

CLIMATIC INFLUENCES IN PRIMITIVE ARCHITECTURE.

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Climatic changes, variations of temperature and rainfall, differences of geologic structure and of animal and vegetable products, the nature of the soil, and the topography of a country—in short, all the factors that constitute environment—are the most important and universal elements in determining the form and construction of the dwelling. Sociological influences, such as mode of life, government, mental status, and the like, are of importance chiefly in the earlier stages of society, and their effects upon architecture gradually lessen with the progress of civilization.

Climatic influences can be traced in our own buildings as well as in those of the most primitive races, in the structures of the nineteenth century as in those of prehistoric times. The builders of the great churches of Europe pitched the roofs at a high angle to permit the easy discharge of snow; in the milder climate of Italy such a course was unnecessary, and a lower or flat roof is found. Large windows, to admit light and heat from the sun, are the rule in the north, while small ones, to keep out the glare, are characteristic of the south. The very mouldings are frequently cut so as to carry off the water or to protect delicate carvings placed beneath them.

The influence of climate and of environment extends to the art of painting. The characteristic features of the various schools of landscape painting are largely the reflection of the environment of the artist. The history of culture and of civilization abounds in illustrations of the influence of environment upon the arts and development of man. In the earliest historical periods the most advanced races dwelt in warm climates, or those in which natural phenomena were uniform. The great nations of antiquity, the Egyptians, Assyrians, Persians, Greeks, and Romans, all originated and thrived in semi-tropical districts. In America the most advanced races, the Aztecs and Peruvians, were likewise inhabitants of hot countries.

It is a remarkable fact that the centre of civilization has shifted

from near the equator towards the poles. To-day the most progressive races inhabit the temperate zone, while the stolid and stationary ones are in the frigid and torrid where there is little variation of temperature. It would almost seem that a diversified climate, one of sharp contrasts of hot and cold, of rain and snow, was essential to a progressive civilization, and at all events it is in such that the intellect attains its most vigorous growth. In Europe the Germans and English are in advance of the Italians and Spaniards, and in our own country the people of New England claim to be ahead of their fellow-citizens in the south. In whatever direction civilization is tending, it is at least safe to say that a uniform environment throughout the world would result in uniformity in thought, in art, in manufactures, and in construction, and to variation in environment more than to any one cause differences in these particulars are due.

Among primitive peoples the influence of environment on construction is very marked, and to it differences can be traced which are not noticeable among advanced races. First of all may be considered the influence of wind. This was an important element in determining the development of the rectangular dwelling, which arose in a desire to exclude it. In part of Tasmania, for example, the natives used windbreaks, but in the western portion of the island, where the weather was more severe, huts were built of wattle and daub. A common method of gaining shelter, illustrated by the Australians and the Coroads, is by placing the entrance to leeward; very frequently no wall at all is built on this side, the ingenuity of the builders being confined to keeping the wind out on the others. The Bachapin houses have a number of devices for excluding the wind. They are surrounded by a fence of closely interwoven twigs and branches, with an opening that conforms to the shape of the body, being wider at the top than at the bottom. The house has two walls, an outer and an inner one; the former is of sandy clay, manure, or grass, thrust in between poles that support widely projecting eaves. The inner wall is without windows and encircles the portion of the house used for sleeping and storing purposes. The roof is constructed in a particularly thorough manner of poles bound with acacia bark, over which sticks are tied transversely, and covered with a thatch of long grass or straw, which in turn is held down by twigs inserted at both ends. Few structures exhibit so many special expedients to protect the inhabitants against the inclemency of the weather as this, but there is a very large class of dwellings,

especially in colder and more windy countries, that show attempts to exclude the air. A favorite device is a single small entrance, which was much used among the Indians of North America, and it need scarcely be pointed out that for this reason openings are closed with doors or shutters, or else a curtain, mats, skins, cloths, varying with the products of the country or the wealth and knowledge of the builders, is hung before them, and protection thus obtained not only against the severity of the elements but from prying eyes.

In some tropical regions it is intensely hot by day and cold by night, a condition of affairs that would naturally lead to the building of houses that could be opened in daytime and closed at night. An interesting example is furnished by the houses of Samoa, that have a low wall, the upper portion of which is closed at night by screens. A similar end is sought in the low circular huts of the Tartars of Central Asia. They are intolerably close by day, but at night, owing to the piercing winds, are as comfortable as they are necessary to the preservation of life.

