On the Older Forms

of

TERRA-COTTA ROOFING TILES.

By

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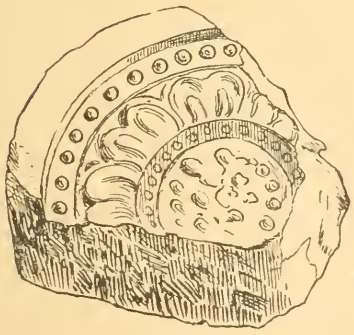

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TERRA-COTTA ROOFING-TILES.[1]

BY EDWARD S. MORSE.

In tracing out the ethnic relations of past races and the lines pursued by them in their migrations, the material to be studied consists not only of the actual remains of man, but also of the objects and results of his handiwork. If the objects have written characters upon them, the story to be unravelled is often easy; the very style of ornamentation betrays their relationship. Of great value to the archæologist are the enduring objects in stone, metal and terra-cotta. It will be found that those features which pertain to the households of a race, and which are successively taught from father to son, or from mother to daughter, such as methods of shooting the arrow or of weaving, are longest persistent.

In language, it is found that those words which have the deepest root often refer to acts of domestic life which pre-

[1] This paper was communicated to the Essex Institute, Dec. 21, 1891. It afterwards appeared as a series of papers in the American Architect and Building News. To the courtesy of Ticknor & Co., the publishers of that journal, the Essex Institute is indebted for the use of the illustrations in this communication.

eminently belong to the family. This fact holds good with regard to the house, and, as we see, the persistent adherence century after century to the same kind of house by migrating tribes, under widely varying climatic conditions, attests to this truth. In studying the origin of Egyptian or Grecian art, the inquirer finds his quest abruptly ended at the line dividing the imperishable stone structure from the perishable mud or wooden one that preceded it. The perishable wooden roof, however, often has associated with it a covering which is the most lasting. Rock crumbles, metal oxidizes, but the rudest earthenware is imperishable, and so the terra-cotta roofing-tiles are often the only surviving relic of a house structure. Furthermore, these objects, being always associated with the house, are intimately identified with every roof-covered family. The persistence of certain types of roofing-tiles among peoples shows the fixedness of a habit. It is a noteworthy fact that the earliest type of terra-cotta roofing-tile ever exhumed still forms the roof-covering of the greater mass of mankind to-day. The enduring nature of these objects will ultimately enable one to trace the paths followed by tile-making races in their various migrations. Wherever the Romans went, the typical Roman tile may be found, often impressed with the stamp of some Roman Legion.

Realizing the imperishable nature of roofing-tiles, and the fact that they are scattered all over the world, it has seemed to me that an inquiry into the various types of terra-cotta roofing-tiles and their geographical distribution might be of value. Unfortunately for the American student, the material to be studied is confined to the Old World, and one must go there for the purposes of investigation.

It would be an interesting inquiry to learn at what time, and where, roofing-tiles were first used. When the earliest hut-builder learned the art of sloping his roof, and

superadded to this achievement the lapping of sheets of bark, or palm-leaves, one over the other, as a rain-shield, the first steps were taken which were to lead to the roofing-tile. That the roofing-tile has a considerable antiquity is certain. Its appearance in Greece dates back to the earliest dawn of Greek art, and yet before this, in Asia Minor, there was a time when the tile was not. Schliemann, in his great work, "*Ilios, the City and Country of the Trojans*," in describing the relics found in the ruins of the first prehistoric city of the hill of Hissarlik shows the almost universal use of pottery by the people. Utensils for every-day life, terra-cotta funeral urns, large terra-cotta bowls, weights for their fishing-nets, handles for their brushes, and even hooks to hang their clothes upon were all made of pottery. "Thus we cannot be astonished in finding in the *débris* of their cities such large masses of broken pottery among which, however, there is no trace of tiles" (p. 214). He infers from this that the flat roof which is found to-day in that region prevailed at that time. Dörpfeld, in a memoir on the origin of the Doric style (a translation of which, by Mr. Edward Robinson, was published in the *Technology Architectural Review*, Vol. III, Nos. 2 and 3), says it was the invention of the terra-cotta roofing-tile that first made the construction of a sloping roof possible. It is probable that the roofing-tile was introduced into Greece from the East, fully developed, and with its introduction the roof, which had before been flat, could now be made sloping. The sloping roof must have preceded the roofing-tile by many thousands of years; at the outset, bark, straw, thatch, rough stones and similar substances were used until better devices were made, which finally culminated in the terra-cotta roofing-tile, the oldest known type of which is, by far, the most common form of roofing-tile in the world to-day.

The antiquity of the sloping roof is hinted at in the finding of cinerary vessels in the form of huts, and consequently known as hut urns. These have been found in Italy, Saxony and other parts of Europe. It is believed that they were made before the age of iron in their respective places. It is interesting to observe that all of them show, not only a sloping roof but a thatched roof as well, with

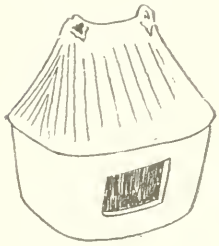


Fig. 1.

Fig. 2.

