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The Japanese Experience of Environmental Architecture through the Works of Bruno Taut and Antonin Raymond

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Abstract

Around 1930 the Modern Movement in Architecture was widespread throughout Europe and America. The next and predictable step was the search for regions that were on the whole deprived of a firm sense of civil building procedures. To a certain extent, the tropics were such an area. Their authorities, mostly for want of social organization or techniques, welcomed the import of a new industrial system of construction which seemed efficient and unprejudiced, instead of creating their own ways from fear they might be old-fashioned. However, as modern fabrics had stemmed from temperate conditions the progress of these was hindered by unsuspected features of the tropical climate: monsoons, earthquakes and hot spells. In the present research, the authors hope to contribute to a careful examination of the designs conceived in Japan to overcome this major contradiction of modern architecture and to provide some hints for the future in Asia. This was done by using accepted scientific design methods such as computer simulation, duly tested by virtue of on-site measurements. As eminent illustrations we will discuss the works of Bruno Taut and Antonin Raymond that were subsequently extended to India or Turkey among other countries.

Keywords: Tropical architecture; brise-soleil; eco-architecture; air-movement; lighting

1. Introduction

It has often been stated that Asia is a continent of stark contrasts. This is clearly seen when we consider the extreme variety of its climates. Tall massifs perpetually powdered with snow (see Fig.1.) are compatible with a scorching summer heat and usually the driest winter is followed by an extreme degree of humidity in monsoon-marked weather.

As in many other regions of the world, Asian architecture has evolved throughout the years in accordance with these climatic conditions.

However, we can make some important distinctions between regions, for instance in Japan reverence for the environment is the main notion of sacred architecture and thus, unlike other countries, such a feature is more steadily reflected in temples than in civil or even vernacular buildings.

There is a general belief supported by Shintô 神道 traditions that the land belongs to natural spirits (the kami 神) and permission to dwell in a place should always be obtained by the builders. The way to receive this boon is to follow the architectural traditions and to observe ceremonies like the tatemae 建前 (literally: before construction).

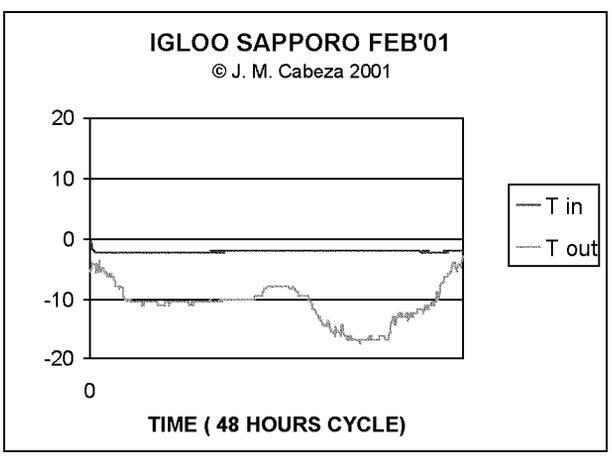

Fig.1. Temperatures inside an igloo constructed by Jose M. Cabeza in northern Japan. Notice how the outside temperature reaches -17.4 ºC

Another example that witnesses the importance of the environment for the Japanese is a chapter from old chronicles –Kojiki 古事記 - mentioning that Amaterasu the Sun-Goddess, during a period of seclusion from worldly affairs, deprived the land of Light. Upon Her return, She bestowed on Her sibling, the first emperor Ninigi-no-Mikoto, a holy mirror, spelling the words: "Regard this mirror exactly as if it were our august spirit, and revere it as if revering us [1]". The mirror is

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treasured today at Ise Shrine as a pledge of the alliance between humans and heaven. (Fig.2.).

In Japan, China, India and other countries the disposition of buildings in relation to the surroundings followed an adroit strategy of natural balance sometimes related to geomancy like Feng-Shui 風水 or Vastu and to the observance of deeply rooted environmental rules. This entailed the use of natural and auspicious materials in wall-claddings, roofs or floors and of course the provision of features to deal with rain, sunlight and the different environmental hazards.

