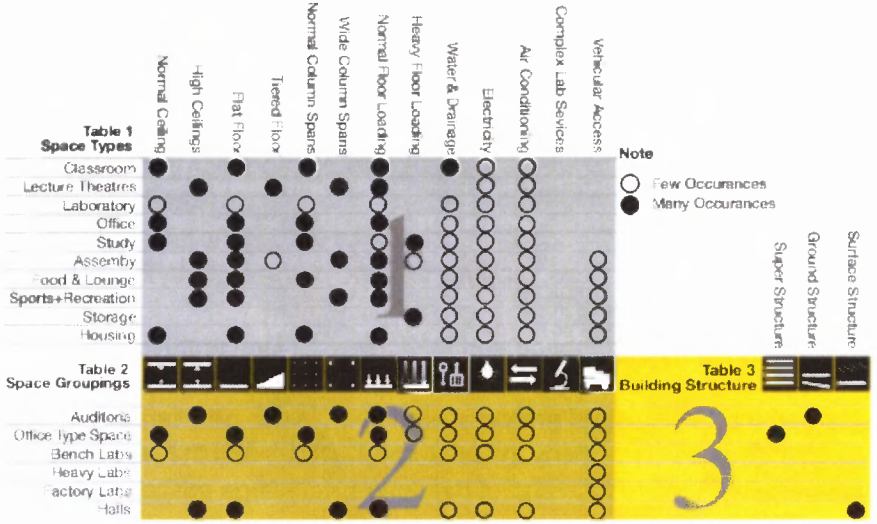
The European Renaissance and Neoclassical Universities

The second type, the European university from the 15C to the 19C, showed the beginning of greater spatial complexity, with tiered floor lecture theatres, particularly the anatomy theatres, and the very early laboratories. Towards the end of the period, very large spaces were



7.6 European Universities: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

7.7 American Campuses: Building & Space Structure



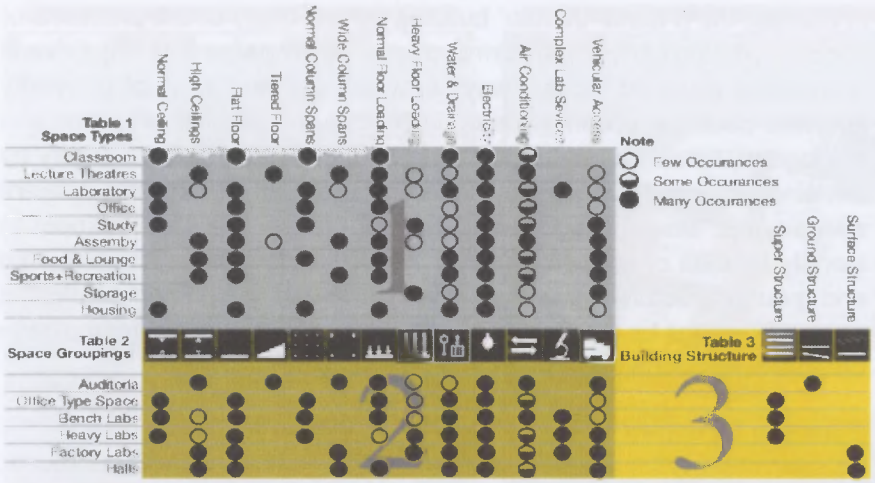
provided for galleries, museums, libraries and assembly halls. These were often top-lit for exhibition purposes. Heavy loading occurred with libraries on upper levels. Services were beginning to appear with the elementary provision of water supply and waste disposal. The period from 1750 to 1900 was a critical phase in terms of technological change. This was when the power of steam was harnessed, coal-gas production was invented and the generation of electricity introduced. Vehicular access was still, largely, by horse drawn carriages, with the first cars only appearing late in the 19C. Table 2 in Figure 7.6 shows that there were now three generic space types, with auditoria becoming common and laboratories just starting to occur.

The European universities brought together this increasing spatial complexity, with auditoria being introduced, as well as a larger array of office type spaces and various types of hall. These were assembled into renaissance building forms in terms of super structure for office type space, but the auditoria and halls soon became too big and difficult to be contained within the structure of a two or three storey building. Consequently they were generally attached to the super structure in various ways as discrete single storey ground structures, as can be seen in Table 3.

The American Campus

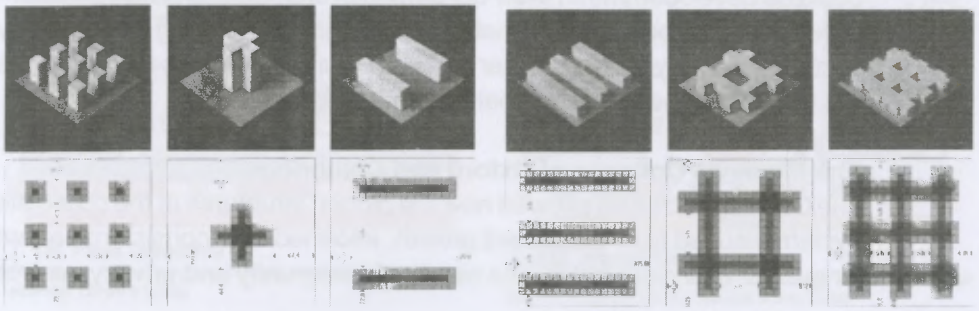
Space types found in the third type, the American Campus from the 16C to early 20C, were virtually the same as for the European universities at a similar time, although the degree of complexity was not as great as in the grand European examples. However, in the early part of the 20C, laboratories became more common and more complex. This is shown in Table 1 [Fig 7.7]. Table 2 in the same illustration shows that four of the six generic space types were in use, with a few occurrences of the heavier laboratories.

A similar situation was found in the analysis of building structure up to early 20C, with very simple assemblies of buildings occurring in much the same manner as the European models of the same period.



7.8 Postwar Universities: Building & Space Structure
Table 1 shows space or **Facility Types** analysed in terms of their physical attributes. These space types are translated into 6 generic **Space Groupings** in Table 2. Table 3 shows how these can be accommodated in 3 types of **Building Structure**

7.9 Three Band Buildings
Studies of various building forms each accommodating the same amount of space by Hans-Joachim Aminde [Linde, H, 1970]

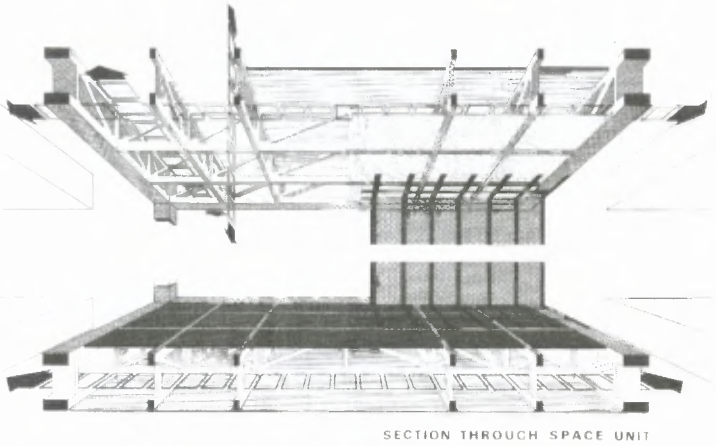


The Postwar Universities

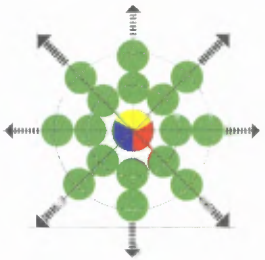
Space in the postwar universities became much more complex. A wide range of room sizes were required, from narrow band spaces to medium and wide band spaces requiring greater spans, heavier loading and a great deal more servicing. Flexibility became essential, both for single users and changing users over time, leading to concerns about modular planning and orders of determinacy in construction, ranging from the permanent carcase to the very impermanent partition.

Tables 1 and 2 in Figure 7.8 show the attributes of the complex array of spaces which had to be accommodated. These included spaces with normal ceiling heights and high ceilings, flat and sloping floors, wide column spans and several degrees of floor loading and top lighting. However, the most dramatic change was the range of services which had to be accommodated for the sciences. In earlier periods, services included elementary provision for physics, chemistry, astronomy and the earth and life sciences. In the postwar period, the range and depth of the basic sciences had not only expanded exponentially, but there was also an increasing blurring of disciplinary boundaries with interdisciplinary branches cutting across two or more sciences. All of this had profound implications for the type of space required and how it was serviced. This is reflected in Table 2 which shows that by this time six families of generic space types had evolved. What the tables do not show, however, are the myriad services required for this highly complex array of space types. What the table also indicates is the large number of spaces requiring vehicular access, a condition that was to have a profound impact on planning structures during this period

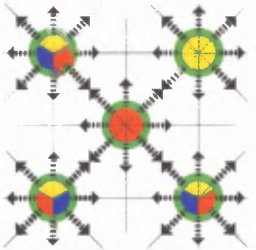
The Postwar universities accommodated the increasingly complex array of space types in super structure of three different types, depending on degrees of floor loading and servicing, as well as the ground and surface structures for auditoria and halls. In practice these were assembled in many different ways. There have been different approaches to dealing with this complexity. Some architects have just 'muddled through' forcing disparate spaces into conventional building frames. Others adopted the American Campus approach of making separate structures for the different functions.



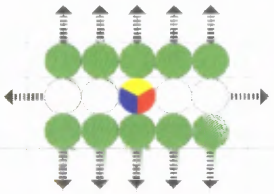
7.10 Loughborough University
The Loughborough studies for the large span 'space unit' which provide for a large range of different space types
[Dowson P, RIBAJ ca. 1967]



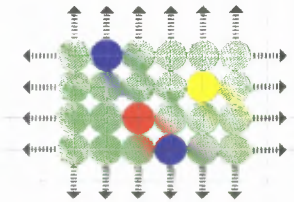
7.11
Centralised or Radial Structure



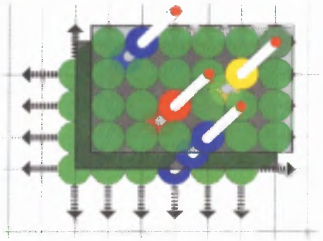
7.12
Nodal or Molecular Structure



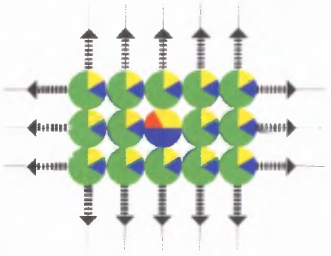
7.13
Bi-polar Linear Structure



7.14
Network Structure



7.15
Multi-level Network Structure



7.16
Organic Planning Structure
Semi-independant colleges with central facilities

In Europe, the 3 band 'Jumbo' building solved many of the problems of accommodating narrow, medium and wide band spaces [Fig 7.9]. Several universities explored various ways in which the vast array of university activities could be accommodated in flexible and adaptable spaces and in long life, loose fit, low energy spaces. Others dealt with diversity by devising 'universal space units' which could accommodate the different space types, albeit at high cost [Fig 7.10]. There were also attempts to identify families of space such as the super structure, surface structure and ground structure discussed previously and to accommodate them in generic buildings for humanities programmes, as well as other for the more complex engineering and science programmes.

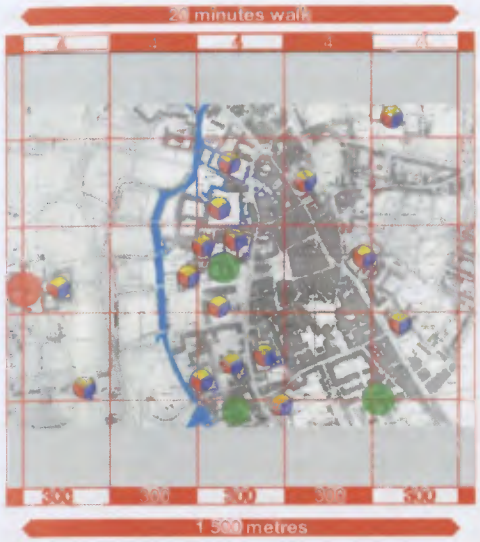
7.1.2 Planning Structure

As seen in previous chapters, the grid is a three dimensional framework. It is the ordering of the plan within this framework which has particularly exercised the minds of university planners, specially in the postwar period. The structure, size and scale of these planning types, together with their potential for growth and connectivity, is fundamental to considerations of planning structures which have ordered the development of universities.

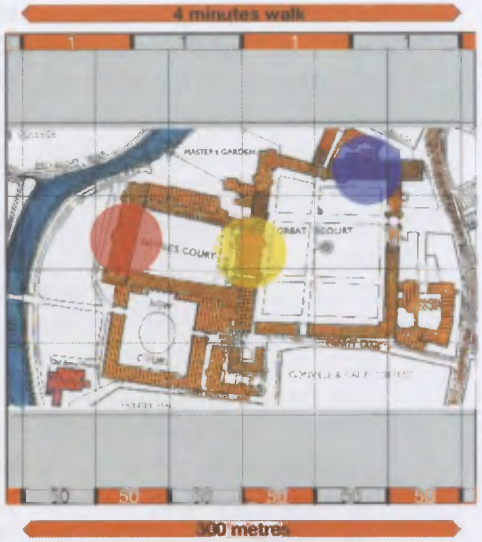
The typology of planning structures has ranged from radial structures ordered around a point, to interconnected nodal systems ordered around a number of points, to the various linear structures ordered along a line, to network structures ordered on a two dimensional surface plane and to the large multi-level networks ordered within a three dimensional frame. Each of these basic types had several sub-types. At the same time they could be developed within a low density, open space dominated framework or high density, building dominated, framework. Overriding this typology was the tendency towards either megastructures or organic structures, as will be seen in the following analysis [Figs 7.11-16].