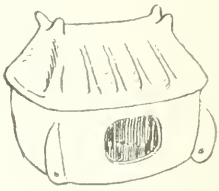


Fig. 3.

Figs. 1–3. Hut urns from Saxony in Museum für Völkerkunde, Berlin.

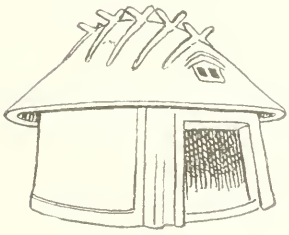


Fig. 4.

Fig. 2. In Vatican Museum, Rome.

Fig. 4. From Alba Longa. A better figure is given in Dennis's "*Cities and Cemeteries of Etruria*," Vol. 1, p. lxix.

the characteristic cross-pieces on the ridge, a feature of the thatched roof which may be seen to-day in every part of the world (figs. 1, 2, 3 and 4).

The sequence in the development of the roofing-tile will have to be studied in Asia Minor, or more probably in China. From the high development and great antiquity of the fictile art in China, and the early and artistic development of the tiled roof in that country, one might be led to believe that in China—the ancestral home of so many arts—the roofing-tile originated. Graeber, in a

memoir to be referred to later on, describes what he believes to be the earliest known terra-cotta roofing-tiles. These were found in the ruins of the Temple of Hera, at Olympia, dating nearly a thousand years before Christ. This ancient tile consists of two elements, a wide under piece (tegula) slightly curved, and a narrow, semi-cylindrical piece (imbrex) which was placed in an inverted position so as to cover the junction of two adjacent tegulæ (fig. 5).

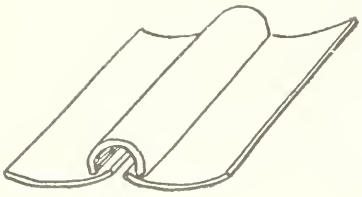


FIG. 5.

Of significance, also, is the statement that the open end of the imbrex, where it bordered the eaves, is closed by a circular disk, ornamented in rosette pattern. To find the counterpart of this we have to go to Korea and Japan and, presumably, China. Fortunately, the varied tastes of the Japanese collector have led to the treasuring-up of old roofing-tiles, either for their antiquity or because they were associated with some famous temple. In Japan, one may often see an old tile that has been dug up utilized for an ink-stone. Ninagawa, the famous Japanese antiquarian, contemplated the publication of an illustrated work on ancient roofing-tiles, to form one of the numbers of his "*Kwan ko dzu setsu.*" The lithographic plates were prepared for this number: whether the text was ever published I cannot say. Fortunately securing a set of these plates, I managed to get from the author, some years before his death, the names and dates of the tiles figured. As to the ages attributed to these there may be some doubt, but that some are Korean is a matter easily established by an expert in pottery, as the clay at once reveals the origin of the piece. Some of these were believed by Ninagawa to

be from eleven to twelve hundred years old. One is said to have come from Asiatic Turkey and to be two thousand years old. It is interesting to observe that the tiles are not only large and massive, but that those made for bordering the eaves have widened margins, variously decorated, generally in scroll pattern, and the joint tile, or imbrex, as it is to-day in China and Japan, has one end closed by a circular disk, and what is very interesting in these ancient tiles is that, in nearly every case, the decoration is that of a rosette pattern! The following figures (figs. 6 and 7) are roughly sketched from the plates in

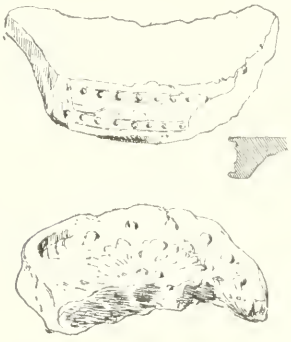


FIG. 6.

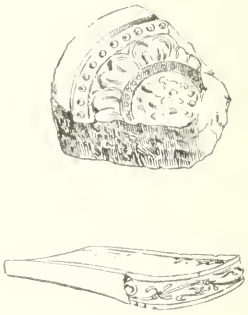


FIG. 7.

question with their identifications as given by Ninagawa. The tiles are in every case very thick, and roughly made; in many instances the under surface bears cloth-mark impressions. Furthermore, all the specimens figured whether from Japan or Korea belong to the normal form of tile, with curved tegula and semi-cylindrical imbrex. This is the earliest form of tile known to the Japanese, and tiles of this kind are called by them *Hongawara* or true tile. This form of tile is to-day the common form of tile in Korea, China, Cochin China, India, as well as in all those countries bordering the Mediterranean. When found far-

ther north in Europe it is usually to be seen on the older buildings and is the tile most often seen depicted in mediæval paintings of places outside of Belgium and Holland.

If this form of tile really represent the earliest type, one might readily believe that its form was derived from sections of bark which must have come early into use as a roof-covering. In lapping the sections of bark from the eaves to the ridge, the concave as well as smooth surface, would be placed uppermost as forming the best water gutters. Other sections of bark, perhaps from smaller trees, would have been used to cover the joints of the larger pieces and these would have been placed with their convex surfaces uppermost. Such surmises are quite justifiable when one sees so many forms of pottery whose shapes have been derived from natural objects, as shown in the Pitt-Rivers collection in the Ethnological Museum at Oxford. [Professor Tylor, its director, has brought out in a striking manner similar relations in other departments of the collection.] In other museums, notably the museums in Stockholm and Copenhagen, the change from stone to bronze and iron shows successive derivations of form from objects first made in a ruder material or from natural objects.