In direct contrast to this system of construction, which is designed to exclude the air, is the system arranged to give it free access. The latter is to be found in all hot countries. Sometimes the dwelling is open at one end; at other times it is without any walls at all. The former may be found among the Tannese, the latter among the Adamese. The Tongans build in a similar manner, but with the roofs descending nearly to the ground. The shed, of course, is the form best adapted to permit the free circulation of air, and it appears in a great variety of forms. The Conibos Indians of Peru supply an excellent illustration, building in the clearings under the direct rays of the sun huge open sheds capable of accommodating three families. In the Hawaii Islands a different custom prevails, sheds being used in summer, and in the cold season dwellings with low walls and high roofs.

Rain also has an important influence upon construction. As has been noted, flat roofs obtain where there is little or no rain, pointed or inclined ones where there is an abundance of it. While this distinction is broad enough to be observed among all peoples, in all parts of the world, and in all degrees of civilization, there are a number of special expedients that have been devised by different peoples as the result of local conditions or their own knowledge. The Abipones, whose dwelling is so rude as to consist simply of a tent of two poles and a mat, dig a trench to carry off the rain. The

granaries, which almost invariably form part of an African village, are frequently furnished with projections that extend beyond the walls to carry off the rain. An interesting series of examples of the same regard for natural requirements is furnished by the stone edifices of more advanced peoples. In Syria and Egypt, where the rainfall is too light to be taken into account in construction, roofs are flat; in Greece and Italy, where it is light but periodical, the roofs are pitched at a low angle; still farther north, in central Europe, where rain and snow are abundant, the roof is sharply pitched. The richly domed roofs of India may have originated through the same cause. A leading characteristic of Indian architecture is a succession of pilaster-like ornaments, surmounted with a dome or roof covering. In a rainy district the simplest way to protect an upright column or post is by a covering, and it is quite likely that such a primitive arrangement may have suggested to the Indian architect the idea of his many domed walls where each upright member appears to have a roof of its own.

Differences in construction result from differences of temperature, as when the summers are short and hot and the winters very long and cold. Under these circumstances the usual method is to occupy a different dwelling each season. Summer houses are light in structure while winter ones are built with a regard to warmth. The Chipewya, for example, in summer use a primitive structure formed by two poles meeting at the head, a ridge-pole, and a strip of birch bark. In the winter they build circular lodges accommodating two families, covered with birch bark held down by sticks; the entrances are closed with blankets. The Comanches have arbors of green boughs in summer and conical lodges of buffalo skins in winter. The Indians of Cooper's creek use windbreaks of branches or stalks of marsh-mallows in summer, and in winter rain and wind-proof lodges of sticks covered with grass or weeds with earth or sand thrown on the top and beaten down. In fact, the practice of building two kinds of dwellings for the different seasons is very common among the American aborigines. A similar custom is found among other peoples. The Ostyaks build huts of birch bark for the summer and for winter yurts of wood and earth, with floor sunk in the ground for greater warmth. These winter houses are occupied by several families, while the summer ones are used by one only. Other north Asian peoples, as the Kamtschatdales and Tschutski, have similar arrangements. The summer houses of the former are elevated

on posts, while the winter ones are partly sunk in the ground. The Innuits live in tents of skins during the summer; as the weather becomes colder they build combination houses of sheets of ice with a roof of skins, and when the winter has finally set in they resort to the typical house of blocks of snow and ice. The Todas, though living in a warm region, have duplicate and triplicate dwellings permitting a seasonal change of abode, a sort of primitive "town" and "country" house arrangement.

A change of dwelling is not, however, necessarily confined to districts having strongly marked seasons, but is sometimes due to change of occupation. The Brokpas of the Upper Indus build separate houses in the fields in summer, while in winter they use communal dwellings. Thus each family is enabled to cultivate its own piece of land in the warm season, while the whole tribe huddle together for greater warmth in the winter. The Zuni and other pueblo tribes of New Mexico adopt a similar method. The Dakotahs erect permanent communal dwellings of birch for the use of the agriculturists in summer, and at other times live in temporary lodges of skins, thus reversing the process of the Brokpas. Temporary tents of poles covered with mats are used by the Chinooks during the fishing season, and permanent board dwellings at other times.

The leading climatic features that have been considered produce what may be termed special variation in structure. These factors, wind, rain, snow, and change of season, do not produce uniform effects, some tribes building more with reference to one than to another. They may, therefore, for the sake of convenience, with the additional element of earthquakes—which cause readily recognized features wherever they occur—be classed together under the general term of secondary climatic agencies.

But there is a much more important element due to climate, and that is the material employed. Difference in material is traceable to the influence of climate and geological formation, and to this cause chiefly is to be attributed the many variations in structure to be found in all parts of the habitable globe.