The Medieval Colleges of Oxford and Cambridge

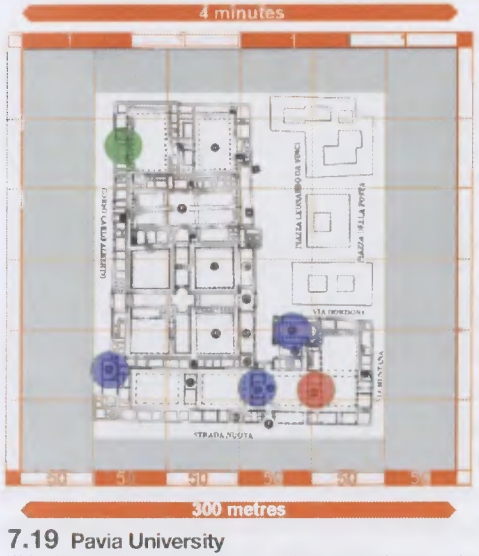
The Oxbridge colleges showed how the hidden structures of the collegiate system resulted from piecemeal growth, informed by a consistent pattern language. This provided for the needs of community and privacy, as well



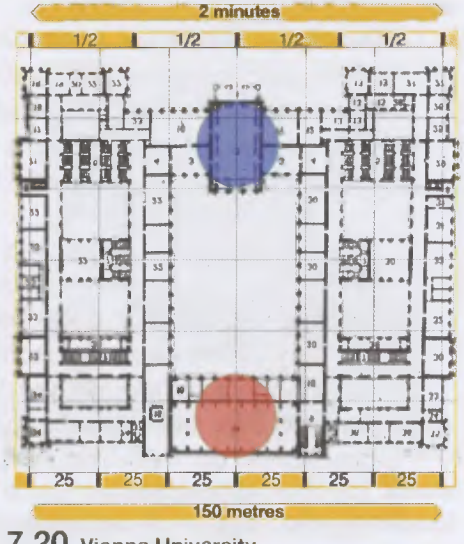
7.17 Oxbridge
Binary nature reflects interdependance of federation of colleges sharing university's specialised central facilities



7.18 Trinity College, Cambridge
Piecemeal organic growth with community & privacy, security & control in environment balancing building & open space



7.19 Pavia University
Web plan in 300m. template showing distribution of places of assembly, Library & Mensa



7.20 Vienna University
Plan accommodated variety of space types in impressive high density structure reflecting national & civic status

as security and control. All of this was ordered, probably intuitively, within a three-dimensional frame, making the best use of land by balancing open space and building form. This 'open architectural order' grew easily by addition of range [wing] and court into organic wholes, with a level of connectivity which satisfied the needs of the time. Courtyards varied considerably in size but, generally, colleges fitted into the 300m. template with most colleges and central facilities falling within the 1500m. template [Figs 7.17-18].

Key facilities such as chapel, refectory and library were located ad hoc and were generally dispersed, as in the case of Trinity College, Cambridge. Environmentally, Trinity expresses the gradation, found in many colleges, from the hard urban landscape at the entrance gateway to the soft rural countryside of the Backs on the river. Plans of the colleges in the towns of both Oxford and Cambridge reflect a binary system, differentiating between the centralised university facilities and the many colleges located throughout the town.

The European Renaissance and Neoclassical Universities

European universities were, usually, an integral part of the city. This is true of Heidelberg, Tübingen, Prague and most other Germanic universities. Unlike the Oxbridge colleges, buildings were undifferentiated from the adjacent city fabric, as can be seen in the cases of Cracow and Prague and many other northern European universities.

Pavia was more complex since the central university buildings, although embedded in the 80m. city grid, were of a different type. To move from the city streets into the university courts was to experience a totally different world. Pavia was similar to many Italian universities, in that it had a very strong development of the central university facilities with a number of separate colleges. Unlike Oxbridge, however, the balance of power in this binary system rested firmly with the central university.

Pavia University fits into the 300m. template, whereas the much larger University of Vienna fits into the smaller 150m. template indicating the

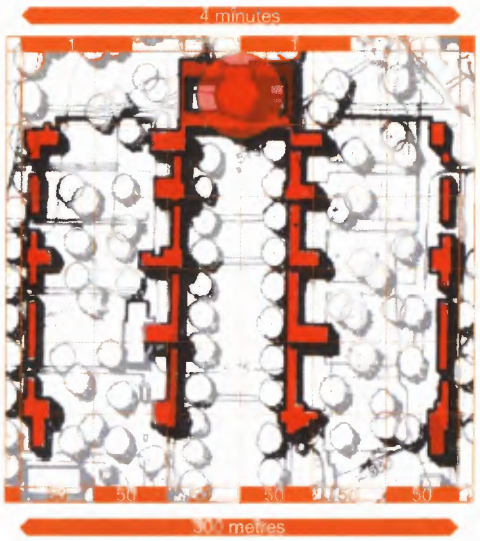
density of this grand urban university built about 100 years later [Figs 7.19-20]. It was typical of the 19C universities which were generally located close to the centre of power, reflecting the greater control of the national, regional or local authority. They were city block developments similar to other civic buildings and, consequently, were part of the dominant urban planning and design regimes. The blocks were not generated by specific university needs. These neoclassical megastructures were large, unified blocks, presenting hard edges to the street but opening into internal courts of various kinds. There were single courts at Cracow but generally there were several courts, as seen at Pavia and Vienna.

The American Campus

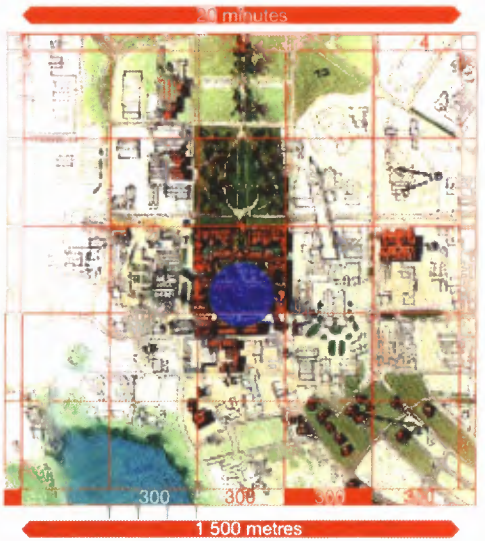
Turner argues that the campus is an uniquely American place. He describes it as "a kind of city in microcosm, [which] has been shaped by the desire to create an ideal community, and has been a vehicle for expressing the utopian social visions of the American imagination. Above all, the campus reveals the power that a physical environment can possess as the embodiment of an institution's character" [Turner, 1984].

American campuses have three major planning characteristics which distinguish them from European universities in the same period. These were the suburban context of their sites, the arrangement of campus buildings into coherent spatial designs and the piecemeal growth of individual buildings within the framework of master planning systems.

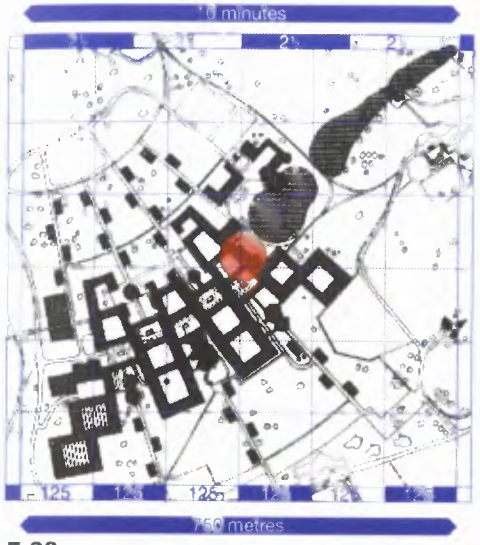
The self-contained community of scholars at the University of Virginia, which was the prototypical American campus, was perceived as an 'academical village' in a low density, open space dominated, setting. This low density framework created the freedom to explore many different spatial development frameworks and design configurations. Although a very small university, the fact that Jefferson's plan requires the 400m. template shows how spread out it was [Fig 7.21]. This is seen together with a contemporary plan for Stanford in the 1500m. template [Fig 7.22]. It is interesting to note that the original Old Quads at Stanford fit within the 300m. template, as does the very similar development of Pavia University.



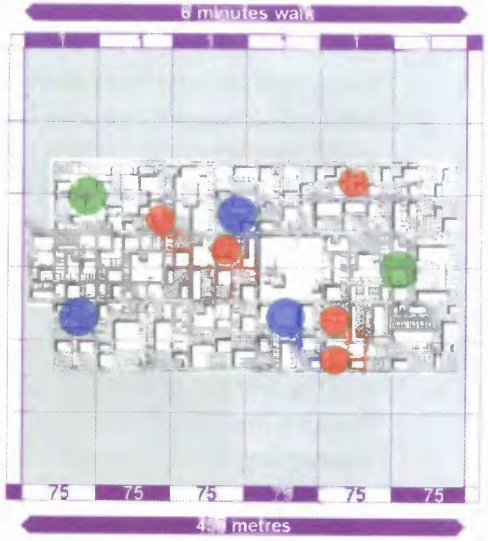
7.21 University of Virginia
Plan in 300m. template. Linear lawn structures uni-polar plan with Library as focus flanked by pavilions accommodating classrooms & staff quarters. Students accommodated in dormitories behind



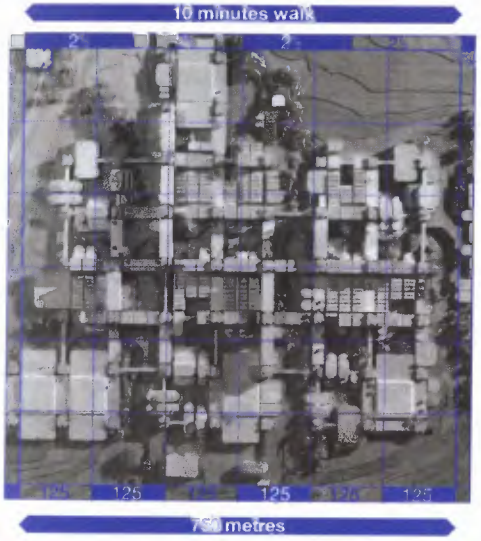
7.22 Stanford University
Plans & model showing gridded arrangement of the old quads with Memorial Church & Memorial Court



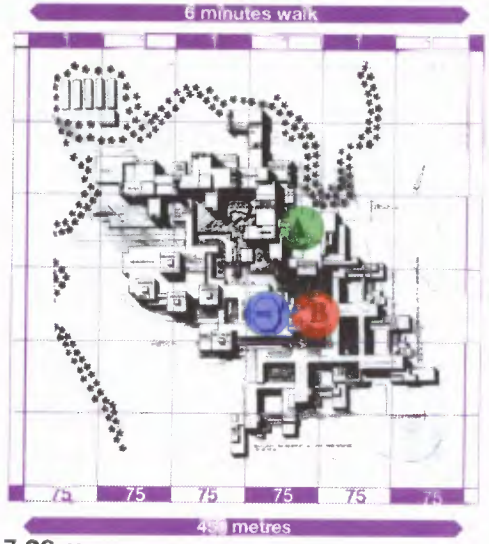
7.23 Essex University
Compact uni-polar linear plan with Library at head. Spine structured by pedestrian deck over service road.



7.24 Berlin Free University
Web plan in 450m. template showing polycentric distribution of places of assembly, libraries & food services



7.25 Lausanne Institute of Technology
Planning structure determines movement system, development axes, zones for different building types & development of central areas & green open space system



7.26 Konstanz University
Example of a high density network with very good connectivity shows difficulties of creating personal space identities in a large multi-functional structure

The Postwar Universities

Educational theory in the sixties was concerned with developing a new 'map of learning' which emphasised formal and informal connections. This was expressed in most of the postwar universities by comprehensive and compact planning, often in the form of megastructures, a preoccupation with growth structures, the significance of the cell and node and by the separation of car and pedestrian. Postwar university planning was influenced by city planning theory, which was, inter alia, concerned with achieving compact city centre plans and social interaction in traffic-free pedestrian and green environments. The major difference, however, was that city plans were scaled to the motor car, while universities were primarily scaled to the pedestrian.

Planning structures used in the postwar universities included molecular, linear and network structures. Plans for the new universities were seldom called Master Plans, as this denoted a rigid predetermined process. They were called Development Plans or Guide Plans which, according to the authors, were open to several future scenarios. In practice, however, they were not able to respond to changing circumstances, except in cases where the original planning intentions were subject to periodic review, by the original consultants or resident professionals with the necessary expertise.

Most of the postwar universities were contained within the 450m. or 750m. templates, the latter being informed by the 10 minute cross-over period between lectures. High density Bochum and low density York both required the 1200m. template with the very dispersed Santa Cruz falling within the 1500m. template [Figs 7.23-7.26 and Fig 7.4].

7.27 Medieval Universities
Hastings Rashdall's Map of Medieval University Towns in Europe [Rashdall, 1895]

7.2 Response of Universities to Changing Contextual Circumstances

In a recent article, Pablo Campos describes the evolution of universities in terms of 'Journeys Towards Utopia'. In the article, utopia is defined as "a transforming concept which has enabled universities to regenerate social principles, review educational structures and change the physical layout of university architecture" [Campos, 2001-2002]. This section summarises and compares the significant social circumstances which gave rise to the changing spatial typologies of universities.

Higher education has existed from ancient times, but it wasn't until the 11C that the first universities, as discernable institutional types, were founded at Bologna and Paris. What distinguished the early universities from the Greek academies, Roman schools, Islamic *madrasas*, monastic and cathedral schools was the comprehensive nature of their curricula, their power to award degrees and freedom from religious and secular constraints as to who was taught and what was taught.