As the origin of roofing-tiles is probably not lost in a very dim past, philology may throw some light on the subject. The material of which they are made is among the most enduring of man's fabrications and the earliest form must sometimes be found.

The arrangement of feathers on a bird in shedding the rain would have given a sufficient hint for the proper arrangement of material on a sloping roof. From the rough natural substances used in the prehistoric roof there came, not only slabs of wood, flat pieces of stone, terra-cotta tiles of many kinds, but worked marble tiles (620 B. C.)

modelled after the terra-cotta tile, small bronze tiles in Pliny's time, thin cleavages of slate, continuous sheet-metal roofs and metal sheets modelled after the forms of interlocking tiles.

As to the relative merit of these various roof-coverings I am not prepared to speak, nor is it with any intention of urging the economic value of this material that this paper is prepared: it seems, however, that the terra-cotta tile roof, when properly made is, all things considered, one of the cheapest and most durable. It is certainly one of the oldest and widest distributed.

Definitions.— At this point it becomes necessary to define the different types of roofing-tiles now in use. Leaving out of consideration all forms of interlocking tiles, and recent modifications of the prevailing types now so well known, we find among the older forms three distinct types.[1]

The earliest form of roofing-tile known consists of two elements, a wide tile (tegula) either square or rectangular, more or less curved in section, and a narrow semi-cylindrical tile (imbrex) usually slightly tapering at one end to fit into the wider opening of the one adjoining. The tegula is placed on the roof, concave face upward, and the imbrex, placed concave face downward, covers the lateral joint between two adjacent tegulæ. I have not been able to learn of any special English name for this tile; in Germany, it is known as the hollow tile. From the fact that it is the earliest known tile, Graeber, in his exhaustive discussion of the

[1] It would be interesting to clear up the nomenclature of roofing-tiles as some confusion exists through the same name being applied to different forms of tiles, thus the latest dictionary—"*The Century*,"—almost encyclopædic in its character, gives under the definition of crown tile the English interpretation thus: "I. A flat tile, a plain tile. II. A large bent tile or arched tile usually called a hip or ridge tile, etc." These tiles are in reality two entirely different forms of tiles and neither could be used for the purposes of the other. The synonymy would have to be worked out by some student on the ground and versed in the subject.

varieties of roofing-tiles in ancient Greece and adjacent countries, uses the name of normal tile for this form. The varieties of this tile and the different ways of using it may be designated in *this* paper as follows: When the tegula is used as an imbrex, as in China and India, it may be called the normal tile (*teg.*) When the imbrex is used as tegula, as in Mediterranean countries, it may be mentioned as normal tile (*imb.*) the ancient Grecian and Roman modification as normal tile (*flat*). The pan tile is one having a double flexure forming in section the letter S and is known in some parts of Germany as the S-tile. This tile is an evident adaptation from the normal tile in combining the two elements imbrex and tegula in one piece. Originating in Belgium or Holland, one can easily conceive a thrifty and frugal people devising an economy of handling in making one piece serve the purposes of two.

The flat tile, or, as it is known in England, the plain tile, has no genetic relation to the other forms of tiles. It is simply a shingle in terra-cotta. It is rectangular in shape, flat, often secured to the roof by nailing, and used, as shingles are used, on the vertical side of a house. In roofing, the tiles are adjusted precisely as wooden shingles are by lapping and breaking joints. The German name, flat tile, will be retained as being more descriptive and probably having priority.

The following outlines (fig. 8) represent in a general way the types and varieties of roofing-tiles with their distribution. It should be understood that colonies past and present of these respective countries, so far as I know, adhere to the form of roofing-tile of the parent country. As an illustration, the few evidences of ancient roofing-tiles in this country trace the flat tile discovered by Mr. E. A. Barber in Pennsylvania, to German settlers; the pan tile,

discovered by Dr. C. C. Abbott on Burlington Island, Delaware River, on the site of an old Dutch House, to Dutch settlers; and, in California, the normal tile (*imb.*) to the old Spanish Jesuits.

It should also be stated that, on the borders of countries using different tiles, the tiles intermix; thus France along