The want of an abundant and readily procured building material is productive of all manner of expedients. In a treeless country the first resort is to skins. Numerous illustrations of this were to be found among the North American Indians before their habits were changed by civilization. The Comanches, the Dakotahs, the Chippewayans, and the Snakes are but a few of those who used

skins for the want of a better material, although it is to be remarked that for the dwellings of nomadic tribes skins are the most serviceable material. The Patagonians and the Arabs used skin tents because timber was scarce. The Mandans were extremely sparing in the use of logs in their houses, for in the region in which they dwelt trees grew only in patches, and being confined to the bottom lands between the banks of the rivers were difficult to transport.

From the use of skins the next step was to the use of clay. The rudest method is simply to spread it over a wood frame-work, as was done in the case of the Mandan huts. This, however, implies only a slight advance in technical skill. A higher stage is exhibited in the houses of the Ashantee. These are formed of a slight frame-work of wood, thickly coated with clay, and smoothed off to resemble columns and paneled walls, a system not very unlike that of the Chaldæans and Assyrians. These structures form a sort of stepping stone to the use of brick, which is at once the highest and most developed method of employing clay as a building material, though moulded terra cotta may be considered to be a still further specialized form of it. The Afghan huts furnish an interesting series. Some, as at Khandahar, are entirely of mud bricks, no wood at all being used, not even in the roof. Others, as in the Pischin valley, have roofs partially constructed of wood, which is carefully carried in each migration. The settled Arabs of Asia usually build with sun-dried bricks. In the case of more advanced peoples there may be noted the use of brick in Assyria and of stone in Egypt, the material in each instance being the most readily obtainable. It would have been quite impossible for Assyria to support its population had it not been for the use of clay as a building material. The arch was first used in treeless countries, or at least where large building materials were not to be had, and may be said to have originated in the use of clay. The adobe houses of North America owe their origin to the absence of any other suitable material or the difficulty of obtaining one.

Some of the above examples show peculiarities of construction due to the presence of certain kinds of materials only, but there are instances where a choice has been made among several kinds of materials. Squier describes houses at the mouth of the Rio Ranees, in Peru, that are built of a peculiar tough turf found in the vicinity. Tule is used in the rainless districts of Peru and California. The use of a certain abundant substance in one district results in pecu-

liar methods which are absent in structures in which they are not used.

The use of stone as a building material resulted from the want of a better and more easily handled substance. The first stage, where some timber can be had, is to build a wall of stone and a wooden roof. Such dwellings are found among the Maiwar Bhils. Stone forms the fabric of the most important edifices of Egypt, and the Doric temple itself, as M. Viollet-le-Duc has so ably shown, is a stone structure admirably designed and executed and expressing in the minutest details the adaptability of the material to the various uses to which it is put. The size of the stone has an important influence on the appearance of the building and the method of construction. In the stone pueblos of America three kinds of walls were used—one of alternate layers of large and small stones, another of layers of large stones, and a third of rubble-work. Lintels are found where large stones can be obtained and arches where only small ones can be had. Incidentally, also, the use of small stones led to the introduction of plastered or stuccoed surfaces.

The Egyptians built huge columns of small stones, covering them with plaster in order to produce the effect of monoliths. The grand yet simple results of Greek architecture were obtained chiefly by the use of large materials, while the richness and variety of the Gothic results from the constant use of small stones. The Romans relied almost exclusively upon the plaster coating or veneer of costly marble laid on walls of ordinary brick for the full effects of their buildings. The use of courses of stone naturally suggested the ornamentation of each row or of certain rows. Soft stone was still further instrumental in the development of ornament. Lastly, it may be noted that a taste for polychromy follows the presence of varied colored stones. The rich appearance of the buildings in the volcanic districts of France furnishes ample illustration. Stone was a substance not much employed by primitive builders, as its use implied considerable technical knowledge, and no works of importance could be accomplished except by means of the concerted action which is only found in semi-civilized or civilized communities. A number of stone huts are to be found in various parts of Europe, dating from a remote past if not from prehistoric times, that are scarcely more than stones piled up with more or less regularity. Few of these exhibit half the care and labor to be noted in the dwellings of the most primitive Africans.

Artificial building material came into use when no other was at hand and when the tribe possessed sufficient technical knowledge to produce it. The Kalmucks use frames of willow covered with felt, made of a number of pieces fastened together with thongs or hair ropes. The Khirghiz build similar tents, but made of reed mats held down by bands embroidered with needle-work. These mats are covered with an outer layer of felt, held in place by white belts crossing each other in various directions. The yurtas of Mongolia are formed of a lattice of wooden laths brought from the Khalka country, where they abound. The roof is of light poles, and the whole is covered with sheets of felt that are doubled in winter. The completed tent bears a close resemblance to a heap of earth, an appearance that may have been sought as a protection against enemies.