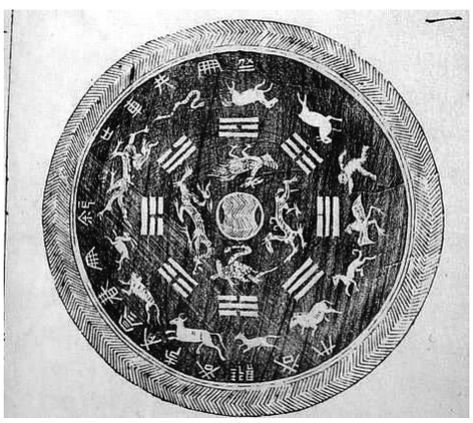

Fig.2. A kind of mirror used in the Tang 唐 Dynasty (China 6th century) depicting the archetypal animals, the eight trigrams of the Yijing 易经 and privileged orientations of Chinese astrology and Feng-Shui. A similar item was offered by rulers of South-China to the mythical Queen Himiko of Japan. (Catalogue of the Bogu Tu, from the Xuanhe era. Chinois 1114, chapter 30, page.14. Bibliothèque Nationale de France. Paris)

Modern European technicians such as Hermann Muthesius, Josiah Conder, Bruno Taut and Antonin Raymond, upon their arrival in Japan pointed to these features as something uniquely Asian and well worth considering for architectural projects.

However at the beginning of the 20th century only the Japanese Empire seemed to be an ideal territory for the establishment of modern architectural practices. Other places like China or India, except for the settlements around trade ports, continued to be closed to foreigners or had been discarded on account of social and political reasons.

As could be expected, at this time Japan itself was again opened to the world after a long self-imposed period of isolation known as *Sakoku* 鎖国 and many of the outstanding environmental features of its building history were prone to change in a modernizing frenzy.

Nevertheless, the well-informed architects that we have mentioned realized the potential that tradition-based design solutions had in the contemporary sphere. A strenuous effort was made by them to revitalize elements such as shoji, 障子 engawa, 縁側 amado 雨戸 or ranma 欄間 . (Fig.3.).

The Shôji for instance is a wooden lattice, covered with panes of paper, relatively impervious and resistant to the wind that works as a kind of sliding door and window, thus enabling ventilation (Figs.4. and 5.).

The shôji is not transparent; our measurements indicate that its transmittance ranges from 0.5 to 0.6 depending on time and weather condition.

Therefore, it helps to avoid unwanted glances but at the same time the light is properly diffused. As it is not glazed, the greenhouse effect associated with solar radiation is kept low.

Fig.3. Antonin Raymond's studio in Karuizawa (Japan) an extraordinary vernacular adaptation of Le Corbusier's project for the Chilean Errazuriz House. An Autobiography, page 131

Fig.4. View of a typical Shoji (Photo: Jose M. Cabeza)

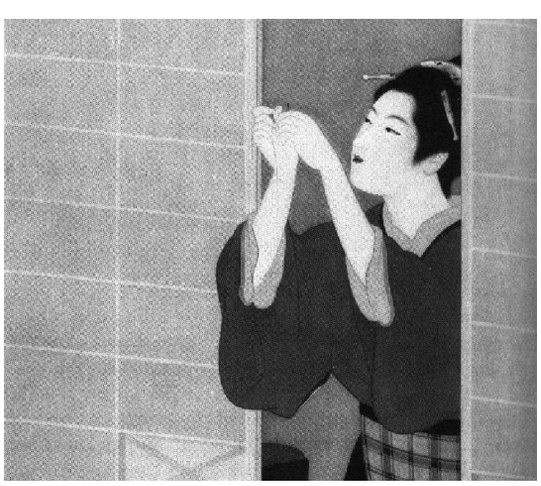

Fig.5. *Evening* by Uemura Shoei (Fragment 1941). At dusk a woman opens the shoji in order to have enough light for sewing. Penelope Mason. History of Japanese Art. page 374