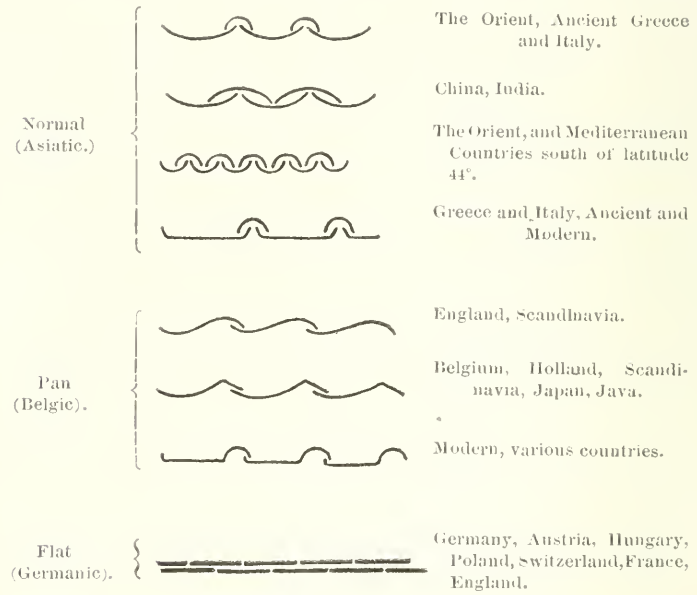


FIG. 8.

the shores of the Mediterranean uses the normal tile (*imb.*); and on German territory, contiguous to Belgium and Holland, the pan tile is often seen.

It will also be found that water-ways have led to the wide dispersion of roofing-tiles, and the occurrence of the pan tile in Poland is probably due to the distribution of this tile along the shores of the Baltic, as the normal tile (*imb.*) is found bordering both shores of the Mediterranean.

CHINA.

China exceeds all other countries in the world in the skill shown in the use of the roofing-tile. Moreover, China, with Korea and Japan, has treated the tile in an artistic way as no other countries have done, except ancient Greece and Rome. The normal tile is universally seen as a roof-covering from Pekin through Cochin China and Anam to the Malay peninsula.

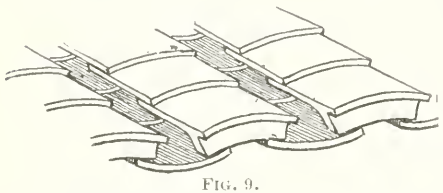


FIG. 9.

The tiles are utilized in a variety of ways as a decorative feature for the roof. Massive ridges are made of them; even gateways of common country houses will have a heavy ridge of tiles. Around Shanghai, these ridges are formed by broad, flat tiles placed on end and packed close together like books on a shelf. At the ends of the ridge they are held up by what appears to be an upturned sheet of metal. In the native city of Shanghai, a small, square, slightly-curved tile is used the same answering for tegula and imbrex. The eaves tile has a flange below; in some cases the under course of eaves tile is simple (fig. 9)

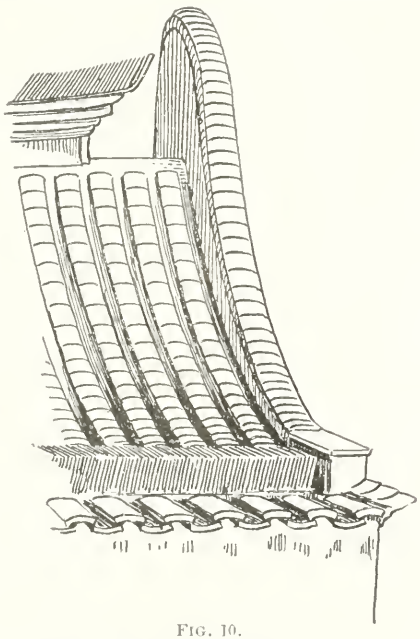


FIG. 10.

while in other cases both tegula and imbrex bordering the eaves have flanges. In the Shanghai house the wall projects slightly above the eaves, and upon this the tiles are placed on end as above described. Outside this is a cornice of tiles terminating in eaves tiles (fig. 10). On the ridge the tiles, placed on end like books, incline from the middle to both ends of the ridge. They do not appear to be attached in any way. Farther south, at Hong Kong and Canton, the eaves tiles are usually simple. At Hong Kong the imbrex is narrow and arch-shape (fig. 11), the eaves having two layers of tegulæ without margin, and the imbrex open. The ordinary Pekin tile has a nearly square tegula, 22 centimetres wide, slightly bent and quite thin. In the eaves tiles, both in imbrex and tegula, the disk and margin are made separately in a mould, and afterwards attached to the tile proper. These portions have flowers and other decorations in relief. The tile portion is

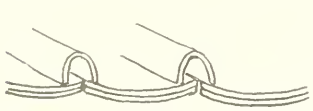


Fig. 11.

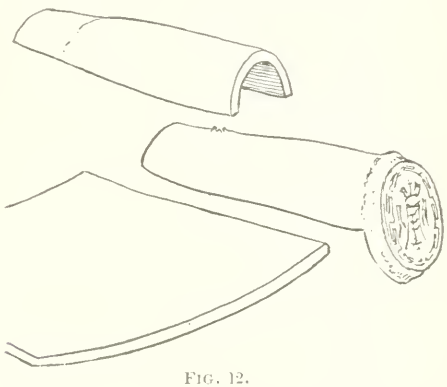


Fig. 12.

evidently made by rolling the clay into a thin sheet and then cutting out pieces of proper dimensions for the imbrex and tegula, and bending them over forms of the required shape. Fig. 12 represents specimens from Pekin

in the museum of the Peabody Academy of Science, Salem. Fig. 13 is figured from specimens of Pekin tiles in the Museum of Fine Arts, Boston. Fig. 14 represents tiles in the Summer Palace at Pekin ruthlessly destroyed by the British. These are sketched from specimens in the South Kensington Museum. Figs. 13 and 14 are glazed a light bluish-green.