However, it was the range of subject matter that was the defining characteristic of a university. Initially, at least one of the higher faculties of theology, medicine, civil and canon law, in addition to the lower faculty of arts [philosophy, grammar, rhetoric, logic, geometry, arithmetic, music and astronomy] were taught. There was a continuing struggle between generalised curricula and specialised fields of study which was reflected later in the postwar schools of study curricula, but these struggles took place within a comprehensive framework, in which educators chose to generalise or specialise.

Specialised academies and technical and professional schools often existed side by side with universities, but none of these could claim to provide the comprehensive range of subjects and depth of study that was the framework of the universities. Later, research became an important part of the role played by universities and, in recent times, extension programmes were added to that role. Thus, today the role of the university can be defined as research [discovery of knowledge], instruction [communicating discovered knowledge] and applying discovered and communicated knowledge to society.

These issues of the role of a university within a rich 'map of learning', the granting of degrees, the power to choose who and what to teach and the freedom from authority were all reflected spatially in different ways throughout the long evolution of the university.

7.2.1 The Medieval Universities

Both Oxford and Cambridge were consciously located far from the secular and religious seats of power in London and Canterbury: far enough to safeguard their autonomy and yet close enough to be part of the cultural and intellectual life of the capital and to maintain contact with influential religious, aristocratic, political and commercial benefactors.

This freedom was also expressed in the spatial development of the colleges, which were not only refuges from a generally hostile external world but were also an expression of independence from local authority and from a frequently fractious relationship between town and gown. This was reflected in the courtyard building form, providing security, control and privacy.

At another level, the spatial development of the colleges reflected the independence of the colleges from the central university. The colleges were communities of masters and scholars living and learning together. Based on the English cathedral monastery model, they were, initially, self-contained communities with their own refectories, common rooms, chapels and libraries. Instruction was by individual tutor or very small group tutorials. Educational curricula were based on the higher faculties of theology, medicine and law and the lower faculty of arts. The only specialised facilities were the classrooms required for teaching large classes, mainly for divinity.

The binary nature of both Oxford and Cambridge reflected a slow evolution from the initial, almost total, independence of the colleges, to the current situation where, with the changing nature of the 'map of learning' resulting in strong curricula interaction and the need for specialised facilities, the primacy of the college has waned, with more and more teaching and research taking place in central university facilities [Fig 7.28].

7.28 Oxford University
The Colleges around Christchurch with the large Tom Quad [Cambridge University]

Initially the European Universities were independent from church and state but this was less so than in England. Many were buffeted by the alternating forces of religious conflict and by the many wars which changed boundaries and authority. In the 19C, they were used as architectonic symbols of national and city pride. This resulted in the construction of the large and monumental neoclassical universities in the capital cities of Europe during the 19C in, inter alia, Vienna [Fig 7.31], Berlin, Helsinki, Oslo, the Sorbonne in Paris and London University.

7.31 University of Virginia
Aerial view with Rotunda in foreground and 'Lawn' flanked by Pavilions
(Dober, 1963)

7.2.3 The American Campus

The American Campus from the 17C to the early 20C was shaped by similar forces to those in Europe and Britain, as far as technological advances were concerned. These were reflected in comparable facilities although less grand than those in Europe. Socially, American universities were a more democratic model, open to all who could afford the fees and, later, scholarships made provision for deserving students who could not. Private colleges for women, such as Vassar founded in the 1850's, were soon followed by many others such as Wellesly in 1875. Co-education, however, was not popular until much later.

The main forces shaping the American Campus were utopian social visions of an academical village located away from religious authority and the corrupting forces of the city. Situated on suburban edges they were, initially, self- contained, micro-urban, communities. These were the first suburban universities, set in the green expansiveness of college grounds, later to be known as the campus. Their planning and design became experiments in city planning, often led by prominent political and business leaders. In the case of the University of Virginia, it was Thomas Jefferson, ambassador, president, man of letters and wealthy land owner, who not only founded the University but also designed it in a form based on the renaissance Ideal City. It had the library as its focus, an expression of an architecturally democratic university, where research played a more powerful role than previously in the traditional American college. Equally significant was the

omission of a chapel from Jefferson's plans, since "he intended his institution to be fully secular and progressive" and he symbolically opened it up to the expanding west [Turner, 1984]. These aspirations created a design ranged on three sides of a shaft of space reflecting many city planning ideas of the time, but transforming them into what subsequently became the American campus model: a model which still influences university planners today [Fig 7.31].

Differing from the organic growth patterns of the Oxbridge colleges and the European universities, both embedded in the urban fabric, they were, probably, the first examples of conscious spatial organisation of university development. The typical American campus was a low density development on a large site, under single land ownership and generally realised in a comparatively short time. Thus, they created the freedom to explore many different spatial frameworks and design configurations related to prevailing urban theory.

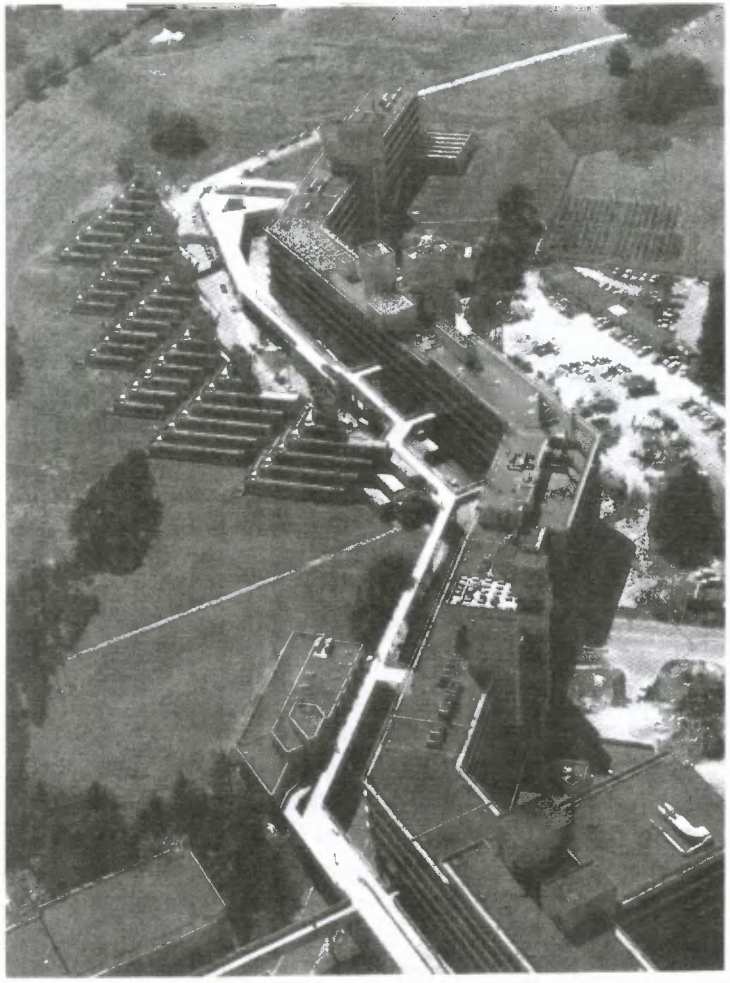
7.2.4 The Postwar Universities

The Postwar Universities were a direct result of the baby boomers who, by the 1960's, were demanding tertiary education. This led to the founding of many new universities in Britain and Europe, particularly Germany, in North America and elsewhere, many of which were planned as part of programmes of regional regeneration. As shown, these universities were products of the sixties, a period of great social and technological change in a global environment [Fig 7.32].

7.32 Konstanz University
Aerial view of megastructural complex
[Humpert, K.]

The universities were in the middle of this changing environment with knowledge, and particularly technological knowledge, being seen as a national resource. It was also a time of student activism and public demonstrations, denouncing unpopular wars, social inequities and demanding more and more say in the world around them.

It was also a challenging period for the academic and physical planners charged with developing an unprecedented number of new universities.



7.33 University of East Anglia
Aggressive forms & off shutter concrete
[Muthesius, 2000]

Most of the new universities reflected the new academic programmes demanding high levels of connectivity between the traditional subject fields, as well as the emphasis on blending the academic and social lives of students. This was particularly important in Britain, with the emphasis on student housing of various types, integrated into the academic life and structure of the universities.

As described previously, this had a profound influence on the spatial planning of postwar universities and led to concerns about planning structures which could accommodate growth and change, compact plans providing connectivity, the separation of cars and pedestrians and the importance of green open space.

Campus design was seldom a priority in this period. Many of the postwar universities were megastructures, built in the architectural language of the time, which included brutal forms of late modernism using various construction systems, generally in concrete [Fig 7.33]. These, unfortunately, showed little awareness of their roots in the great traditions of American and European university building and the timeless heritage of the ancient world, from which so much could have been learned.

7.3 Synthesis

At the beginning of this thesis, it was noted that there has been no holistic study of the relationship between the changing nature of universities and their spatial structure. Consequently, many of the lessons of history have been lost to modern university planning. It then stated that the thesis sought to fill this gap by investigating two central, interrelated, hypotheses, namely that:

- there is a discernable evolution of university building as a series of distinctive spatial types from the 14th to the 20th centuries; and that
- this evolution can be explained by changing contextual, social and technological circumstances.

The research has traced the historical development of universities and shown that there have been four distinct spatial types: the Medieval Oxbridge Model; the European University between the 17C and 19C; the American Campus; and the Postwar Universities. Each of these types has been described through analysis of the attributes of the individual spaces, how they have been assembled into building structure and, how, in turn, these building structures have been planned in three-dimensional spatial frameworks.

It has also shown how these types have evolved out of educational forces which sought to bring together 'all disciplines as one', with differing degrees of emphasis on the discovery, communication and application of knowledge, set within contexts which, at various times, needed to seek safety from hostile surroundings, independence from religious and secular authority, create utopian democratic environments, invent an industrial revolution and open up rich worlds of cultural and scientific discovery.

This synthesis seeks to bring these social and spatial threads together by identifying major differences and similarities relating to influences which have affected spatial structures. These influences are of two kinds: influences resulting from the expression of social and economic relationships in space [national location, institutional power, social relations and the interface between town and gown]; and the changing attitudes towards the different elements of spatial structure [open space systems, movement, major university buildings and growth and change].

7.3.1 Influences Resulting from the Expression of Relationships in Space: National Location

The location of universities has varied from sites in small towns remote from the city, to monumental sites within great cities, to suburban green-field sites, and to large estates on the edges of provincial towns.

Like cities, many universities have been developed at the confluence of major trade routes. The earliest university at Bologna was sited at the crossroads of the important trade routes between Naples in the south, Antwerp and London in the north, Venice in the east and Avignon in the west. Significantly, Bologna was located between major centres of power in Venice and Florence. In order to express their freedom from religious and secular power, the early universities tended to be located away from the large cities. This was expressed clearly at Oxford and Cambridge and throughout Europe as reflected, inter alia, in Uppsala, Cracow, Padua, Pavia, Salamanca and Coimbra universities.

At first these universities were spatially indistinguishable from other buildings in the towns. This was certainly the case at Paris, Heidelberg, Prague and Cracow. Increasingly, however, because of tensions with the town people, university buildings became defensible spaces with controlled access. In the case of the Oxbridge colleges, this was expressed through secure courts and gateways. With growing affluence, the colleges became large, and with their castellated gateways and splendid chapels, increasingly differentiated from the surrounding fabric of the town.

Later, in the 18C and 19C with the rise of nationalism and urbanisation, European universities became expressions of power and status and were located in the great capital cities such as Vienna, Berlin, Oslo, Helsinki, Paris and London. In Vienna, for instance, the 19C university was one of the monumental institutional buildings which formed part of the Ringstrasse re-development, expressing not only the status of the university but also the power of the state. One of the benefits of these inner city locations was that universities developed a symbiotic relationship with their surroundings, using the cultural resources of the great cities including housing for students.

This was in contrast to the American campus where universities were conceived as small towns with autonomous communities. They were commonly located on suburban campuses away from the corrupting forces of the city, promoting the concept of community. These academical villages, which embraced open space and the countryside, were seen as instruments of colonisation and nation building.

In the postwar period, the location of the new universities in Britain and Europe was commonly used for the economic regeneration of regions which were under-developed or declining economically. Additionally, these locations were able to provide sites of sufficient size to accommodate all university academic and social programmes, including housing and recreation, on a consolidated site at costs much lower than comparable sites in developed regions. In England, these sites were often part of an old estate with a stately home on which to anchor new development.

Institutional Power and Social Relations

The binary nature of Oxford and Cambridge differentiated them from their European counterparts. Initially the university was dominant, but very soon the colleges, with their ability to attract funding from church, state, alumni and private benefactors, became the focus of university activity, except for some teaching and graduation ceremonies. The different binary and unitary institutional structures were expressed very clearly in the city plans of Oxford and Cambridge with their proliferation of large colleges and relatively insignificant central facilities. This is contrasted to the southern European universities as can be seen at Pavia, with its dominant university facilities reflecting the concentration of power at the centre.

Today, universities tend to be unitary institutions with strong central governance. This has generally been the case in Europe, although, from the earliest time, independent colleges have existed. Collegio di Spagna in Bologna was built in the 14C to house Spanish students. Others followed for the foreign or *transmontane* students. Paris, to this day, has the Cité Universitaire with many residential units for students from other countries. Nevertheless, in Europe, the central university has always been dominant, both in power and facilities.

Another institutional difference affecting space was in attitudes towards student facilities. British universities have always sought to integrate academic and social life, maintaining that university culture does not only take place in the classroom. The notion of an integrated community of scholars was fundamental to the Oxbridge collegiate building forms.

