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The Climatic Adaptation of the Modern Architecture to the Tropics in the British Commonwealth (Its Early Stages of Scientific and Rational Approaches)

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ABSTRACT

This paper deals with the early stages of the development of scientific and rational approaches to the consideration of climate in the design of modern architecture for tropical conditions in the British Commonwealth during and after World War Ⅱ.

Key Words:Modern Architecture, Climate, Tropics

Preface

Most architectural historians so far in the West have paid little attention to the modern architecture in tropical countries, probably because it has never been regarded as an important area for the development of architectural style which was promoted mainly in the Western world excepting a few cases in India and Brazil. However, it may still have a significance with regard to the process of its adaptation to the extreme climatic conditions rather than just confirming the evidence of direct copying from Europe. In this respect the interest of this paper is in clarifying the early stages of scientific and rational approaches to the consideration of climate carried out by British architects and scientists. And it is intended in this pa-

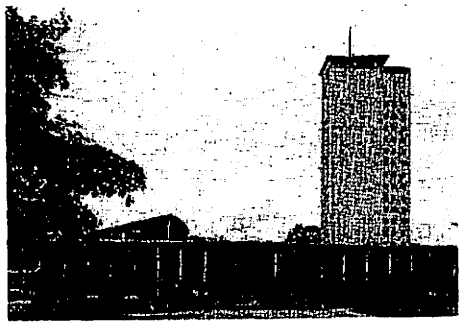

Fig. 1 Administration Block, Univ. of Ibadan, by M. Fry, J. Drew et al. (1953－59), Ibadan, Nigeria (Photo: author)

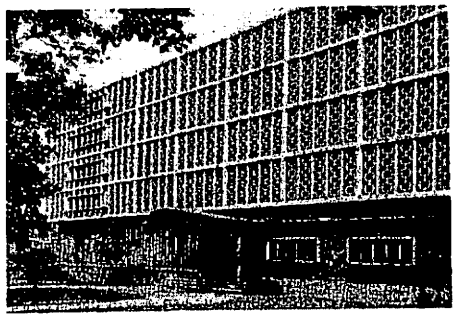

Fig. 2 University College Library by M. Fry. J. Drew et al. (1954), Ibadan, Nigeria (Photo: author)

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per to explain general scenes in London, where has been the centre of their activities in Britain and the British Commonwealth, and also general scenes in Ghana and Nigeria, both of them are ex-British colonies in West Africa, as examples of tropical countries.

1. Early Stages of a Scientific Approach to Climate

Before and during the second world war there were a few organizations concerned with building research in Africa and their interest was mainly in materials for building and civil engineering such as road construction. In fact the great need for a scientific approach to the Tropics began in the field of low cost housing and village planning. Because of the rapid urbanization and civilization in towns in the colonies, a great deal of low-cost housing suitable for the climatic conditions was demanded. [1] [2]

In Britain perhaps one of the most important figures, who studied environmental comfort, was Thomas Bedford. His early work was accumulated in a book, 'Modern Principles of Ventilation and Heating' (1937) concerned with the British climate. [3] However, during the war his interest was extended to requirements in extreme conditions such as those in ships in tropical waters. Later he produced the influential paper, 'Environmental warmth and its measurement' which was the forerunner of research into tropical climate. [4] After the war several interesting attempts were made for ordinary civil life such as the Singapore Index (1959) by C.G.Webb which simplified the grade of comfort calculated with dry and wet bulb thermometers and air speed for the sake of making it comprehensive to measure personal comfort in a low-latitude. [5]

2. Fry and Drew

Most important amongst the architects who pioneered the scientific and rational approaches to the Tropics are Maxwell Fry and Jane Drew who were also the leading architects of the British Modern Movement at that time. During the war they went to West Africa as

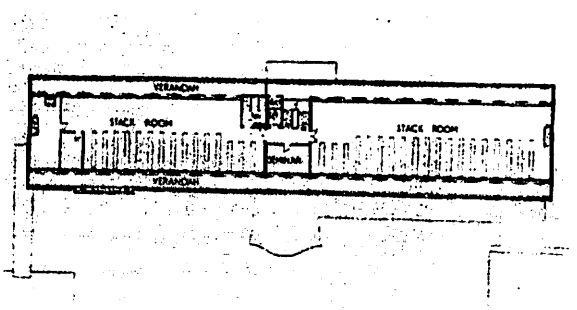

Fig. 3 1st Floor Plan of Univ. College Library (Source: Tropical Arch. by M. Fry & J. Drew)