A work entitled *Illustrated China and its People*, by J. Thompson, contains some conspicuous examples of Chinese architecture, notably the Tienhon-kung or "Queen of Heaven Temple" at Ningpo. This wonderful structure as well as certain monumental buildings in and about Pekin, as, for example, the sacrificial-hall at the tomb of Yung-lo and the Bronze Temple at Pekin, and structures at Canton and elsewhere, all show the use of the normal tile, the eaves tegulæ in

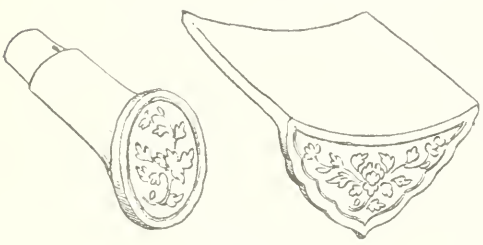


Fig. 13.

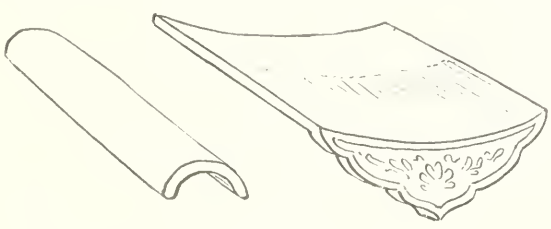


Fig. 14.

some cases having very long and pointed margins, with edges scalloped. The Imperial College, Pekin, is tiled after the style seen at Shanghai (that is, with tegula used as imbrex), but with wide, and flaring margins on the

eaves tiles, the imbrex in this case having a supplementary flange, which flares above (fig. 15).

Photographs of streets in Pekin show a roofing-tile not unlike the usual form seen in Shanghai. A modern tile

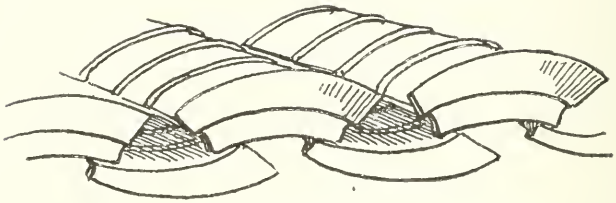


Fig. 15.

of hard, white stone-ware, richly glazed is said to be Chinese. It is a modern production (fig. 16), in Museum of Fine Arts, Boston.

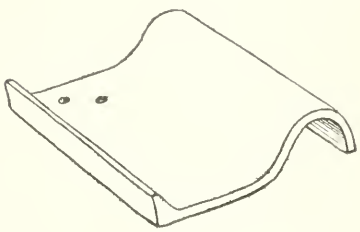


Fig. 16.

COCHIN CHINA.

In the Colonial Exhibit at the Paris Exposition, a building was erected representing a type of the Cochin China house, in fact the entire building was brought from Tonquin. The roofing-tiles as shown in this structure differed in no respects from those found in China proper (fig. 17).

KOREA.

The notes concerning the roofing-tiles of Korea, I gather entirely from Mr. Percival Lowell's interesting work entitled *Chosön. The Land of the Morning Calm.* From the illustrations of this book, reproduced from photographs made by its accomplished author, I am able to present the accompanying figures.

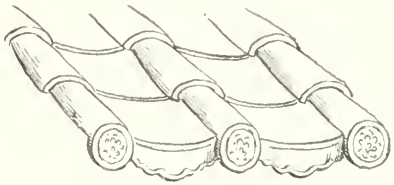


FIG. 17.

The Korean roofing-tile is of the normal type and is derived directly from China. In the common houses and shops there is no attempt at architectural effect in the way of a heavy or ornamental ridge, though a simple tiled ridge is seen on all the buildings, neither are the eaves tiles different from the others except that the tegulæ are often doubled at the eaves. The end of the imbrex is simply closed with white plaster (fig. 18.)

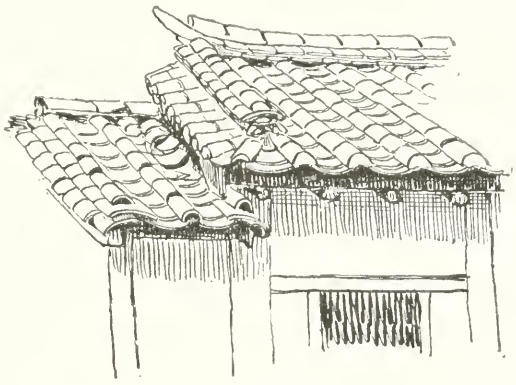


FIG. 18.