To a large extent this was continued in the 'redbrick' or civic universities of the 19C and early part of the 20C. It was also very much part of the planning of the postwar universities in Britain. This differed from Europe where student facilities, housing in particular, were not considered a primary university concern. Student accommodation has always been a concern of universities in North America, with Canada following the British model and the United States tending to provide a residential structure which was looser than the collegiate system.

Town and Gown Interface

The nature of the interface between the university and its surrounding community has always been a concern affecting university spatial development. Generally, this has been a hard edge with the university having to protect itself from, often, hostile local communities. The nature of this hostility has varied, but at all times, there has been conflict between the unruly behaviour of spirited young men [and later, women], and a conservative provincial or suburban community.

This was certainly the case in the medieval period, with universities locating in provincial communities which were sometimes involved in local uprisings and even civil war. The consequences of this were the hard edges of the Oxbridge colleges, with total security regulated by gateways, porters and proctors. Similar conditions existed in the European universities although the nature of the social friction gradually changed to suspicion about unfamiliar religious, political and scientific ideas propagated by radical staff and students.

In contrast the American universities espoused the democratic idea of opening the universities up to their community hinterlands and even, symbolically, to settlement of the west. This was most eloquently expressed

in the iconic plan for the University of Virginia, with its library and colonnaded arms embracing the lawn to the west, suggesting the whole range of values to which the expanding American democracy aspired.

The nature of the edge has been a continuous concern of postwar university development. This concern has been of a contradictory nature. On the one hand with increasing democracy, there has been a need for integration and inclusivity. This has led to a soft edge, opening university facilities up to community use in off-peak periods and to adult, continuing education and extension programmes, thus enabling the tax payer to make use of university resources. On the other hand, there has been a need for greater security to combat radical student movements, revolutionary forces in some instances and, more recently, terrorism. This has led to hard edges which have often been played out with access control systems, internal barriers and gated precincts, even within the university estate.

7.3.2 Elements of Spatial Structure

Open Space

The 'Backs' at Cambridge give an indication of ways in which open spaces were used in the early universities. It shows a stratification from an urban environment through the college courts to rural countryside at the back. Kings Parade, Trinity and St. Johns Street was a busy city artery with much commercial and recreational activity, the college courts were havens of peace and security, while across the river Cam, the Backs were a bucolic environment which was used for grazing livestock and cultivating fruit and vegetables. Later, much of this became developed with grass courts for tennis and croquet but there is still evidence of its productive use as grazing pasture. This evolution from productive green space to suburban recreational space was repeated on many of the American campuses.

Open space has been a major factor in structuring the early Oxbridge colleges, the European universities and the American campuses. Responding the contextual social environment, the Oxbridge colleges and European universities were essentially closed space systems creating a secure academic world apart from the hustle and bustle of the city. In the Oxbridge model, these were soft and green in contrast to the hard paved urban

contexts of the European model. Both were internal clusterings of open space, formal in the European case and informal in the English colleges. The American campus, on the other hand, was based on an external structuring system, using space in a very strong and comprehensive manner with great spatial shafts structuring the array of pavilions. It reflected city planning ideas of the renaissance Ideal City in ways which opened it up to the surrounding community and beyond.

Movement

Movement in universities has changed from systems based on the pedestrian, horse and carriage and, in some cases river transport, to rail and the motor car. For the first six hundred years of their emergence as an institutional type, universities were planned for pedestrian movement, for carriages, for deliveries by horse and cart, and in some instances by barge. In the 20C, however, the transport revolution brought mechanised movement onto the campus. Some of these modes were public transport, in the form of buses and rail of various types. Some were in the form of individual bicycles. But most were the private motor car which, as in the city, has had a devastating impact on the environment. In the postwar period, universities have had to accommodate an avalanche of parking which, in spite of various management procedures and the provision of structured parking, has left many, once green, campuses covered with tarmac.

Movement in the postwar period had a major impact on university spatial planning. Changes in educational patterns were expressed in the new 'map of learning' which resulted in compact plans. These emphasised the need for movement between lecture theatres within the 10 minute 'cross-over' period. In addition, university planners separated people and cars in many different ways, some on one level and others with service and parking below pedestrian decks.

However, it was the issues of pedestrian connectivity which was to have the most profound impact on the postwar universities. Efficiency of the various planning structures was measured in terms of their relative connectivity. This led to the development of web structures of various types, exploiting the efficiency of the grid, sometimes on several levels. Many of these were in the

form of megastructures which brought with them new problems of spatial growth and change, as well as issues of how individuals could personalise their spaces in a new and unfamiliar environment.

University Facilities and Buildings

In medieval times the major institutional buildings were the very fine chapels. Also important were the refectories and, later, with the invention of printing, the large libraries. European universities from the 16C to the 18C were similar, although the chapel was not always dominant and, in the case of Pavia, was superseded by the major place of assembly, the aula maxima. Initially the chapel was the dominant element in the early American campus plans but, for the first time with the University of Virginia, the central focus became the library, an expression of Jefferson's aspiration to create an architecturally democratic university, where research played a role it never had in the traditional American college.

University space types started in medieval times with a few simple facilities having virtually no services. The beginnings of complexity emerged in the 18C and 19C with elementary servicing leading, in the 20C, to the large range of facilities with highly complex services required to meet the needs of technology, industry and society in the postwar years.

As at the planning scale, architects have had to plan for a rapidly changing and uncertain future at the micro scale. In this context, some have responded by developing sophisticated, but costly, universal space types capable of accommodating almost any university activity. Others have designed a limited range of space types which are assembled into generic building structures capable of accommodating a range of humanities or science type activities.

Many campus plans have been based on a belief in the importance of distinguishing between foreground and background buildings. Foreground buildings accommodate more public functions such as libraries, assembly halls, student unions and central administrative facilities, which express the major purpose of the institution. Background buildings are more private,

housing general academic and non-academic functions. More recently, however, with the rise of individualism, well known architects have designed relatively insignificant background buildings as landmark buildings paying little or no heed to user requirements and to the contextual composition. This has frequently had devastating effects, since few universities have had the modelling techniques and sophisticated procedures for understanding their impact on the campus environment as a whole.

Whereas previously buildings tended to be individually crafted, in the postwar period building forms were often based on industrial systems and on prefabrication. Architecturally, they were designed in the language of late modernism with its predilection for off-shutter concrete and aggressive building forms. This was in stark contrast to the classical style of the American campus, the impressive renaissance and neoclassical styles of the European universities and the organic harmony of the Oxbridge colleges.

Growth and Change

One of the major variables in the planning process has been the rate of change. Growth and change were fairly static in medieval times. God was in his heaven and all was right with the world. This changed with the social and technological revolutions of the 18C and 19C. It also changed in the postwar universities characterised by population and knowledge explosions. This has been one of the major issues influencing the university spatial environment in recent times.

Planning types have varied between the organic plans of the medieval colleges, to the large monumental 19C megastructures and the comprehensive plans of the American campus and postwar universities. The organic plans, with their ability to grow incrementally, reflected the medieval situation with major uncertainties about growth and funding necessitating a piecemeal approach to development. This took place, however, within a common cultural value system which resulted in harmony of the whole, even though the parts were built at different times and in slightly different styles.

The European renaissance and neoclassical universities were built in periods of relative affluence which enabled large structures to be planned and completed in one operation. This was not the case with the American campus where both growth and funding were uncertain. This again resulted in piecemeal growth but, unlike the Oxbridge colleges, it took place within a low density open space dominated environment. It was in this context that the conscious spatial design of universities within a comprehensive master plan began. The master plan attempted to establish a clear framework within which future development could take place by means of free-standing pavilions, set within a predetermined spatial framework.

Postwar universities were planned in a period when it was possible to project growth with some accuracy. It was also possible, at that time, to rely on state funding for universities which were seen as an important national resource. Development plans which prescribed a sequence of construction with some accuracy, could therefore be drawn up. However, they were beset by another form of uncertainty. In a period of immense technological change, uncertainty existed, not only about academic content, but about the impact of the computer on educational and information technology. This material uncertainty was accompanied by social, sexual and spiritual ferment which had consequences for university governance, academic planning and social behaviour and which had particular influence on the nature of student facilities.

With the accelerating rate of change, the future became a major issue in the planning of universities. Futurologists assembled large data bases which attempted to predict various futures through the construction of simulation models. Some architects drew up development plans which sought to prescribe the future at the macro scale: others tried to established a spatial framework which allowed maximum individual architectural freedom within a set of guidelines controlling edges and building form. At the other end of the scale, there were those who thought, perhaps naively, that a pattern language and spatial syntax could be devised and agreed on by all involved in the development process.

7.4 Conclusion

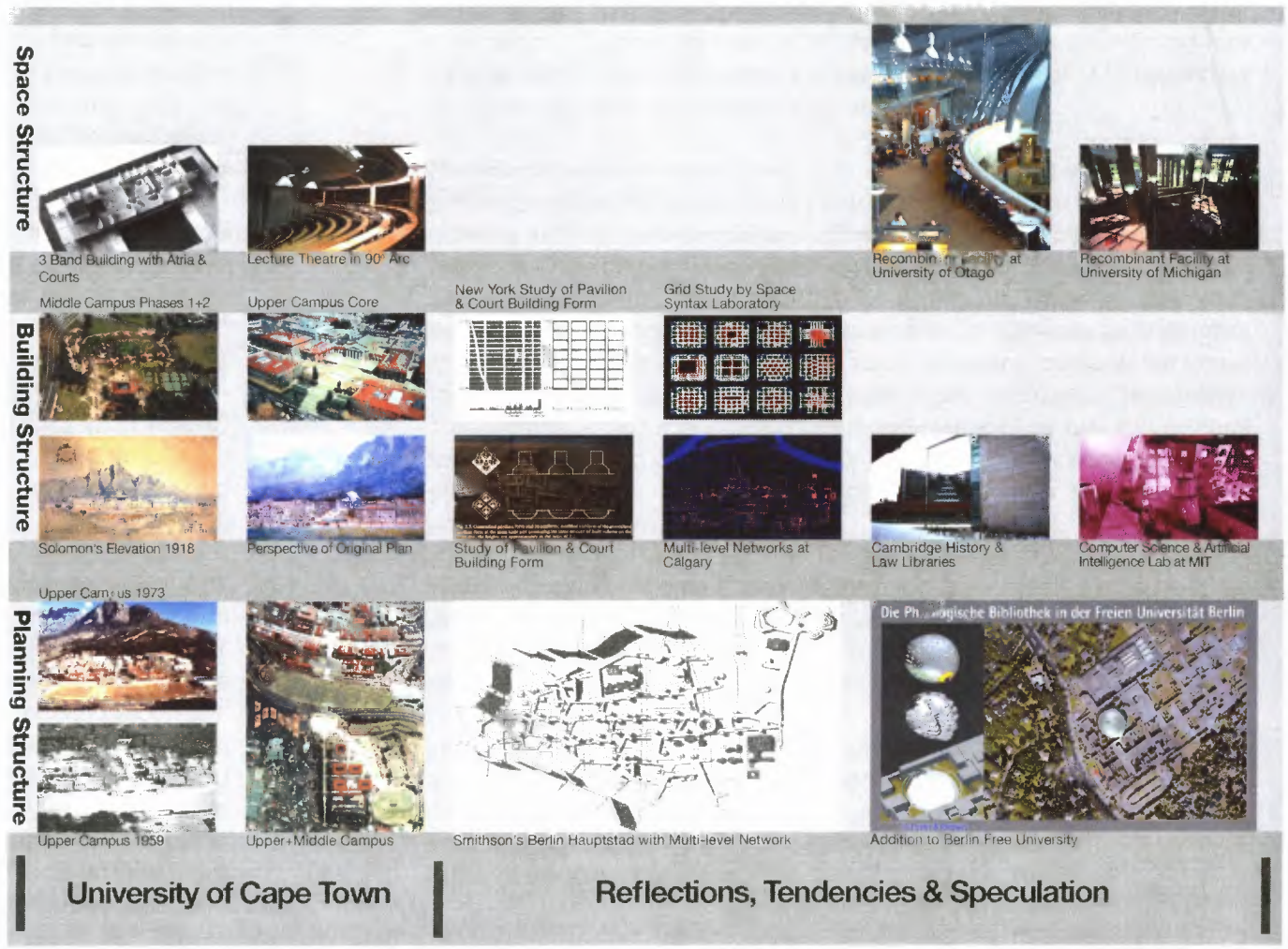
These university space, building and planning structures have not evolved randomly. They have incorporated fragments of their heritage from the ancient world, the world of Islam and the monasteries. They have been influenced by the English cathedral monasteries, the Italian renaissance palaces, the Ideal City paintings, city planning of the 19C, and postwar educational and urban planning. These influences have generally been a two way process with iteration between city and university and university and city, but they have all contributed to the university becoming a distinct spatial variant, particularly at the finer grain of building and space structures.

Finally, it is useful to reflect back on the sweeping statement by Joseph Rykwert who, at the beginning of the postwar period, identified the university as the archetypical building of the modern era, arguing that: "Historical epochs might also be classified by the type of building which is the archetype or paradigm - depending on which way you are looking - to all that gets built in the age. That is what the temple was in ancient Greece, ... the baths alone to imperial Rome, the cathedral to the Middle Ages, the palace to the 17C and so on until you come to the block of flats in the period 1920-1940. And for us now it is the university" [Rykwert, Zodiac 18].