2. The Japanese sojourn of Bruno Taut

One such revival of traditional architecture was undertaken by Bruno Taut, a political refugee in Japan from 1933 to 1936, who immediately admitted that "the modern Japanese have in their houses a quite right point; the traditional Japanese house can no longer be inhabited by the current people of Japan…people who sit in chairs and tables will no more stay crouched under the kotatsu wearing several layers of kimonos or remain trembling in the house while the cold winter winds whistle through the rattling shôji." [2]

Fig.6. Window conceived as a folding screen designed by Bruno Taut at Hyuga House. Atami (Japan).
(Photo: Jose M. Cabeza)

Taut claimed that during the rainy season in Japan considered by many as "the most dangerous season" the air was "saturated with water, in no way cool, but hard and sultry". He even added: "as far as I know, there is not in Japan any newly built school, university or office building, public or private, that shows the minor trace that the Japanese climate has been considered for them. All office buildings have the windows closed during the hardest rain of the monsoon, and through the public buildings no wind runs, lecture theatres of the universities, which have no openings, lie with their wider side to the west, where the afternoon sun impinges in a tough and lasting hotness on the professor and students already damp with sweat and so on." [2]

Consequently Taut devoted himself to the task of finding a modern idiom for the climatic elements of the Japanese house, especially in the aspects of ventilation, sun and light control (Fig.6.).

In his 1936 book *Houses and People of Japan* Taut proposed the following: "After all it can't be terribly difficult to find an arrangement for simultaneously shading roofs and providing light for the rooms inside. You need only lay out a low row of windows above the fore-roof. Light can be easily regulated by means of blinds. In this way too, you could have ventilation during the day and fresh air at night. There would be no need to shut yourselves up in a box for fear of burglars then!" [3]

This process of thinking culminated with his protracted sketch for the façades of the Okura Villa in Tokyo where he incorporated noki and engawa with a kind of light-shelf intended to ensure ventilation in the rainy periods. (Fig.7.).

Taut had started as an industrial design teacher in Japan and his models of lamps and furniture were sold at the Miratiss shop in Tokyo. He was convinced that lighting on the table at a Japanese traditional house, designed to live and work on the same tatami floor, was inadequate. Thus, his section with increased height and clerestories would contribute to remedy this major drawback boosting the production of European-style chairs and furniture, a curiosity at the time in Japan.

We have simulated with our computer software [4] this section in winter and in summer to assess its performance (Figs.8., 9. and 10.) and have found it likely that the levels of illuminance would be augmented as compared with the traditional façade when the sun is present.

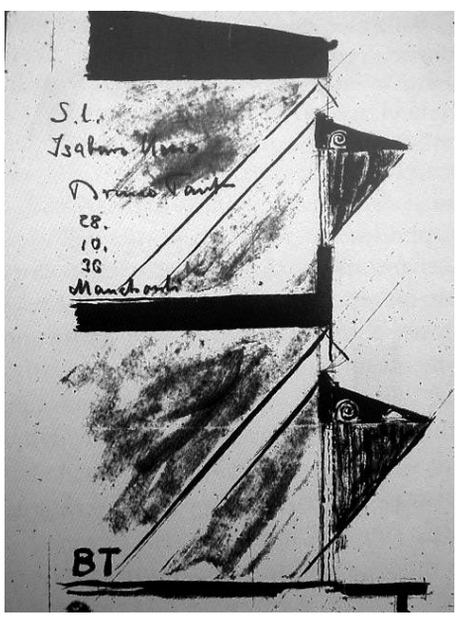

Fig.7. Sketch for a section of the Okura Villa in Tokyo. Notice the patterns of sun-rays and shadow drawn by Bruno Taut and the case for venetian blinds. (Image from the article: New Japan what its Architecture should be. Published in: Japan in Pictures Vol IV., Nº 11; November 1936)