On the better class of buildings, especially certain pavilions in the new palace grounds, the eaves tegulæ have

widely turned margins which are also flaring, projecting at such an angle as to hold the snow, as shown in one of the photographs. This expanded margin has a simple design in relief. The imbrex is also closed by an oval disc, with

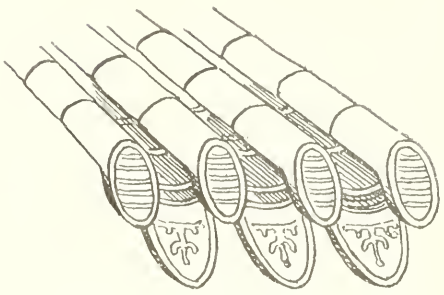


FIG. 19.

a simple design in relief. The oval form of the disc is produced by its diagonal position on the semi-cylindrical imbrex (fig. 19). In a collection of photographs taken by Mr. Lowell, and not published in his book, other forms of eaves tiles are shown associated with pavilions in the Emperor's grounds. One form is represented in fig. 20. In some buildings a few of these peculiar tegulæ decorate the eaves for a few courses from the corner of the roof only, while the remaining portion of the eaves show simple tegulæ. The ridge is also a more conspicuous structure than is seen on the common buildings, though not approaching the Japanese tiled ridge in size or complexity. The end of the ridge terminates in an inverted eaves tegula with broad, turned margin.

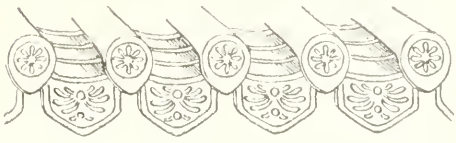


FIG. 20.

It is a curious commentary on the shiftless and poverty-

stricken ways of the people to observe in one of the main streets of the capital, awkwardly-shaped thatched roofs in juxtaposition to simple tiled ones.

Korean roofing-tiles are bedded in mud and clay as is the custom in Japan. Fig. 21 is reproduced from a tracing

FIG. 21.

made from a native Korean drawing in the National Museum in Washington. This sketch represents Korean tilers engaged in tiling a roof. One is occupied in drawing up the tiles by means of a rope, while another is catching balls of mud or clay which are being tossed up to him from below.

JAPAN.

The form of roofing-tile varies in different parts of Japan. In the southern part the normal tile (*imb.*) is in common use, the pan tile (Yedo tile) is also commonly seen. In Tokio the normal tile reveals along the eaves either a simple tegula or one with turned margin,

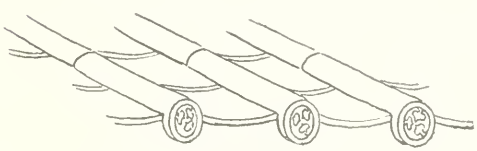


FIG 22.

with decoration in relief; the eaves imbrex is always closed by a circular disc having in relief the Tokugawa crest, or the crest of some Daimio (fig. 22). An eaves imbrex is shown in fig. 23. The usual tile in Tokio, as well as in Kioto, is a slight modification of the pan tile known as the Yedo tile. This tile like the Belgian form has one curved and one flat surface. The tiles of this kind bordering the eaves have, in one form, the plain flange, the lower edge of which, instead of following the curve of the tile, is straight (fig. 24). Fig. 25 represents a roof covered with this form of tile. In the usual form of this tile, however, the eaves tile carries upon it an

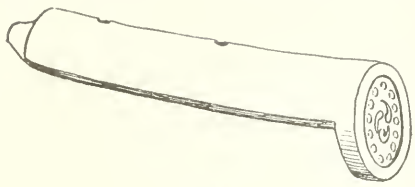


FIG. 23.

FIG. 24.

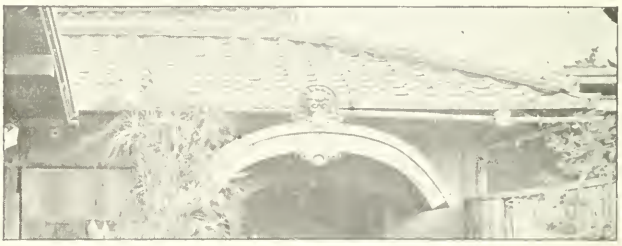


FIG. 25.

imitation of the eaves normal tile, the circular disc of the imbrex portion projecting beyond that portion representing the tegula (fig. 26). In Nagasaki the pan tile bordering the edge of the gable is bent abruptly downward.

It may be observed as a curious feature that in Japan the pan tile laps to the left as seen from the ground, while in all other countries, with rare exceptions, it laps to the right. (Here is added another of the curious instances of reversal which some writers seem to be so fond of connoting.) The temples and castles in Japan are usually covered with the normal tile. When the roof is covered with metal, as is often the case, rounded ribs are introduced to carry out the appearance of the ridges made by the imbrices, even to the circular discs and turned margins at the eaves. In the province of Iwami a simple pan tile is made having a glazed surface. A glazed ridge-tile

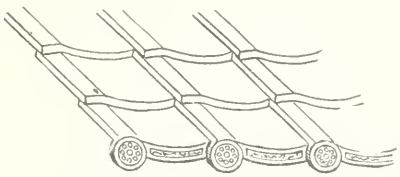


FIG. 26.

FIG. 27.

is also made in this province, angular in section, so as to rest like a saddle on the roof (fig. 27A).

Two hundred years ago a pan tile, brown glazed, was made in the province of Bizen. A temple at Uyeno in Tokio, burned at the time of the Revolution in 1868, was covered with these tiles (fig. 28). The Tokio tile is made of a dark gray clay, smooth, and presenting a nearly black surface; it is quite thick though light.