This review suggests that this statement is questionable. It was possibly true that they were the archetypal building forms for the period between 1960's and 1980's, with the sheer volume of exciting new universities and social aspirations for every child to benefit from tertiary education. However, it is doubtful if that is the case today, when the first image of 'university' that comes to mind is, probably, still the classical pedimented portico. Unfortunately, many buildings that reflect the current architectural paradigm are expressions of power, money and image, often designed by very good architects, who create authorially distinctive buildings which are destroying the spatial fabric of our streets while peppering the skyline of our cities and now, alas, our universities.

EPILOGUE

The University in Time and Space



EPILOGUE

The University in Time and Space

Synthesis, Reflections and Tendencies

The Prologue described the purpose of the thesis and it's hypothesis. It established a methodology and conceptual framework within which the work has occurred. Chapters 1 to 7 are the main body of the work. They set out the social background to the universities, describe the formative past, identify four major university spatial types and conclude by demonstrating a discernable evolution of university buildings as distinctive spatial types from the 14th to the 20th centuries, types which are a result of their contextual environments.

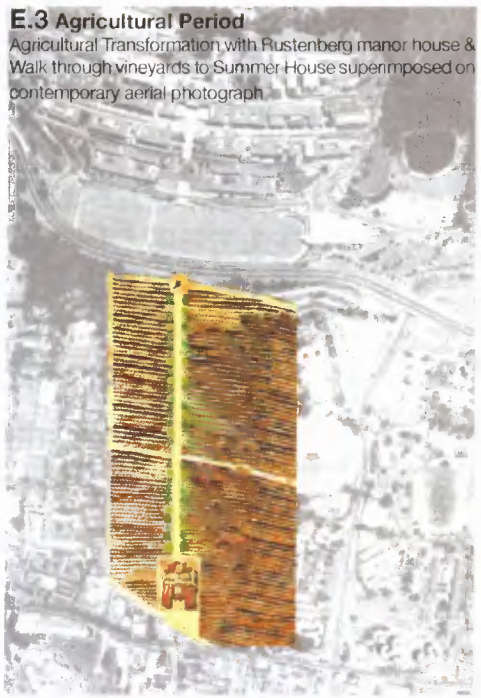
The Epilogue is somewhat peripheral to the main argument of the thesis. It arises out of the recognition that universities occur, not only in time, but as robust social institutions, across time. Any one institution may reflect the influences of a number of periods, since there is considerable 'idea transfer' across time and across space. The theme of 'across time' orders this epilogue. It is in three sections.

The first deals with the University of Cape Town which reflects many of the salient features of the four university types. The second consists of general reflections on some of the major issues prompted by planning in the postwar period, while the third contains reflections forward on current tendencies and speculation on some of their spatial implications.

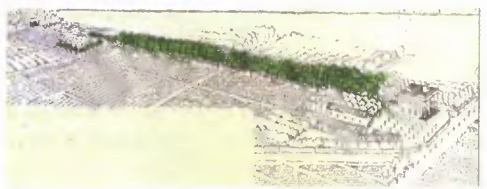
The chapter is, by definition, more personal, reflective and speculative than the main body of work. It is, however, considered to be important in 'rounding off' the work.

E.1 Navigator Image
The Navigator Image presents an overview of the Epilogue
The upper three bands give a preview of the space, building & planning structures: the spatial structures explored in the document

E.2 Location of University
Aerial photograph of Cape Town showing geo-morphology & location of UCT Campuses



E.3 Agricultural Period
Agricultural Transformation with Rustenberg manor house & Walk through vineyards to Summer House superimposed on contemporary aerial photograph



E.4 Agricultural Period
Agricultural Transformation with Rustenberg manor house & Walk through vineyards to Summer House [Biermann,1955]

E.5 Agricultural Period
Photograph of Summer House designed by Thibault in 1760, showing Walk through vineyards & mountain backdrop
[UCT Special Collections]

1 University of Cape Town : Environmental Transformation and Synthesis

Previous chapters have studied in depth several colleges, universities and campuses from the four periods. The University of Cape Town does not fit into this framework. It is, however, an important contribution to the thesis since it synthesises elements of the Oxbridge, European, American and Postwar models. Not only this, but it is located on a site of scenic grandeur and is part of a process of environmental transformation which began in 1657. The University is located on the slopes of Devils Peak, the eastern buttress of Table Mountain. It is on a slope falling from west to east on land which is steeped in South African history. This land has undergone a continual process of agricultural, horticultural and architectural transformation over the past 350 years.

Agricultural Transformation [Figures E.3-5]

The first stage was agricultural transformation. It started in 1657 with a land grant to 'free burghers' of the Cape, to develop an orchard for the Dutch East India Company. The farm, known as Rustenberg, provided fruit and vegetables to the ships of the Dutch East India Company which were plying their trade between Holland and the East. During the next two hundred years, extensive agricultural development took place on either side of an axial walk running from east to west, up the mountain slope. This walk was aligned on the tip of Devils Peak and terminated in a fine Summer House or Belvedere designed by Thibault in 1760. This small but monumental Summer House played a major role in structuring the environmental design of this stage.

Horticultural Transformation [Figure E.6]

It also played a major role in the second stage of transformation, which began in 1893 when Cecil Rhodes, the then Prime Minister of the Cape Colony, acquired it as part of an extensive land deal in which he bought up numerous farms in the area. With increasing suburbanisation, only half of the original walk remained. During the horticultural transformation, this was planted with exotic plant material from many parts of the world. The walk still terminated in the monumental Summer House, but was now planted with a symmetrical arrangement of plumbago, camelia japonnica,

E.6 Horticultural Period
Horticultural Transformation super imposed on contemporary aerial photograph

E.7 Architectural Period
Architectural Transformation super imposed on contemporary aerial photograph

E.8 Early Sketch
Solomon's 1918 proposal with top of Japonnica Walk, Summer House, echelon of steps, Jameson Hall & Devils Peak [UCT Special Collections]

E.9 Perspective of Intentions
Perspective as planned with Jameson Hall & academic terrace above the residences terrace overlooking playing fields
[Painting by GE Pearse]

jacaranda and turkey oaks. Other planting included a range of flowering gums and other plant species from Australia and New Zealand. The Summer House was open to the public and there are many old photographs of elegant gatherings around the Summer House and its newly planted rose garden.

Architectural Transformation [Figures E.7-9]
Following the agricultural and horticultural transformations, the architectural stage began in 1917 with designs for the new campus of the University of Cape Town. The University, which began as a tertiary institution in 1829, is South Africa's oldest university. For almost a hundred years it was sited on the Hiddingh Campus, on the edge of Cape Town's CBD.

The land which Rhodes had assembled formed one large park, the Groote Schuur Estate, part of which was left by Rhodes for the new Campus of the University. Two of the foremost architects of the time, Herbert Baker and Edwin Lutyens, were considered for this commission but both were busy in India with the design of the new capital and its major buildings. Finally, Joseph Solomon, a protegé of Baker's, was appointed, with Lutyens acting in an advisory capacity when visiting Cape Town on his trips to India.

Solomon could have selected any site within the extent of the Groote Schuur Estate, but it was his genius to choose to graft his grand plan for the University onto the previously developed structure of Summer House and Japonnica Walk on the lower slopes of the mountain. As can be seen from the original elevation [Fig E.8], the Summer House became the centre point of a major axis which stretched from the bottom of the Japonnica Walk through the Summer House, the lower terraces and a great echelon of steps which culminated in the focal building, the Jameson Memorial Hall, seen against the backdrop of Devils Peak.

Once again, the Summer House played a major role as can be seen from the original plan and elevation. Solomon was very conscious of the dramatic nature of the site. In an article written in 1919, he compares the new University site to the dramatic mountain side sites of ancient Greece,

E.10 Genoa University
Influence of stepping development at University of Genoa

E.11 Sorbonne
Entrance to Sorbonne in Paris

E.12 Oxford
Influence of Oxbridge colleges [Thomas Photos, Oxford]

E.13 University of Virginia
Major influence Rotunda, Lawn & Colonnades of Virginia

E.14 University of Cape Town
Aerial photograph from 1950's [UCT Special Collections]

E.15 University of Cape Town
Aerial photograph in 1970's after construction of the freeway
[Bob Denton]

those on cliff edges and the many hill top sites such as the Acropolis in Athens [University of Cape Town Redevelopment Survey, 1964]. He also compared the sloping nature of the site to those of the Universities of Genoa, Cornell and [Berkeley] California, noting that "of these none is comparable in majesty and grandeur, to the mountain site of the new University at Groote Schuur". Further, he noted that from the elevated terraces, there would be views of Table Bay to the north, False Bay to the south and the Hottentots Holland mountain range, 40 miles to the east over the Cape Flats [ibid].

"It is the desire of those in charge of this great enterprise.....to treat the grounds and buildings together, forming one harmonious whole. The intention is that architecturally, and within the limitations that circumstances impose, the new University of Cape Town shall represent the highest aspirations as to external dignity and beauty, simplicity and scale, of our national life. In his surroundings, the student will have within a few minutes distance, rich woods and mountain scenery which will rival Shelley's bird haunted walks of Magdelene. He will be conscious of spending those early years in an environment comparable with the best that either modern or ancient universities can offer ....." [ibid].

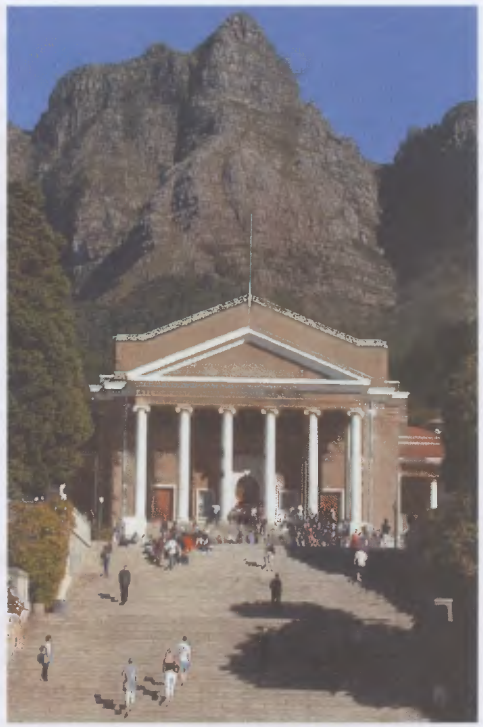
In 1917 Solomon travelled extensively in Europe, Britain and the United States. Here he visited some Italian Renaissance universities and was particularly impressed by how the University of Genoa handled the difficulties of building on a steeply sloping site. In Paris, he visited the Sorbonne and wrote that in many respects it reflected the ideas he had about the new campus [Phillips, 1993] [Fig E.10-11].

In Britain he visited Oxford and experienced the college system of a cloistered community of scholars. He visited several universities in the United States, including Jefferson's University of Virginia, which was probably the most important experience of his travels [Fig E.12-13].

On his return, he produced his first plan, which was approved in December 1917. The scheme was anchored on the Summer House, with the major visual axis running up the slope to the focal assembly hall flanked by the

E.16 UCT Central Plaza
Jameson Hall with colonnaded connection to Students Union overlooking the central plaza

E.17 UCT Foreground Buildings
Jameson Hall with colonnaded connection to Library & Union as foreground buildings



E.18 UCT Jameson Hall
Main Assembly Hall & its steps with mountain backdrop

E.19 & 20 UCT Central Plaza
Jameson Plaza with views towards mountain & sea in the background on right

library and students union. The secondary, operational, axis was structured by an avenue, with a terrace of academic buildings on either side. Below was a residential terrace, with the men's and women's residences on either side of the major axis. These residences overlooked a terrace of playing fields, the lower parts of the Campus and the distant mountains.

The three major terraces were structured by the grand echelon of steps which linked the playing field, residential and academic terraces. What is remarkable about the plan is the counterpoint between the visual and operational axes and how they intersect in what has become a plaza of great intensity, framed, on the west, by Jameson Hall with its colonnaded link to the library and union, on the south and north by fine academic buildings, with a prospect to the east of great beauty. This central place is, indeed, one of the major university experiences [Figs E.14-20].

The plan reflected the influences which Solomon had absorbed from his travels: the terraced and stepped handling of slope from Genoa, the cloistered residences on the Oxbridge model and many examples of the pervasive influence of Virginia from the prototypical campus plan, with the focal Rotunda, down to the serpentine wall surrounding the wardens gardens.

After the untimely death of Solomom in 1920, the realisation of the project became the responsibility of Cyril Walgate, working together with the established firm of Hawke and McKinley. Walgate had worked for Baker in India and was a sensitive and practical man. It was he who was responsible for the curvature of University Avenue, the secondary axis, in order to achieve a better fit between the academic terrace and the lie of the land, a move which added immeasurably to the containment of this linear environment and which also saved costs..

By the end of the 1950's, Solomon's plan had been realised and the Campus could claim to be one of the finest in the world. However, two related events subsequently conspired to tarnish that image. The one was the alignment of one of Cape Town's new freeways on the doorstep of the University,

E.21 UCT Upper & New Middle Campus
Main structure of Upper Campus, Summer House, Japonnica Walk with diagonal connection to Middle Campus

cutting Solomon's scheme in half by separating the Upper Campus from the Summer House and from what, subsequently, became known as its Middle Campus. The second event was the impact of the postwar baby boom on student enrolment which, as elsewhere, resulted in a large building programme in the late sixties and seventies. Much of this building took place on upper terraces, behind the academic terrace, where no development had been contemplated. To exacerbate the situation, this development took place outside the architectural guidelines established to unify building in the historic core of the Campus. The result was a depressed environment and a reduction of the dramatic visual impact of the Campus from a distance. Additionally, Jameson Hall was built during the depression and was a shadow of the dominant domed building envisaged in Solomon's plan. Sadly, with the rash of building on the upper terraces, the central buildings were visually reduced in scale and some of the overall concept has been lost [Fig E.15].