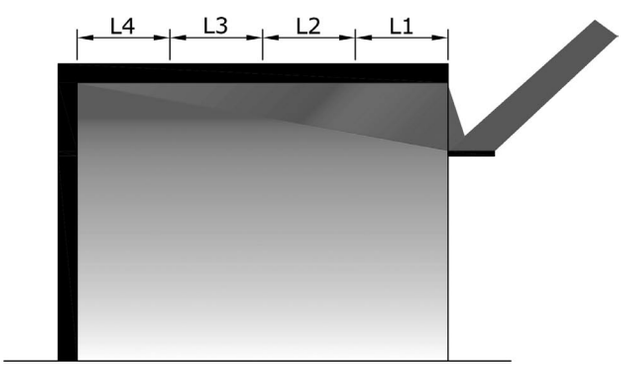

Fig.8. Typical section used as model for the simulation of Taut's sketch for the Okura House in Tokyo

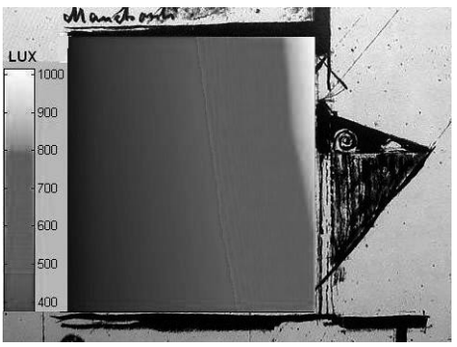

Fig.9. Summer sectional distribution of daylight at the Okura Villa. Values in lux

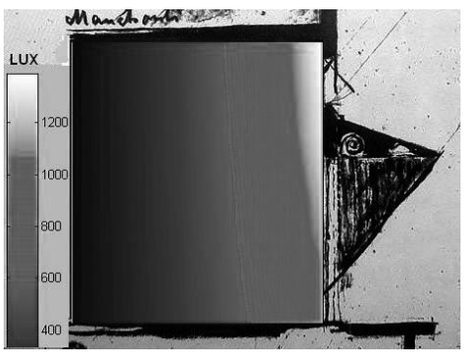

Fig.10. Winter sectional distribution of daylight at the Okura Villa. Values in lux

Fig.11. One of the last works of Bruno Taut a High School in Izmir (Turkey), with overhangs and clerestory windows in the South façade. Photo: Kurt Junghanns. Bruno Taut 1880-1938. Berlin 1971. Fig. 318

Fig.12. A representative work by Raymond, the house for F. Inoue at Takasaki (Gunma Prefecture) with shoji and exposed timber frame. The Japan Architect 33, spring 1999, page 63

However, under a cloudy sky the level of light is very low and the effect sought by Taut may not have been realized. Even so, he maintained this section in some posthumous projects of 1938 for school buildings in Turkey (Ankara, Trabzon and Izmir, see Fig.11.).

3. The Architectural Oeuvre of Antonin Raymond

Another important architect who took great pains to preserve a Japanese light in his projects was the Czech-American Antonin Raymond. Together with his wife, the artist Noemi Pernessin, they established a practice in Japan in 1920 that lasted until 1970.

As in the case of Bruno Taut, whom they apparently never met the Raymonds were always concerned with the use of natural materials adapted to the Japanese climate. In fact, this was the main source of problems in their association with Frank Lloyd Wright for the Imperial Hotel at Tokyo [5]. Antonin Raymond extracted many lessons for his projects from the traditional solutions that he knew so well as a result of his frequent trips and explorations in the Japanese countryside and also in China before the Pacific War. He was particularly concerned with ventilation and sunlight.