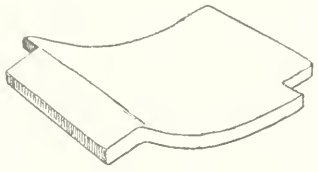


FIG. 28.

I know of no roofing-tile that approaches the Japanese tile in perfection of finish: they are also much higher priced than any other tile known

to me. In comparison, the Chinese tile seems roughly made, is thin, and often warped. The India tile is equally poor in workmanship. So accurately made are the Japanese tiles that roofs may be seen covered with a broad, slightly curved tegula, no imbrex being used (fig. 29). These tiles, like all Japanese tiles, are bedded in mud, and in this instance the edges of the tiles are so straight as to meet together quite perfectly. Simple tegulæ are often used as ridge-tiles on a thatched roof (fig. 27B).

In the better class of tiled roofs it is customary to point with white plaster a number of courses of tiles from the

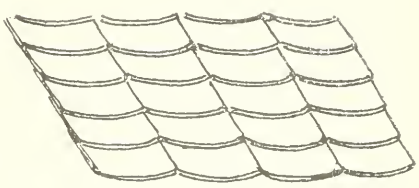


Fig. 29.

ridge, the hip and the eaves, and in some cases the whole tiled surface is treated in this way.

The Japanese ridge is often a very complex and remarkable structure, sometimes of ponderous proportions, with supplementary ridges running down on the hips, and even diverticular ridges near the eaves. These are, or ought to be, built up of tiles and plaster, but oftentimes the bulk of the mass is made up of a carpenter's device consisting of a framework covered with boards, the sides plastered white and having all the appearance of a solid mass of plaster and tiles (fig. 30). The terminal ridge-pieces are often marvels of the tile-maker's art.

Mr. Kashiwagi, a Japanese antiquarian of Tokio, told me that he had records of green-glazed roofing-tiles of the

normal type being used in Japan over a thousand years ago; whether made in Japan or imported is not known. Ninagawa figures in his work on Japanese pottery fragments of what he considered the first glazed pottery made in Japan, and these show a green glaze.

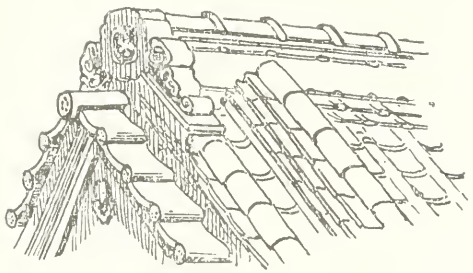


FIG. 30.

In the following figures are shown, by way of comparison, a Japanese (Nagasaki) tiled roof (fig. 31) and the roof of the Temple of Hera, at Olympia (fig. 32), as restored by Graeber. The terminal ridge-tile, the imbrex closed by a circular disc (not, however, represented in fig. 31), the plain tegula at the eaves with simple margin,

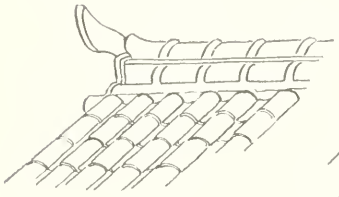


FIG. 31.

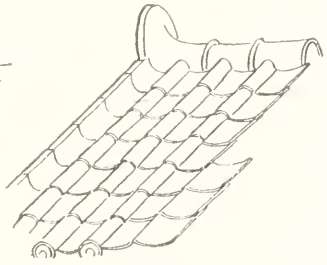


FIG. 32.

present striking resemblances between roofs separated by nearly three thousand years in time and thousands of miles in space. (For further information regarding tiled roofs in Japan see Morse's *Japanese Homes and their Surroundings*.)

INDIA.

So far as museum specimens and photographs have enabled me to judge, the roofing-tiles used everywhere in India are of the normal type (usually *imb.*). Judging by the form of the imbrex as shown in photographs of Bombay houses, it would seem that in their manufacture a tapering cylinder of clay is turned on a potter's-wheel, and then cut in halves longitudinally, and these halves are used as tegula and imbrex. As an evidence of this, in the Bombay roof the tiles bordering the eaves terminate as cylindrical tiles, the tapering end entire and projecting slightly beyond the eaves, while the larger end is cut half-way through to accommodate the overlapping and inverted tiles

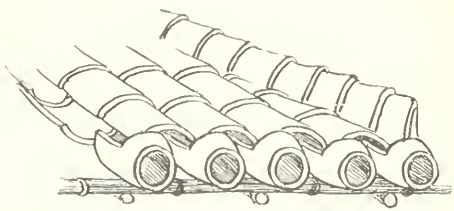


FIG. 33.

that cover the under courses, as shown in fig. 33 (sketched from a photograph in the India Museum, London).

In Madras the normal tile (*teg.*) is used. In some cases the eaves have two thicknesses of tegulæ below and three above (fig. 34). The tiles used at Poona, near Bombay, are a variety of the normal type (fig. 35), the tegulæ being flat with upturned edges.