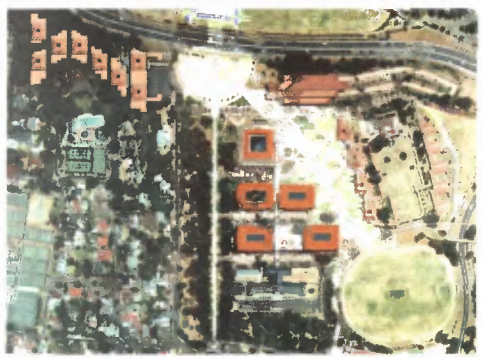
Aware of the erosion of the quality of the original plan, the UCT Planning Unit was established in 1969. A plan was developed which aimed to arrest development on the Upper Campus and open up the Middle Campus below the freeway. The plan reintroduced the idea of a spatial framework centred on the Summer House, with three terraces of academic buildings structured on a diagonal from the Summer House. The plan retained the historic Walk and sought to unify the Upper and Middle Campus. It proposed several ways of overcoming the hostile barrier of the freeway, including the road in 'cut and cover' under the playing fields and a sunken pedestrian concourse below the freeway.

The first phase of the Middle Campus was constructed in the middle 1980's. It was planned after the postwar universities in the 1960's and 70's. As described in Chapter 6 [Page 134], it sought to create a spatial framework which brought together some megastructural benefits from this period within an open, organic planning structure. The spatial development framework resulted in a diagonal spatial connection to the Summer House, reinforced by major pedestrian routes on terraces, covering ground structures, which accommodated lecture theatres and a library continuum linking three terraces of academic buildings [Figs E.21-25].

E.22 Middle Campus Model
Model of Middle Campus terraces showing diagonal connection to Summer House; 1984

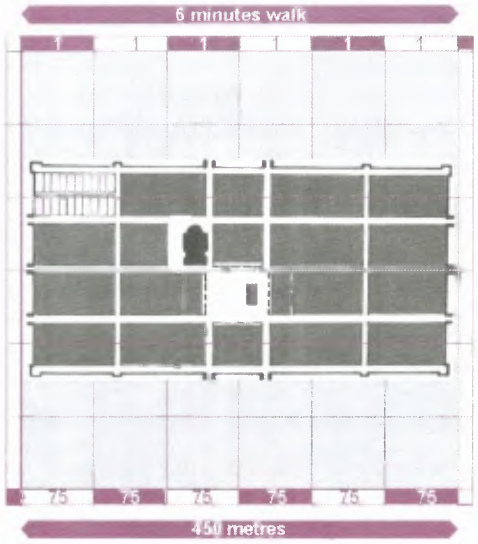
E.23 Middle Campus Model
First Phase of Middle Campus showing diagonal connectin to Summer House; 1988

E.24 Middle Campus Model
First Phase of Middle Campus t showing diagonal connection to Summer House; 1988. Student housing ranged around Woolsack Lawn in background



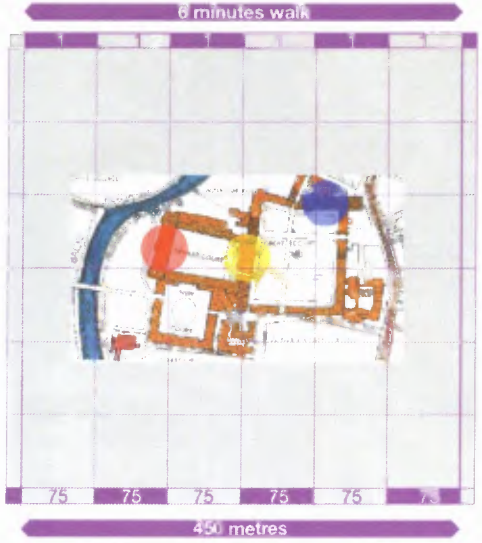
E.25 Middle Campus Plan
Middle Campus Plan with diagonal connection to Summer House & conservation of Japonnica Walk with hiearchy of planting

The University of Cape Town reflects a synthesis of the four planning types identified in this thesis. It shows how these types can be held together within a robust spatial development framework, using a consistent architectural language with a clear differentiation of foreground and background buildings framing the strong design structure. Finally, the development which occurred in the agricultural and horticultural periods, as well as that which occurred in the early architectural period, was a model of environmental transformation in a setting of exceptional beauty and grandeur.

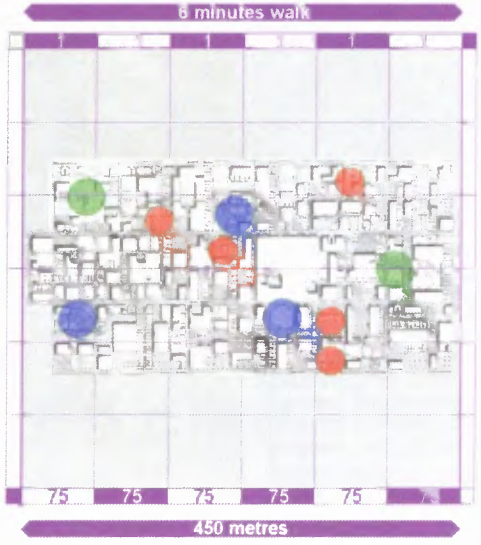


E.26 Montpazier
Plan of the French Bastide Montpazier in 450m. template

E.27 Pavia
Plan of Pavia town & university in 450m. template



E.28 Trinity College
Plan of Trinity College, Cambridge in 450m. template



E.29 Berlin
Plan of Free University of Berlin in 450m. template. Similar grain to Bastide

2 General Reflections on Issues Prompted by the Postwar Period

There was a common perception in the postwar period that campus planning was an extension of architecture. This resulted in a preoccupation with space and building structures without a similar appreciation of the spatial framework within which the organisation and design of the development took place, together with the procedures required for long term implementation.

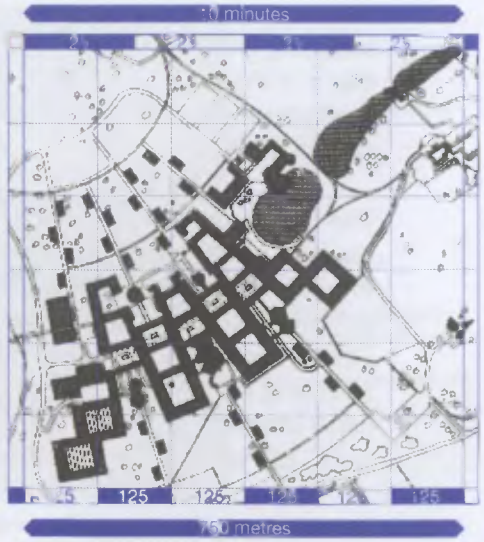
Geometry of the Environmental Framework

Three dimensional design takes place within a spatial frame which is ordered, either consciously or unconsciously by a geometry which may be organic or artificial. If artificial, it may or may not be Euclidean. This spatial frame represents an armature which is both a controlling and generating medium, opening up design options for three dimensional structures.

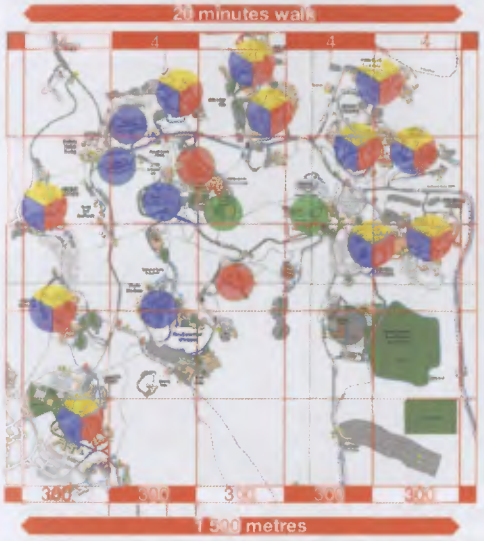
The significance of these structures for growth and connectivity was analysed in Chapters 6 and 7. What has not yet been discussed is the size and scale of this three dimensional grid as applied to universities which, since they are generally designed for the pedestrian, differ from city scales, which have, primarily, been determined by vehicular movement.

It is useful to compare the grain of the plans in the various templates comparing the historical grids for pedestrian movement with the most accomplished of the postwar universities, the Free University of Berlin. The whole of Berlin is contained within the 450m. grid, as is the French Bastide, Montpazier, and most of the Greek city of Priene. However, the spacing of the main circulation in the University of Berlin Arts & Sciences Faculty is about 70m. [about a one minute walk] and about 45m. in the case of Priene and Montpazier. Nevertheless, the size of major open space and foreground buildings, such as places of assembly, is almost identical to that in the plan for the monastery of St Gall. The grain of these plans is different from the Oxbridge colleges shown here in the form of Trinity College, Cambridge in the 300m. template. Great Court is one of the largest courts, with Neviles and New Court being more typical. Nevertheless, it indicates the open grain of these colleges [Figs E.26-29].

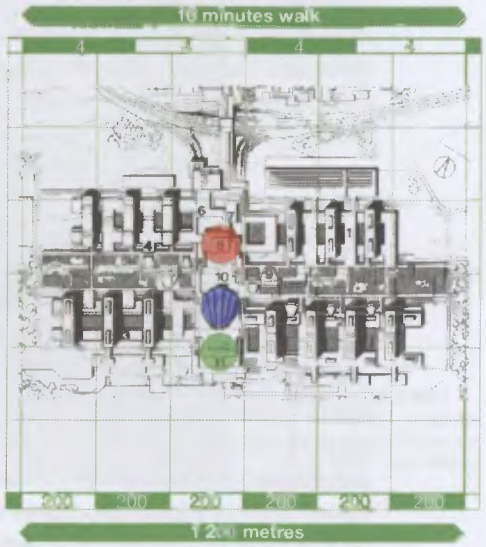
E.30 Konstanz University
Plan of Konstanz University in 450m. template



E.31 Essex University
Plan of Essex University in 750m. template



E.33 Santa Cruz
Plan of Santa Cruz in 1 500m. template



E.32 Bochum
Plan of Bochum University in 1 200m. template

It is interesting to note that the large high rise web for the University of Konstanz is contained within the 450m. template, while the linear plan for the less efficient University of Bochum needs a 1200m. template . Most of the new English universities fit in the 750m. template. Many of the other open space dominated American campuses, such as the relatively small University of Santa Cruz, require a 1500m. template [Fig E.30-33].

As discussed in Chapter 3, one of the remarkable aspects of the Oxbridge colleges is the balance of buildings to open space, with an area of building approximately equal to the area of land. This issue indicates the importance of the third dimension in ordering the spatial framework. As noted in Chapter 3, the court form places the same amount of floor space on the same site area, with the same condition of building depth, but in only one third of the height of its anti-form, the pavilion or tower [Fig E.34] [Martin and March, 1972].

The illustrations in Figure E.35 show Martin and March's studies for New York. The diagram on the left indicates the existing plan of Manhattan, with extruded pavilions on single 'postage stamp' plots. These pavilions are taken to have an average height of 21 storeys. The diagram on the right shows a different configuration with larger plots developed with 7 storey courtyard forms. These contain exactly the same area as the 21 storey pavilions, but with better environmental conditions [Martin and March, 1972].

While the grid is only one aspect of the increasingly complex and multi-layered design process associated with university planning, it is the basic geometric structure or infrastructure which orders the spatial development of the built environment. According to Professor Bill Hillier of the Space Syntax Laboratory in the UK, all settlements evolve towards grids, but not necessarily regular grids. Because grids are structures that link different places, the structure of the grid determines to a large extent which part of the grid will be busy and which will not [Roberts and Thrift, 2002].

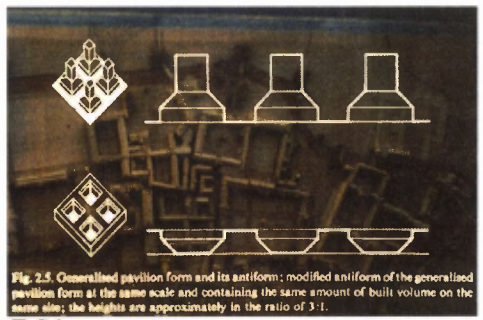
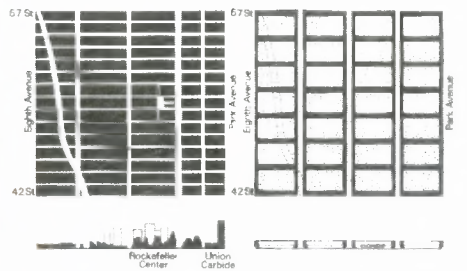


Fig. 2.5. Generalised pavilion form and its antiform; modified antiform of the generalised pavilion form at the same scale and containing the same amount of built volume on the same site; the heights are approximately in the ratio of 3:1.