In his 1938 book, Raymond adduced that:

"The first principle which all great architecture teaches us is to regard local conditions as the one known basic factor from which to start, and to allow the structure to take the most logical shape dictated by local conditions. Flowers and animals do thus in different climates." [5]

But his genius was not restricted to Japan. In 1937, forced by the rise of militarism, he left Tokyo temporarily though he managed to build an extraordinary compound in Pondicherry (India), the Ashram for the guru Sri Aurobindo. Here in two tall blocks of dormitories for the disciples (Fig.16.), the first modern brise-soleil appears in all its magnitude. The drawing of Raymond explains succinctly that this façade is a "window arrangement for tropical countries."[6] (Fig.14.).

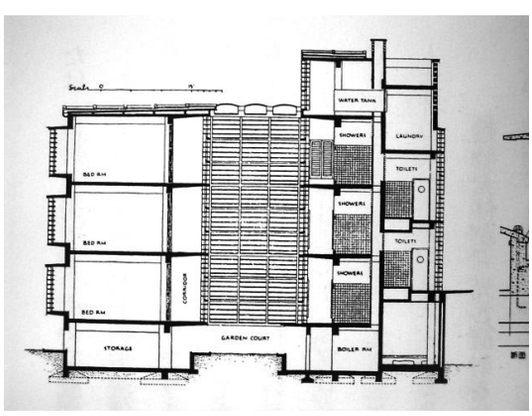

Fig.13. South-north Section of the Ashram for Sri Aurobindo. Pondicherry (India). Hiroshi Misawa. The Architecture of Antonin Raymond. page 85

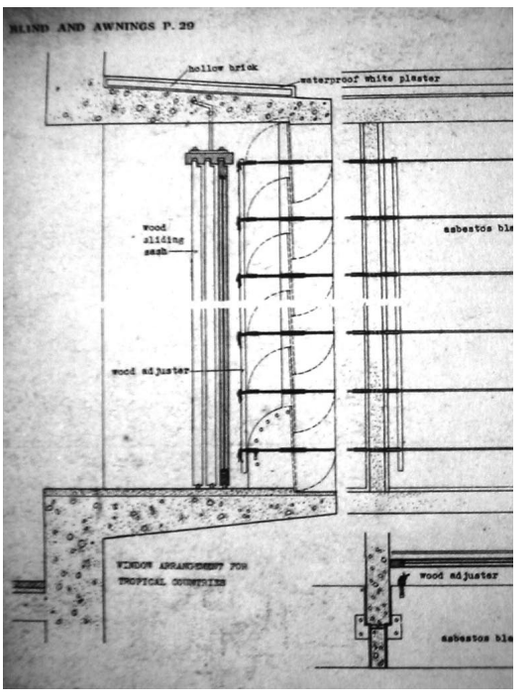

Fig.14. Detail of the wooden system for rotating the louvres of the façade. Antonin Raymond. Architectural Details, page. 29

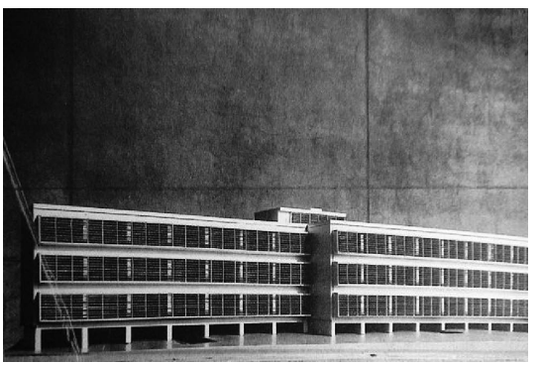

Fig.15. The model produced in Japan for the Ashram Building. The Works of Kunio Maekawa. page 69