Sometimes a material is used because it is the most convenient, though a better may be had with little trouble. The Chinese mud hut is a case in point. It is composed of mud and millet stalks and has numerous advantages in the eyes of the natives. The materials can be had on any plain for the mere picking up. In addition each man can build his own hut, an advantage not to be despised where incomes are microscopic. When the floods and the rain threaten to dissolve the habitation, the owner takes his family and household goods to the roof, and as the water gradually disintegrates the walls the whole structure sinks softly down, safely preserving the precious freight. The ranchos of Chili, built of twigs and rushes and plastered with mud, are constructed so as to be easily taken down and rebuilt.

Closely allied to houses built entirely of mud are those constructed of wattle and daub. Such dwellings are of frequent occurrence, and illustrations are supplied by the Mundrucus of Brazil, the Araucanians, the Malagasys, the Gonds, and many others. In the northern interior of Australia the natives constructed huts of boughs covered with grass and leaves, with a thick outer covering of mud. The Fuegians sometimes placed turf above their shelters of skins, bark, or grass, and the dwellings of the Ostayks, the Tschutschki, and the Oonalashka are all covered with earth. Such structures are to be found not only where better material is wanting, but where the people are too indolent to devise better methods.

Further variations in buildings are due to the fact that a peculiar material is within reach which gives a character to the architecture.

The light and graceful character of the dwellings of eastern Asia is due to the abundance of bambu. Among the people using this eminently adaptable material are the Nagas, the Khryings, the Javanese, the Sumatrans, and a host of others. It is the foundation of all east Asian building, and though it reached its highest form and fullest development with the Chinese and Japanese the less advanced races well understood its capabilities and made good use of it. The Javanese houses are built of a frame-work of bambu and poles covered with plaited bambus or reeds. The roofs are of reeds, leaves, or pieces of bambu split and applied to each other by their alternate concave and convex surfaces. The floors are of split bambu. The Sumatran dwellings are largely built of palupo, which is bambu opened and made flat by notching the joints on the outside, cutting away the insides, and drying the shell in the sun. It is sometimes fastened with nails, sometimes woven together. The floors are of bambu, with an upper layer of split ones. The roofs are varied. Some are covered with palm leaves, formed into sheets, doubled at one end over a lath and tied to the rafters; others are of narrow split bambus laid so as to form a triple covering; others are covered with a substance resembling horse-hair; and still others have split bambus arranged as in the Javanese houses. The high arched roofs of the New Guinea houses are due to the elasticity of the bambu. It is generally used throughout the east for floors even if in no other part of the dwelling, as it is more readily worked than palm wood. All these structures exhibit the simplest and most obvious applications of bambu to the needs of construction, but the full development, as seen in the houses of China and Japan, is so close to the methods of civilization as to remove them from the scope of this paper.

Other trees tend to the formation of characteristic structures. Palm leaves are extensively used for thatching wherever they are found. In the Brierly Islands the houses are built of slender poles lashed together with rattans and thatched with grass which still has the roots attached to it, over which are placed a few leaves of the cocoa palm. In the dwellings of the New Zealanders and the Waraus palm is also employed as a thatch. The Arawaks of Guiana build their houses entirely of palm. Grass is also very generally used for thatching purposes.

Bark, when it can be obtained in sufficiently large pieces, forms an excellent building material. Examples of its use have already

been noted in the shelters of the North American Indians and the Australians. In high latitudes a variety of expedients are resorted to in order to supply what nature has denied. Snow and ice are pressed into service when nothing else is to be had, and form good and serviceable shelters. No useful substance is permitted to be wasted, and driftwood is treasured when it can be obtained. The Innuits usually build with snow when they can get no drift-wood. The bones of animals are sometimes used, so pushed for means of shelter are those living in the extreme north. The Tschutski build a frame-work of wood and whalebones, and other northern people construct dwellings entirely of the bones of whales, walruses, etc. These structures are circular, dome-shaped huts of ten or eighteen feet diameter; the lower part is of stone, the upper of bones, that gradually incline inwards, meeting at the top. The crevices and the outside are covered with earth, and in the winter an additional layer of snow is carefully spread over all.