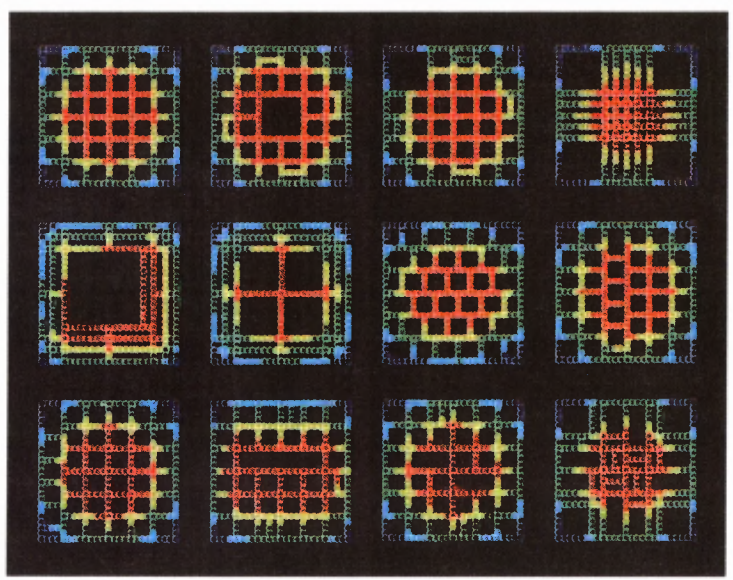
E.34 Pavilion & Court

Research shows that the court is a building form which uses land most efficiently. A study of the characteristics of the pavilion & court forms show that the court places same amount of floor space on same site area with the same building depth but in only one third of the height of the pavilion [Martin, L. & L.March,1972]



E.35 New York Study

On the left is diagram of New York showing the extruded single plot development which are an average of 21 storeys. The diagram on the right indicates an equal area of development a comprehensive development of pavilion forms 7 storeys high [Martin, L. & L.March,1972]



E.36 Street Grids

The twelve grids are made up of the same number of cells. Red indicates lowest trip length to all other cells & blue the highest. The most trip efficient grid is top right with small blocks in centre & larger blocks towards the edges [Roberts and Thrift, 2002]

Hillier explains that 'space syntax' is a theory of space and a method of analysing and designing space. It is based on two ideas. One is the idea that it is the pattern of space that counts, the other is that space isn't a background to what human beings do, it is intrinsic to what they do [Roberts and Thrift, 2002].

The Space Syntax Laboratory has analysed various street patterns by applying mathematical formulae to different parts of cities. These determine the streets that will be busiest, shown in the warmer colours in the diagrams in Figure E.36. The twelve grids are made up of the same number of cells. Red indicates the lowest trip length to all other cells and blue the highest. The most trip efficient grid is top right with small blocks in the centre and larger blocks towards the edges. Universities, of course, operate at a smaller scale, perhaps similar to the small blocks at the centre.

As noted previously, unlike many cities, the major structuring device in universities has been pedestrian movement. This has been an underlying aspect of the grain of the grid. With the widespread use of the car this has changed, particularly in North America. In contrast, the postwar universities in Europe and Britain have been able to avoid this to a large extent by their compact plans and widespread use of public transport. The problem has, thus, been reduced to minimal roads, allowing emphasis to be placed on pedestrian movement and the human realm.

Design

While the grid is only one aspect of a complex and multi-layered process, it establishes the spatial frame within which the manipulation of the visual order takes place. Historically, in city and campus design, open space has been used as the principal structuring device. This can be in the form of spatial axes or shafts which inform so much of North American campus design, or those clusters which create the opportunities for organic incremental growth embodied in the Oxbridge courts and *madrasas* of North Africa and the Middle East. As we have seen, both of these structures are found in postwar universities, as well as the many variations and hybridisations of the grid or web structures and, in some cases, multi-nodal structures.

E.37 Foreground & Background Buildings
Aerial view of University of Cape Town showing clear distinction between special foreground buildings and general background buildings

E.38 Gehry at MIT
The Computer Science & Artificial Intelligence Laboratory by Frank Gehry [Reiss, 2004]

These structures recognise that the primary role of buildings is to define and give scale to public open space which is a form of social infrastructure. These concepts include understanding the nature of background buildings as 'walls' which contain open spaces and provide settings for foreground buildings and the myriad architectonic and symbolic elements which articulate the campus and vest it with dignity and meaning. They include defining elements such as gateways, places of arrival, monuments, sculptures, and focal points. They also include landscape components like walks, street furniture, lights, paved courts and places, plants, lawns and surrounding trees, arboreta and recreational space. Wayfinding and sign systems are increasingly recognised as a fundamental part of the campus environment which, through a process of cognitive mapping, help make spatial complexity more legible [Figure E.37].

The issue of positive space, or the role of open space in campus design, has created a fundamental problem for architects, who see the making of solids as the dominant element, rather than the space which binds them together. It is the issue of positive and negative, seen many years ago in Nolli's well-known plan of Rome, which shows the dominant external space and how it is integrated with interior public space "into a singleness of thought and experience" [Bacon, 1967].

This architectural malaise is seen more and more frequently in universities for, with increasing affluence, institutions have been able to afford the services of major architects who have used the opportunity to design background buildings as signature buildings, generally paying little regard to the contextual fabric within which they are constructed or to needs for useability and adaptability. Thus one has Frank Gehry [Fig E.38] and Stephen Holl designing background buildings at MIT with an architectural virtuosity that overshadow the big central building. Similarly, at Cambridge University both James Stirling and Norman Foster have designed authorially distinctive buildings which, regardless of their individual architectonic quality, disregard context and, in the case of Fosters Law Library, competes with Stirlings adjacent History Library for architectural acclaim [Figs 39-40].

E.39 Law Library, Cambridge
Stirlings History Faculty building in background with Foster"s Law Library in foreground

E.40 History Faculty Building
Stirling's History Faculty Building, Cambridge

E.41 Free University of Berlin
Proposed new Philology Library by Foster & Partners
[www.fu-berlin]

In a surprising move in 1997, the Free University of Berlin appointed Foster to design a new library for the Faculty of Philology in the celebrated postwar scheme by Candilis, Josic and Woods. Without reference to the surviving architect of the original scheme, Manfred Schiedhelm, Foster, who apparently acknowledges this complex as one of the icons of his youth, has elected to demolish six of the courtyards to form a site for the new 10 000m^2 library. The five storey building is to be housed within a free form spherical skin consisting of frames of radial geometry. What this does to the integrity of the original idea of a poly-centric plan in a neutral web remains to be seen [Figure E.41].

This raises the issue of what Edmund Bacon has called the 'Principle of the Second Man'. Bacon believes that "any really great work has within it seminal forces capable of influencing subsequent development around it, and often in ways unconceived by its creator.....it is the second man who determines whether the creation of the first man is carried forward or destroyed" [Edmund N Bacon, 1967].

Whatever the merits of Foster's intervention at Berlin, it certainly does not carry forward the intentions of its creators in planning a university complex which is regarded as one of the major achievements of the postwar university planning movement. This is in contrast to the additions to the University of Cape Town where the design for the new Middle Campus attempts to maintain the integrity of, and to reinforce Solomon's original scheme in a manner probably "unconceived by the creator" [Fig E.42].

Nevertheless, architectural variety on the American campus has become a fully acceptable, even desirable, phenomenon according to Turner. This not only reflected the importance that modern architecture placed on originality, but it also expressed, according to Yales University's President Griswold, the diversity of the post-war university [Turner, 1984]. However, Christopher Alexander decries the state of university planning where the individual parts take control and the whole is lost or, conversely, the whole is made to take control and the integrity of the parts is lost [Alexander, 1975].

E.42 University of Cape Town
University of Cape Town's extension of old Upper Campus, centred on old Summer House, with strong diagonal connection for new Middle Campus

The issue of the appropriate character for university buildings has been considered in two recent publications. Brian Edwards writes in 'University Architecture' that "one of the best measures of a university is whether it looks like a centre of higher education. Such criteria transcend function and address questions of meaning and identity.....for a university to fully fulfil its mission, the fabric of education [both buildings and spaces] needs to reflect academic aspirations. A university committed to testing and applying new skills or knowledge should embrace these in its built estate. New concepts in education lead to environments of innovation" [Edwards, 2000].

In another book, 'University Builders', Martin Pearce argues that "no matter that at graduation ceremonies students and staff may array themselves in the cloak and mortarboard of 13C apparel, the reality of modern education represents a cataclysmic change that has profound repercussions for university architects.....universities need to commission a variety of new buildings and building types [and].....recognise the value and prestige that architecture can provide as an outward symbol of an educational body. Education is an invisible substance; architecture allows it to become material" [Pearce, 2001].

This begs the question of how to find an appropriate character for the 'cataclysmic change' in modern education and 'environments of innovation' which 'address questions of meaning and identity'. Christopher Alexander's master plan for the University of Oregon at Eugene was an attempt to find deeper meanings in the physical patterns and structures of universities. His findings were summarised in six principles: organic order, participation, piecemeal growth, patterns, diagnosis and co-ordination [Alexander, 1975]. They were also eloquently recorded in his description of organic order at Cambridge, as described in Chapter 3 of this thesis. He notes that the perfect balance and harmony of the parts of the colleges between the street and river and then asks "where did this order come from? Of course it was not planned..... And yet, the regularity, the order, is far too profound to have happened purely by chance. Somehow the combination of tacit culture defined agreements, and the traditional approaches to well-known problems, insured that even when people were working separately, they were

E.43 Oxford Skyline
Timeless way of building at Oxford [www.ox.ac.uk]

E.44 Pavia Court
Timeless way of building at Pavia

E.45 Virginia Lawn
Timeless way of building at Virginia

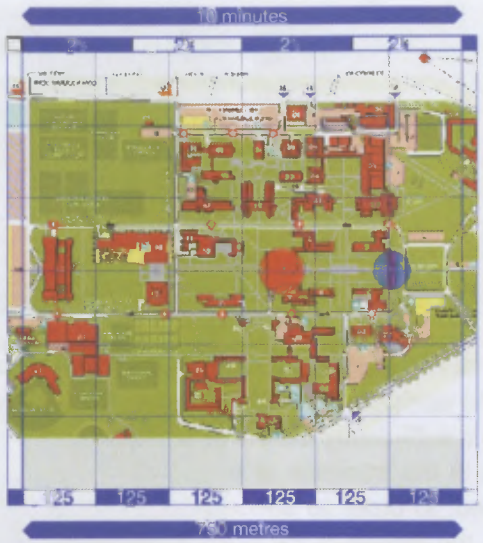
still working together, sharing the same principles. As a result, no matter how unique and individual the pieces were, there was always an underlying order in the whole" [Alexander, 1975].

In his recent book, 'The Nature of Order', Alexander continues this search to identify living parts of an organic 'wholeness'. He notes the absence of reasoned discourse in an architectural world ruled by money, power and images which has led to the latest architectural fashions of, *inter alia*, modernism, post modernism, architecture for the poor, architecture of high technology and critical regionalism [Alexander; 2002].

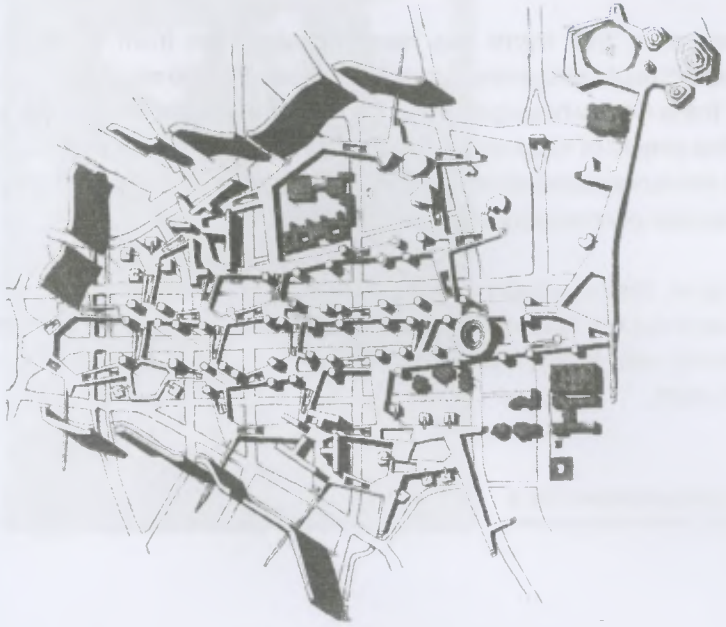
What the experience of university building has shown is that there are a wide range of images and structures within the university tradition from which to start inventing the future, rather than a mindless application of current fashion which only leads to meaningless variety and eventually chaos. This is a very serious matter, since university buildings are not short term procurements but long term investments [Figures E.43-45].

It is useful to talk about the theory of tacit cultural agreements, whereby an organic wholeness is achieved, and to distill them into a pattern language which results in a timeless way of building. But these theories did not find widespread support in the day-to-day space management and planning of universities. What was seldom established in the postwar universities, or indeed in any 'master planning' process, were procedures for maintaining the plan. There seemed to be little understanding that planning is a process, not only a product, and that what happens after completion of the 'plan' is, in many ways, more important than the plan itself. Consequently, instead of the on-going planning processes taking place pro-actively in a long term framework by a specialist planner, it generally took place re-actively in a short term framework by a generalist manager .

In this context, it is useful to consider the case of Rice University, where the resident campus planner had worked in the office of the original architect and was able to guide future development through its formative years.This was achieved by clear guidelines and by persuading the university community to work towards the original intentions, in spite of influential donors and



E.46 Rice University
Plan of Rice University in 750m. template



E.47 Berlin City Plan
Plan proposed by the Smithsons. Multi level city with pedestrian web over street web [Lewis, 1967]

ambitious presidents, to achieve a Campus which, after nearly a hundred years, is a remarkably unified architectural whole [Fig E.46].