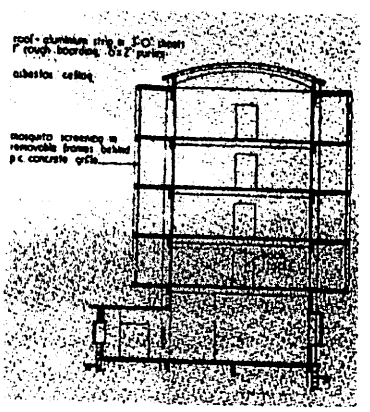

Fig. 4 Section of Univ. College Library (Source: Tropical Arch. by M.Fry & J.Drew)

Town Planning Advisers (1943–45) to the British Resident Minister and from their experience in Africa they published the first practical reference for tropical town planning called 'Village Housing in the Tropics' (1947). At that time there were few professional references for tropical building design and town planning.[6] Their approach was interdisciplinary ranging over agriculture, geography, meteorology and so on. Their most important reference was their experience and intuition, which extended the English empirical approach to tropical modern architecture. Fry says, 'It was full of introductions that had a lot of information and at the end of each chapter there was a page of what to do–do this, do that. It was immensely successful and went into one edition after another and was made in a form that could be slipped into a District Officer's pocket'.[7]

As for housing design for comfort their suggestion was not always based on scientific experiment, but also on careful observation and intuition. Bungalow type houses were basic references for them in terms of comfort, that is: sunshade, protection from heavy rain, ventilation, orientation to the prevailing wind and so on. These fruits became accepted as basic rules for their own and other architects' designs. Also it provided the basis for their two subsequent books; 'Tropical Architecture in the Humid Zone' (1956) and 'Tropical Architecture in the Dry and Humid Zones' (1964) which became standard texts for tropical architects.[8] At that time several important and popular books were published such as 'Tropical Houses' (1961) by David Oakley, 'Grammer of Architectural Design with Special Reference to the Tropics' (1963) by Miles Danby.[9] [10]

3. Conference at the University College London

In March 1953 an epoch–making event took place: a Conference on Tropical Architecture at University College London (U.C.L.). It was of great interest to all in the tropical building field to see the general background of design and planning, scientific research into the climate, problems of architectural style etc., brought together for serious comparative discussion. [11] The main reason why this conference was held was to demonstrate clearly the need for some standing organization which would be concerned with architecture and planning in the Tropics, and the direct result of the event was the establishment of the Department of Tropical Architecture at the Architectural Association (A.A.), the first head of which was Max Fry. Later the department was transfered to U.C.L. as the Development Planning Unit (D.P.U.) in 1971, run by Otto Koenigsberger who was the chief promoter of the conference and also contributed much to the establishment of the department at the A.A..[12]

Although it is noteworthy to see the work and influence of Charles Webb who was a physicist and did research in Singapore on comfort in battle ship boiler rooms etc., scientific research for designers proper, hardly seemed to be developed well. At the conference G.P. Crowdon and T.C.Angus of the London School of Hygiene and Tropical Medicine reported on their original research, 'Indoor Climate and Thermal Comfort in the Tropics'. [13] And even a wind tunnell experiment was still in its infancy, though the first experiment conducted by the Texas Engneering Experiment Station had showed interesting results. [14]

In the early 1950s Otto Koenigsberger had also been undertaking research at the London School of Hygiene and Tropical Medicine into climatic design for the Tropics. His study was deeply influenced and informed by his experience in India as Director of Housing for the Fed-

eral Government of India etc. from 1939 to 1951. It is worthwhile to mention his name as one of pioneers who developed scientific and national approaches to tropical modern architecture and planning and also to mention the influence that he had on some 800 architects from tropical countries and the British who passed through the A.A.Tropical Dept. between 1953–1971. Later his work bore fruit as 'Manual of Tropical Housing and Building'.[15]