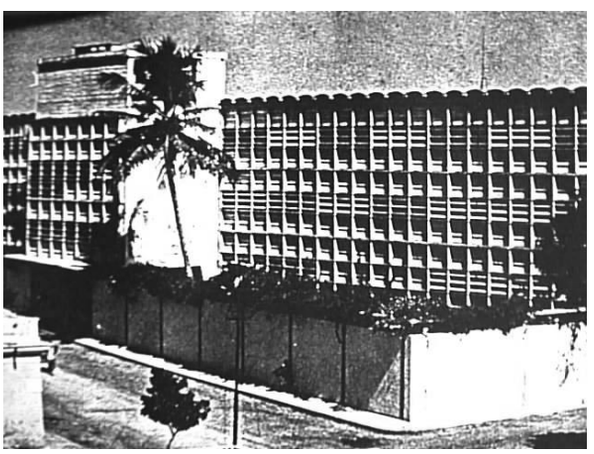

Fig.16. View from the north of the dormitories in the Ashram of Sri Aurobindo. Pondicherry, India. Notice the façade covered by blinds made of mineral fibre. An autobiography. page 165

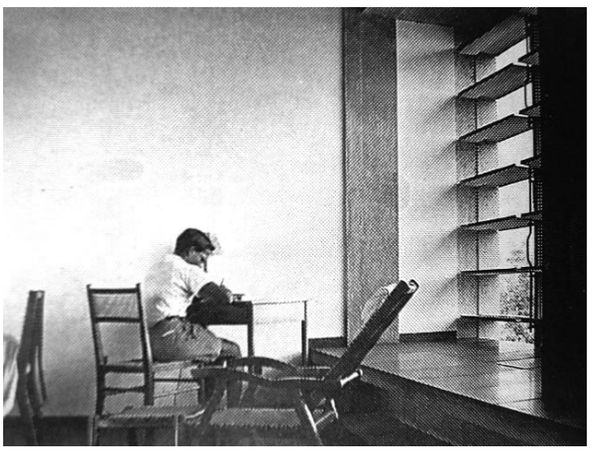

Fig.17. The brise soleil from the interior of the rooms facing south. Hiroshi Misawa.
The Architecture of Antonin Raymond. page 84

Influenced by his intense experiences in Japan, China and later at Angkor Thom in Cambodia (see Fig.25.), [7] Raymond became aware of the importance of shadow and reflected light in Asia and thus adapted the properties of horizontal "mirrors" and stone railings to buildings several storeys high. The performance of such a system was satisfactory when compared with a conventional window (See Fig.18.).

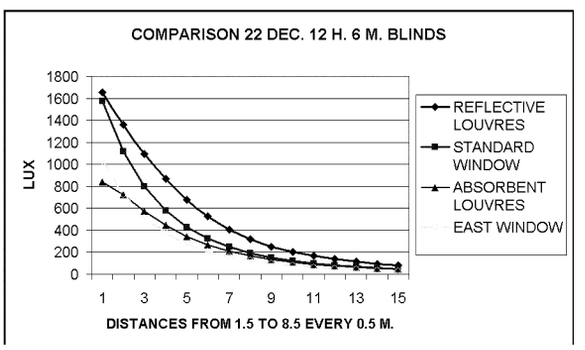

Fig.18. Simulation of the effect of blinds of different colours in Raymond's project (See Fig.17.), compared with a room without blinds oriented to the South and to the East.

The project was first designed in Japan (Fig.15.) with the distinguished concurrence of the architect Kunio Maekawa, a former disciple of Le Corbusier. Nonetheless, Antonin Raymond, assisted by François Sammer and George Nakashima departed from the original plans and decided to cover the building with vaults of precast concrete to provide for a vented roof. The façade was exclusively composed of large horizontal louvers that enhanced cross ventilation and through their changes in texture soothed the modern fabric displayed in the two volumes of the complex. (Fig.13.).

Stone from the local quarries and a touch of wood added a sense of warmth and intimacy that went far beyond the rigid codes of industrial materials and raw concrete that prevailed in the latter modern buildings at

Chandigarh and Ahmedabad (especially in those by Le Corbusier) (Fig.17.).