Apart from the use of animal skins and bones in building the dwelling there are certain structural devices intended to prevent the living animal from interfering with the comfort and safety of man. Some authorities affirm that the abundance of reptiles in the island of Timour led to the custom of elevating the houses on posts. In the dwellings of the Brierly Islands, which are also elevated, a special device is introduced as a guard against rats, consisting of an oval disk placed between the joist and the post. In some parts of Africa it has been stated that the natives build their huts in trees as a protection against lions. Nearly all African granaries are elevated on posts to keep the grain safe from the ravages of rats. The records of African travel abound with accounts of the ravages of the dreaded white ants and the care that must be taken to protect everything edible in the way of wood or other substances.

Some few of the leading characteristics of primitive architecture have been passed in review. Viewing the subject from the standpoint of the influence of the environment only, many features which are to be attributed to sociological influences have been omitted.* Limiting ourselves to this position, it is evident that however spontaneous architecture may be at the present day, however much it may be the creation of the fancy, the expression of a refined and cultivated

* See "Sociological Influences in Primitive Architecture," *American Naturalist*, January, 1888.

taste, a desire for the odd or the beautiful in its earliest conception, its rudest forms, it was nothing more than the action of the environment on the mind of man. If the climate was warm he built himself a dwelling that gave him as much air as possible; if it was cold all his resources were devoted towards obtaining heat. If it rained regularly or constantly he gave his roofs a sharp incline; if there was no rain the roofs were flat and afforded a pleasant place of resort in the cool of the evening. If there was no stone he made bricks, and if a pliable wood was at hand he devised a light form of structure the very ornamentation of which was in harmony with it.

In primitive architecture there was no effort for effect—no loss of material; primitive man had neither the time nor the intellect to spend on structures that are dictated solely by fashion or caprice. He advances slowly and with caution, evolving beforehand his methods of procedure. From natural shelters like caves he gradually progresses through the various stages of a single windbreak to a partially closed hut, and finally to the perfected form of an enclosed dwelling. In the case of sedentary tribes these dwellings are constructed with great care and skill, and sometimes attempts at ornamentation are made. With nomadic tribes there is less architectural advancement, but each applies his knowledge and means as best he may. To us, with our comfortable homes, our huge hotels, our gigantic office buildings, our churches, our theaters, our railway stations, our factories, our elevators, our steam heat, our electric light, and the thousand and one conveniences and necessities of modern life, the structures of primitive peoples appear meager and insufficient. It should be remembered, however, that many of our modern conveniences are intended to supply artificial wants and that the necessities of to-day were unknown the day before yesterday. The hut of the Adamese doubtless answers all his ideas of comforts and is eminently adapted to the life he leads. We, on the other hand, are constantly striving for changes and improvements and are never satisfied with the best results we can obtain. Primitive architecture may be stationary—it may exist in forms to-day that were employed thousands of years ago—but it is the faithful reflection of the environment and is thoroughly suited to the uses to which it is put. No further confirmation of this is needed than the fact that when Europeans take up their abode in tropical countries they follow the native methods of architecture so far as a prejudiced judgment will permit.

Nothing can be more rash than to attempt to formulate a law of architecture. The records of primitive architecture illustrate no law other than the action of environment and sociology. We may indeed say that man uses the best material known to him in the best way he can. This is, in fact, but one of the great principles underlying all architecture, both primitive and civilized, though perhaps it is best illustrated in primitive forms.

BRASILIAN INDIANS.—An important paper on the Indians of Brasil has recently appeared in *Archivio per l'antropologia e la etnologia* (the journal of the Italian Society of anthropology, ethnology and comparative psychology, published at Florence). The paper is by Dr. Alfonso Lomonaco, and is entitled "Sulle razze indigene del Brasile, studio storico." It occupies pages 17-92 and 187-270 of the first two numbers of the current volume (v. 19, 1889) of the *Archivio*. The paper begins with an introduction, and is divided into four sections, as follows: part 1, "The native races at the time of the discovery of Brasil," treating of the Tupy, the Tapuyas and the Aymores or Botocudos; part 2, "Brief remarks on the history of the natives of Brasil from the discovery of the country to the present epoch;" part 3, "The present native tribes of Brasil," treated under the following headings: "The present number of savages in Brasil; their subdivisions, based on the classification of Martius; the Tupis; the Ges or Crans; the Goytorkazes; the Guerens or Crens; the Gucks or Cocos; the Parecis or Parexis; the Guaycurus; the Arnaks; the tribes of the Rio Purus studied by Chandless; the tribes of the Xingù and of the upper Amazon; mixed races of Brasil; domesticated Indians; the future of the present natives; conclusions;" part 4, "Language and literature of the natives," including twenty-three Tupi legends collected by Dr. Cortes de Magelhaes.

A short bibliography is appended to the paper and a plate of typical Brazilian Indians.

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