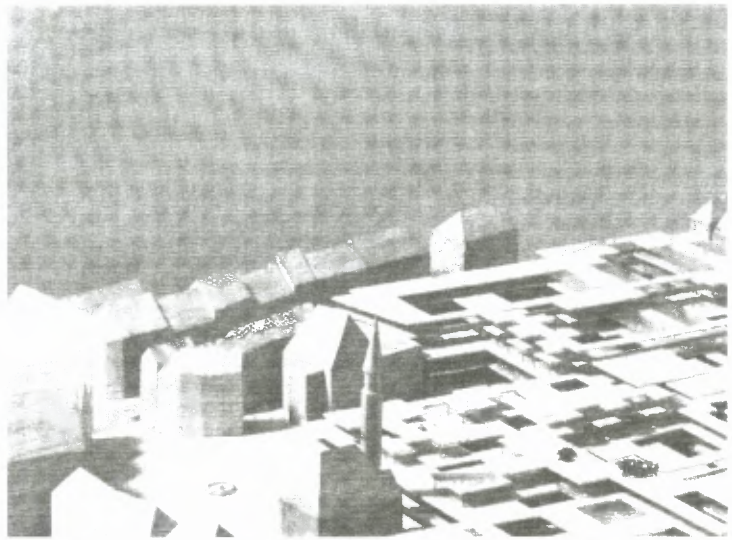
Multilevel Networks

It is strange that, after the widespread press coverage of university building in the sixties and seventies, there has been little critical follow up, revisiting many of the schemes that were not only important to university planners but also, as micro urban units, to city planners.

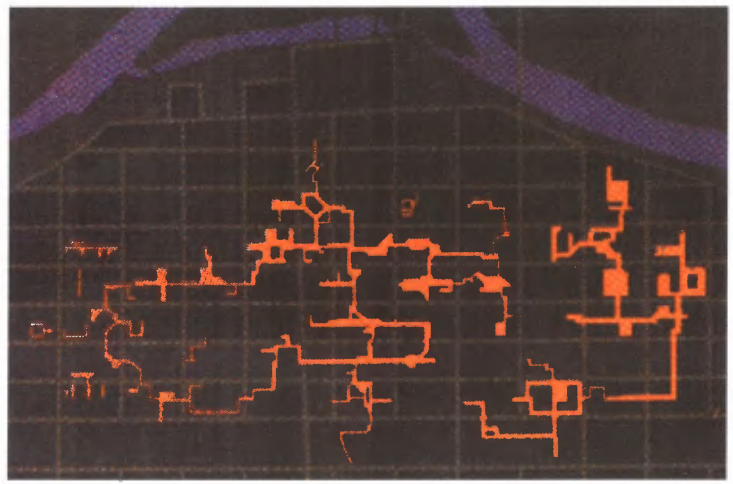
Apparently no serious evaluation has been made of the multilevel networks, the megastructures which, at a theoretical level, answered so many of the issues raised by the new development programmes. For example, how have Konstanz University and the McMaster Health Sciences complex performed and what have been the social consequences of living in these large spatial frameworks? These are important questions for, within the university community, both the need for comprehensive planning and structuring, together with the users desires for spatial self determination has been recognised. There have been many problems with these buildings, both at social and architectural levels. But were there also benefits, and if so, how did they weigh up against the difficulties? Is the 'new map of learning', with the cross disciplinary blending of subjects still a valid generator for university spatial planning?

These questions are also important for urban planners, with many urban and university proposals in the 1960's and 70's emphasising compactness, connectivity and the articulation of movement. Urban examples include Hook new town project, Cumbernauld, the serious theoretical work of Team 10 [Figs E.47-48] and the many projects and writings of the Japanese Metabolists.

Almost all this work has been in disrepute for a number of years yet, with little critical attention, multilevel cities are being developed in a sporadic, piecemeal way, not by urban professionals, but by developers, politicians and bureaucrats. Underground shopping malls are found in most cities: some, as in Montreal, have multi-layered connectors to major city building



E.48 Frankfurt City Centre
Competition proposal by Candilis, Josic & Woods. Multi-level grid of pedestrin circulation precursor to Berlin Free University [Field, G et al, 1999]



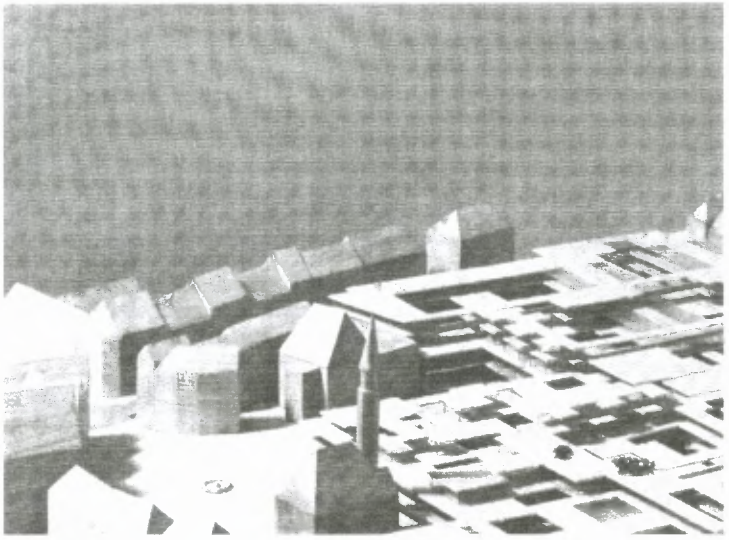
E.49 Calgary's Skyways
Ad hoc growth of Calgary's Plus 15 Skyway system in 2003. System was started in 1972
[James and Yoos, 2004]

and transit systems. The early 'skyways' in Minneapolis and Saint Paul are enclosed above street circulation systems. These streets above streets are proliferating in North America, with developments from Cincinatti, Spokane and Charlotte to Indianapolis, Des Moines, Dallas and Calgary. Like their counterparts in Hong Kong and other Asian cities, all have extensive and growing pedestrian networks crisscrossing the city above the street. What began in the 1960's as a few blocks connected by tunnels or bridges, have now become extensive pedestrian networks, sometimes extending over 10 kilometers [Figure E.49] [James and Yoos, 2004].

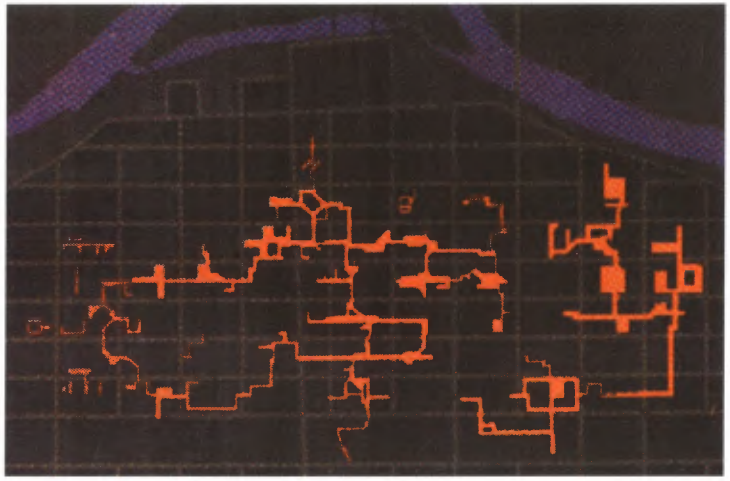
The functional imperative which drives these developments is, essentially, an attempt to compete with the suburban mall. Skyways need to reach a point where a sufficiently extensive network is created above the streets, so that it is in the interests of every major commercial development to be connected, in order to succeed economically. With each new nodal connection, the growth of the system accelerates [ibid].

Recently, however, this trend has received attention from planning professionals, with eight of the nine schemes proposed for the reconstruction of the World Trade Centre having elevated bridges or tangential intersections high above the streets of Manhattan. Describing their projects as multilevel cities, or as interconnected structures with continuous floor plates, they emphasise spatial connectivity and hybridisation.

Surely, therefore, the time has come for a re-evaluation of the 'high rise webs' that were such a feature of the postwar university and which seem to be even more valid today, with some of the tendencies emerging in the university context.



E.48 Frankfurt City Centre
Competition proposal by Candilis, Josic & Woods. Multi-level grid of pedestrin circulation precursor to Berlin Free University [Field, G et al. 1999]



E.49 Calgary's Skyways
Ad hoc growth of Calgary's Plus 15 Skyway system in 2003. System was started in 1972
[James and Yoos, 2004]

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E.50 University of Michigan at Ann Arbour
Exhibition area in Media Union

E.51 University of Michigan at Ann Arbor
Library section in Media Union

E.52 University of Michigan at Ann Arbor
Entrance foyer in Media Union

3 Current Tendencies and Speculation on their Spatial Implications

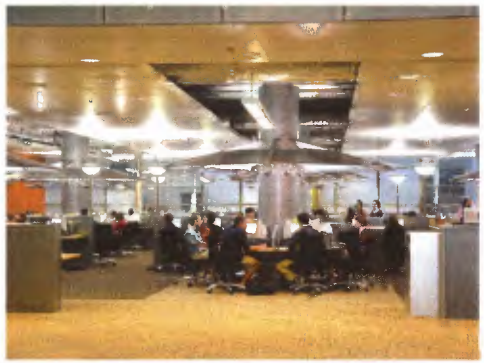
More than most building types, university buildings have to be able to adapt to change, sometimes slow and spasmodic and sometimes rapid. These forces are caused by paradigm shifts in the conceptualisation of university activities, by innovative programmes and new technological processes. These are some of the tendencies that can currently be discerned, together with the challenges that they will bring.

Current Tendencies

The structure of education has undergone a revolution recently, with change from a teaching based culture to a student centred culture: libraries and seminar rooms have been replaced by learning resource centres; staff rooms and common rooms by e-mail addresses, and examinations by computer aided assessment. Student expectations have changed, from passive note takers and receivers of given wisdom to proactive demands on the content and quality of their education [Pearce, 2001].

This dynamic has led to the development of new student information technology centred building types. One such development is the recombinant facility. Recombinant facilities are new university building types which are emerging in North America and are starting to be applied elsewhere. It is a concept which brings together library information, high technology computing facilities and student amenities. This idea was first articulated by Rodney Rose in 1997. He sees a new building type emerging on campuses which is interdisciplinary, offers all hours access and brings together traditional facilities with virtual environments. He compares the evolution of this university building type to other recombinant facilities which have occurred over the last 50 years, such as planned residential communities, shopping malls, theme parks and integrated health centres [Rose, 1997].

This new university planning paradigm is interdisciplinary, has unlimited access with diverse, collaborative funding and is under institutional 'ownership', compared to traditional facilities being single discipline, having limited access, restricted funding and 'owned' by departments.

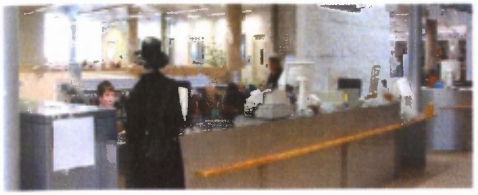


E.53 & 54 Otago University
Information Services Complex [www.library.otago.ac.nz]

E.55 & 56 Otago University
Information Services Complex [www.library.otago.ac.nz]

The Media Union on the Northern Campus of the University of Michigan at Ann Arbour is a recombinant facility which focuses on needs for all hours access to a major library and multimedia resource centre adjacent to a range of student services and food services, as well as to banking and retail facilities [Figs E.50-52]. Other recombinant facilities are the Johnson Centre at the George Mason University, where the library, students union and computing facilities have been brought together. There are similar facilities at the Universities of Iowa, Southern California, Missouri, Indiana and East Michigan as well as Calgary in Canada. The University of Otago in New Zealand planned an Information Services Complex as an 'information market place' of arcades, concourses and public areas. It was to be linked to an existing library and the plan included a media centre and computer cluster in a 24 hour zone, together with student services in the form of cafes, lounges, and shops, including the campus computer store. The whole building was to be wired for the use of portable computers at any station and there were outdoor picnic niches which were also to be wired for the computer. The objective was to create a 'technology rich' student environment, most of which was open 24 hours a day [Figures E.53-58].

These are some of the changes which university space and building structure will have to accommodate. Others are the widespread impact of the digital revolution with an increasing number of technologies being introduced, including the convergence of television and computing with the emphasis on widespread use of the internet and intranet, with high band width connectivity. One impact of this is the 'smart classroom' which, as noted previously, can deliver a variety of instructional materials in different media. "At the very least, a lecture theatre now requires a computer work station integrated with a podium and a computer connected video projector to supplement the old blackboard and slide projectors; the podium is no longer a place for reading from a book or lecturing from written notes but a spot for directing and interpreting a stream of bits" [Mitchell, 1995].



E.57 & 58 Otago University
Information Services Complex [www.library.otago.ac.nz]

The development of these new space types will generate new university building structures. Recombinant facilities, for instance, will have a similar impact on the assembly of space types as the shopping malls had 50 years ago. The digital revolution and impact of information and media technologies will mean further loading on the already crowded duct spaces, but none of these are likely to have the impact that the tiered lecture theatre had in the 18C, or the scientific laboratory in the 20C.

Future Challenges

It is clear that we are moving towards a learning society where knowledge and learning are a fundamental element of post modern consumption. But in what environments will this consumption take place? Desktop-to-desktop video networks open radical possibilities of teaching in virtual, rather than in physical settings. Students may have office conferences with faculty members without leaving their residences. Seminars might be conducted without seminar rooms. Symposia might virtually assemble people from widely scattered locations. Lectures might be performed from distant places, without the need to concentrate students in auditoria [Pearce, 2001].

As the century draws to a close the idea of a virtual campus - parallel or perhaps replacing the physical one - seems increasingly plausible. "If a latter day Jefferson were to layout an ideal educational community for the third millennium, she might site it in cyberspace" [Mitchell, 1995]

In the nine years since Mitchell's publication there is little doubt about the feasibility of the virtual campus, although it will probably be developed piecemeal within universities, the commercial sector and the home. There is doubt, however, about whether the private virtual environment can replace the social university in all its dimensions and with its range and depth of academic activities. It is difficult to see how a virtual campus can replace human interaction in the research environment, discussion and debate in the teaching environment and general interaction in the social environment. These university spatial environments can, at their best, evoke, strengthen and carry forward those rich and timeless academic traditions inherited from medieval, renaissance, new and postwar worlds.

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