4. The Building Research Station and its Tropical Building Section

Of great importance in the field of building research was the United Kingdom Building Research Station (B.R.S.). The B.R.S. was concerned with several studies on the Tropics such as concrete and timber used in marine works, the corrosion of ferrous and nonferrous metal and so on. And the war stimulated research on building problems for two important reasons; demand for the development of local materials as import substitutes and the need for information on the risk and cause of breakdowns because of severe climatic conditions. However, these studies were, in the first instance, of marginal applicability to ordinary civil life.[16]

The B.R.S., which has played an important role in scientific research for British architects and engineers, was founded in 1926. And it was the main research organization in the Commonwealth and sporned two very important off-springs; the Central Building Research Institute (C.B.R.I.) in India and the West African Building Research Institute (W.A.B.R.I) with branches in Nigeria and the Gold Coast. At that time a book called 'Principles of Modern Building' (1938) by R.Fitzmaurice had been one of most useful and popular references for architects up to the 1950s.[17] The auther was on the staff of the station and the research was based on the climate of England. However, it was still useful especially for the use of new building materials. Also the B.R.S. has been influential through its inspiration and organizational structure to colonial co-organizations.

According to A.M.Foyle, 'The problem set by the physical requirements of tropical living and planning solutions had led to a scientific examination from first principles of the problems of tropical buildings and design, backed by official bodies such as the Beaureau Central d'Etudes pour les Equipments d'Outre-Mer in France, the Building Research Station in England and their several facilities in West Africa itself and their findings have acted as a spur to the design ingenuity of a new generation of young architects'.[18] As it evolved at that time in West Africa, science often seemed to predominate with an emphasis on the purely mechanical function of devices for breeze induction and sun exclusion. These devices do, however, present great opportunities for aesthetic expression.

In 1944 the Colonial Office set up an ad hoc study on housing research and the group recommended the establishment of a centre for the collection and dissemination of information on housing and building in British territories overseas. In 1948 George A.Atkinson, who is an architect, was appointed to the station as Colonial Liaison Officer. Atkinson and his small staff maintained close contact with building overseas by visits and correspondence.[19] The work developed to such an extent that in 1952 a special Tropical Building Section was established at the station. Eversince the section has played an important role in the provision of scientific research information and also to consult with individual architects on projects in the Tropics.

A principle way to disseminate information was through their periodical called 'Colonial Building Notes'. From 1950 they issued the periodical, which contains digests of publication, particularly those of the B.R.S., of interest to colonial builders and short items of information relating to housing and building in the British and other tropical territories.[20] There were four main aspects of concern in colonial building; (1) housing and town planning, (2) design for comfort in hot climates, (3) behaviour of materials in the Tropics and (4) building materials and methods suitable for colonial conditions.[21] Some 800 copies of each issue were distributed to public authorities individuals and others concerned with building in the British territories. Besides information from the B.R.S., the notes contained information from other countries concerned with tropical building research. The notes covered important and useful research so well that it could be said to have been a world-wide reference on tropical building and housing research, and also it could be assumed that many pioneers must have refered to these notes extensively.

It is also noteworthy that the staff kept direct contact with architects, who had problems in designing and building for tropical climates. George Atkinson consulted with many architects including almost every pioneer in ex-British colonies. For example at the time of the design for the Library of the University of Ibadan (Fig.s 1-4) by Max Fry, a building which is one of the landmarks of the modern movement in West Africa, Atkinson provided information about natural ventilation and prevention of mould on books. And also his recommendation to use white chippings on bitumenous roofing prevailed widely among flat roof buildings in the Tropics. In the case of the Architects Co-Partnership (A.C.P.) for the design of the Western Region Marketing Board Offices in Ibadan, Architectural Design describes that the firm had worked in collaboration with the Building Research Station and the Colonial Office, and their gradually aquired knowledge of methods, materials and prices was the result of streneous enquiry into the performance of each successive building.[22] And moreover, Yearly seminars were held at the B.R.S. for architects, engineers and government officers concerned with planning and design in the Tropics. The meetings lasted about for two weeks and about twenty to twenty-five people came from all over the world to each seminar. This kind of demonstration also helped the deffusion of scientific and rational approaches to architectural design and planning.