The American Architect Benjamin Polk working extensively in India from 1952 to 1964 recognised that "the brise-soleil sun-protection system comes as an extension of the column and lintel from the nature of the structural concrete frame. It replaces the dust-collecting masonry open-work screens that have become an almost ever present "petticoat" laid over tropical buildings in the name of modern architecture."[8]

4. A Japanese Origin for Light Reflectors

Both Taut and Raymond had admired the simplicity and cleanliness of Zen-style gardens.

These gardens known as Karesansui 枯山水 are void spaces treated like a shallow pond filled with rocks and gravel that are generally set in front of the main hall of a temple. Their principle aim is to assist in Zen meditation by helping to concentrate the mind. We will not discuss here their many aesthetic or spiritual properties but we have observed that this type of garden is invariably oriented to the South and the colour of the sand employed to decorate it is always white or clear.

We have applied our simulation method to this special compound of reflective surfaces and chose the famous precinct of Ryoanji in Kyôto, made of raked sand with a disposition of 15 rocks. (Fig.19.).

At the temple, the enclosing southern eaves receive reflected radiation from white quartz sand. This material is very porous and, consequently, it will not heat up as much as other materials. In summer values of around 8,000 lux have been measured on the underside of the wooden roof. (Fig.20.).

We have conducted our simulation for a typical summer day considering intensities of up to 100,000 lux on the horizontal plane [4]. The results (See Fig.21.) closely agree with the measurements taken on the site.

This simulation proves that the design of the Karesansui greatly improves day-lighting inside the temple; the colour and orientation of the surface are not casual as the gardens in all other orientations are covered with moss of low albedo. On the other hand, the inclination of the roof reinforces the effect of conveying light to the main altar which is also composed of reflective materials like mirrors and gold leaf.

Fig.19. View to the south of the Garden of Ryôanji in Kyôto. Notice the rocks apparently immersed in white gravel and the surrounding walls and trees. (Photo: Jose M. Cabeza)

Fig.20. The southern eaves of the temple at Ryôanji with light-coloured wooden rafters. (Photo: Jose M. Cabeza)

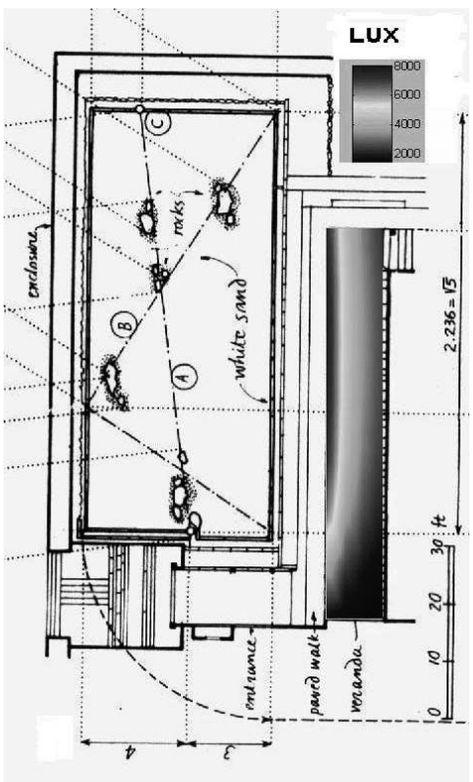

Fig.21. Radiation field under the roof of the temple of Ryôanji showing an average value of 5,000 lux.

The gardens of this type may constitute the first light-shelves in history. They come out of a spiritual need for "enlightenment" (satori) but they also enhance physical illumination and may be the only resort in a near-tropical climate where another kind of disposition to reinforce light such as a skylight would be impractical because of heavy rain and high solar altitudes. What is more, this reflection system helps to reduce the limitations of the shoji previously described.

The Karesansui works equally well in summer and winter and it is indeed a "sacred place" because maintenance is difficult and expensive in the middle of the luxuriant vegetation of Japanese woodland.

Another name for Karesansui is Saniwa 砂庭 (sand garden) an old denomination of fortune-tellers in the Heian Era. Thus, the name suggests that important private ceremonies could have been celebrated there in olden times.

The timid attempts designed by Japanese architects to find an alternative system of lighting represented for instance at the Memorial of the Meiji Gaien (The imperial Picture Gallery, Figs.22. and 23.) by Riki Sano 佐野利器 soon proved impractical for the aforementioned reasons.

It is therefore understandable that the modern European architects could reject such environmental connection systems and replace them with Japanese sources like the Saniwa or Karesansui.

Fig.22. Main façade of the Meiji Gaien Memorial in Tokyo. Arch. R. Sano. (Photo: Jose M. Cabeza)

Fig.23. The vaulted skylight of the Picture Gallery in Meiji Gaien by R. Sano. Notice the dim effect of light in April. (Photo: Jose M. Cabeza)

In several parts of the world independent experiences of the same matters were conducted by the end of the 1930's. Southeast Asia was one such place. As we have seen, in the remote French colony of Pondicherry (Tamil Nadu) a building known as the Sri Aurobindo Ashram marked a highpoint.

Although this simple, unassuming project served as a mighty counterpoint to modern debate, it passed almost unnoticed among the plethora of realizations witnessed by the country. Therefore the Sri Aurobindo Ashram designed by Raymond in 1936 was the sole exception of a seminal work outside the area of Chandigarh, Delhi, Ahmedabad or Bombay. As such, for Southern India it came to be regarded as a unique and outstanding modern response to tropical architecture.

The building bears important similarities to the project for the Ministry of Education in Rio by Lucio Costa, inspired by Le Corbusier, and to this matter we have dedicated another article. [9]

Fig.24. The Ministry of Education and Health in Rio de Janeiro. Arch. Lucio Costa. (Photo: Nelson Kon)

Though it is likely that Le Corbusier's ideas could have been influential in the conception of the projects for both Pondicherry and Rio de Janeiro, it is clear that based on the Asian experience Raymond's brise-soleil has performed better in time and does not show the inconveniences that affected the appreciation and maintenance of the louvre system of Rio de Janeiro. (Fig.24.) We could summarize these differences by stating that Raymond's building was not merely rationalist but rooted in the deep architectural traditions of Asia while at the same time always echoing climatic conditions.

The projects presented by Taut and Raymond alleviated the concern that the Modern Movement's preoccupation with solving environmental affairs had disappeared. As a matter of fact, in many places, modern architects had yielded to a compromise that heralded standardized architecture.

The same Kunio Maekawa, a former loyal member of Corbusier's and Raymond's Studios, even had to declare that:

"Although Le Corbusier manifested that modern architecture is rationalist architecture, after all my experiences I feel I have seen the limit of such architecture and realized that there is no use in its pursuit." [10]

5. Conclusions

Japanese traditional architecture is unique and truly environmental, thus, the modern architects whose careers developed in such a milieu performed with natural sensibility towards the local climate and atmosphere in a move that openly defied the postulates of the so-called International Style.

This inclination manifests itself in many forgotten works of architects obscured by the Pacific and European Wars, which clearly predate regionalist movements in architecture.

In this sense, both Taut and Raymond among others can be considered as true pioneers of environmental architecture.

Following their theories and examples we have striven to demonstrate with the help of contemporary simulation tools the efficacy of the solutions that were so inspirational in their work and that still continue to exert a positive influence on designers from all over the world who approach the questions of the environment with naïve and contemplative eyes.

To show once again the importance of Nature as a timeless source of expression in the Oriental mind we would finally like to draw the example of a rare Chinese-Japanese character which depicts the Sun, the Moon and a Mirror-like object; generally translated as "Alliance" (盟 Chinese *Meng* Japanese *Mei*), thus suggesting a lasting truce with Nature.

Coda

Following his countryman the novelist Tanizaki, the Japanese philosopher Watsuji forewarned in 1929: "Neither climate can be separated from history nor history can be separated from climate."[11, 12]

Fig.25. Stone balusters at a window (Angkor Wat).
(Photo: Jose M. Cabeza)

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