In West Africa, with a visit by two officers from the B.R.S. in 1948, the establishment of the West African Building Research Institute was suggested and the institute was founded in 1952. The headquarters were in Accra in Ghana and a branch was opened in Zaria, Nigeria. By 1960 the headquarters was almost ompleted and the main body of staff had been recruited.[23] Before the establishment of the institute, there were four Public Works Departments (P.W.D.) in West Africa; Lagos, Accra, Freetown and Bathurst, which were concerned with building problems. However, their influence to the work of modern British architects seems to have been not strong considering the amount of works by the P.W.D..

5. Classification of Climate

It was George Atkinson who first explained the classification of tropical climatic conditions for the use of architectural design.[24] [25] The classification is indispensable for rational design strategy. As Patrick Wakely says, '....the classification differs from those used by

agriculture, foresters, mariners and the air transport industry, the requirements of each of which need different emphasis', it was needed to classify especially for the design of buildings for the protection and comfort of people who live in a tropical climate.[26] At that time one of the most useful references for the classification was the work of Koeppen, who was a German geographer. His classification was based upon vegitation and Atkinson adopted his work into the architectural classification because of the similarity; a concern for living things. At first he classified tropical climate into three major categories, that is, a very hot and dry climate, hot and humid climate and cooler upland climate. Then he subdivided into six sub-categories; Equatorial, Island, Monsoon (Intermediate), Desert or Semi-desert, Maritime desert and Mountain or Plateau (Upland).[27] [28] It was quite practical for architects to use this classification, for it clarified characteristic suggestions for each category and determined the outline of design. At that time many buildings were wrongly designed by architects who drew plans in England without proper climatic information and also without visiting the sites. Sometimes that caused serious troubles especially with industrialized materials which were obtainable from Britain. The main reason for the trouble was the lack of comprehension about real climatic conditions. Although there had been meteorological data covering all major areas of the world then, there were few guide books or manuals for design in the Tropics.

The outline of his suggestion for four major categories were as follows. 1. In a hot-dry climate, which covers northern Nigeria such as Kano, thick walls and small windows are preferable for rooms used in the daytime. For rooms used only at night, a thin structure which cools down rapidly is preferable. Because of severe sun light and hot-dry air his emphasis is on the exclusion of direct sunlight into rooms and on the use of proper building materials specially concerned with its conductivity and thermal storage. As a consequence, the shape of buildings tend to be massive.

2. In a hot-humid climate, which covers many major towns along and near coastal areas, he suggested that free air movement, protection against squall and driving rain, sun shade and thin-construction. For this is the convenient way to reduce the effective temperature quickly. Several means were suggested as counterplans such as cross-ventilation which tends to shape one room thick buildings, facing a prevailing wind direction which should be the first consideration, large openings protected by canopies or verandahs so that they can be kept open for ventilation when it is raining, sun shades which were popular in the form of brise soleil coloured white, and thin walls and roof, for thick construction gives little benefit during the day and is of some disadvantage at night.

3. An Intermediate climate can be seen in the interior of large land mass and consists of dry and wet seasons characterized by seasonal monsoon. Dry season resembles a hot-dry climate and wet season is similar to a hot-humid climate. As a consequence design strategy for this climate depends on each predominant season and it is ideal to combine light weight structure with heavy structure into a whole.

4. In an upland climate which can be seen in Uganda and Kenya, particularly in Nairobi where climate does not differ very much from those to be found in the warmer areas of the British isles, his recommendation was that comparatively thick walls, some ceiling insulation, moderate window openings which can be shaded, verandahs and some form of heating, usually an open fire, Because of large daily range of temperature, time-lag of structures is

useful. So it is appropriate to use materials which have large thermal capacities like stone, concrete and so on. Generally this climate is fairly comfortable for white settlers with the exception of the strong sunlight during daytime which can be reduced by means of screened openings.

Conclusion

In the early stages of the modern architecture in ex-British territories, the scientific approach to tropical architecture was carried out mainly by the B.R.S. and its Tropical Building Section, both of which played an important role in providing information ranging over many topics for architects who designed for tropical countries. At that moment architects, who worked in these regions, were pioneers literally struggling with the climatic problems. And they developed their designs with the cooperation of these government bodies whilst drawing on their own experience in the Tropics. At that time proper facilities for educating architects, especially for tropical countries, were established in London.

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