This tile is 23 centimetres long: the exposed edge is 14 centimetres wide and tapers rapidly to a width of 9 centimetres, with rounded ends. The imbrex is semicylindrical, 28 centimetres long, 10 centimetres across at the exposed end, and tapers to a width of 6 centimetres.

These tiles are light-colored, porous, and very roughly made. The specimen figured is in the great Indian collection made by Dr. Jagor, now in the Museum für Völkerkunde, Berlin. From a few photographs that I have seen of Indian houses there seems to be no modification of the eaves tiles for architectural effect.

The English buildings in Agra and an English church in Bombay, and doubtless English buildings in other parts of the empire, are covered with the ordinary pan tile.

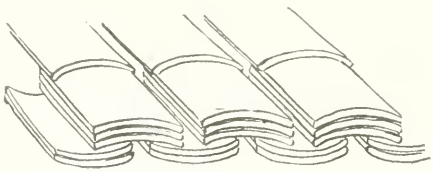


FIG. 34.

FIG. 35.

CEYLON.

At Columbo the normal tile (*imb.*) is seen, the eaves tile having a double imbrex. At Candy, the famous temple is roofed with flat tiles having square ends, presenting in the photograph the appearance of a shingled roof. Other buildings near the temple are covered with the normal tile (*imb.*).

PERSIA.

Judging by the few pictures and descriptions available, the normal tile (*imb.*) seems to be the one in common use. In former times, judging by the high skill attained by the

Persians in brick enamelling, and the wonderfully glazed, flat tiles for interior decoration, the palaces and mosques must have presented a most beautiful and brilliant appearance. In the article "Tiles" in "*Encyclopædia Britannica*," it is stated that the roofs of some of these important structures "are covered with magnificent, lustrous tiles decorated with elaborate painting, so that they shine like gold in the sun. They were especially used from the thirteenth to the fifteenth century." From this statement one gets no idea of the form of tile used.

The high attainment reached in relief work and colored enamels by the early Persians may be seen in the wonderful wall made of brick brought back from Persia by M. Dieulafoy, and displayed in a special room at the Louvre. On this wall are depicted in colored enamels a number of archers, known as the Susa archers.

TURKEY.

Photographs of buildings in Constantinople and other places show the universal use of the normal tile (*imb.*); the semi-cylindrical ridge-tile accompanies it. The Constantinople tile seems slightly more angular in section than that of Italy.

SYRIA.

In Jerusalem and Jaffa, the normal tile (*imb.*) seems the only roofing-tile in use. The joints between the tiles are often pointed with plaster.

EGYPT.

When a tiled roof is seen, it is covered with the normal type (*imb.*). The courses are laid close together, as in the modern Greek roof, and, as in the Greek roof, the interstices between the tiles at the eaves are filled with plaster.

GREECE.

The normal tile is the only form seen in Greece and the adjacent islands. The usual narrow form (*imb.*) common to the Mediterranean countries is also the prevailing form in Greece. In many instances the two elements of the tile are less cylindrical than those of Italy. Greece is the only country in Europe in which the broad, curved tegula with narrow imbrex is seen. In Elensis, roofs covered with this typical normal tile occur. In Messenia the wide tegula is used as an imbrex, as in China. On the old cathedral at Athens, a Byzantine structure dating back to the early part of the thirteenth century, a large curved tegula with narrow imbrex is found (fig. 36); all the courses are thickly plastered and bear the marks of great age, and at the eaves the imbrex is supported some distance from the tegula by a mass of stucco. The dome is also covered with the same kind of tiling, the tegulæ being cut tapering as they approach the apex of the dome, the imbrices standing out as prominent longitudinal ribs from the apex of the dome to its base. There is also another Byzantine church in Athens roofed with the same kind of tile.

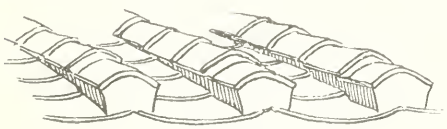


FIG. 36.

In the modern houses at Athens and in other places the tiles are more flattened than is usual with this form, and at the eaves the upper and lower elements are separated by a considerable space and filled with white stucco. This presents the appearance of an imbricated edge along the eaves. With the exception of certain examples in Spain this is the only attempt, so far as I have been able to ascertain, at the ornamentation of the eaves tiles seen west

of China. In some places in Greece, as at Eleusis, for example, the tiled roof shows broad bands of white painted tiles at the ridge, hip and eaves, with an intermediate band in the middle of the roof; other bands cross these at right angles to the ridge. In the photographs rectangular areas of dark tiles show between these white bands. A treatment of the roof presenting a similar appearance is often seen in Japan and Siam, in these cases white plaster being used. At many places, as at Delphi, Dimitzana and Catania it is customary to place upon the tiles angular fragments of stone; these are placed parallel to the ridge, hips and eaves. Occasionally the same treatment may be seen in Constantinople and Stamboul.

In none of the various forms of normal tile seen in Greece to-day is there an eaves tegula with turned margin, or an eaves imbrex, closed by a circular disc. In all other respects, however, the normal tile approaches nearer the Asiatic tile, as seen in China, Cochin China, Korea and Japan than does that of any other country west of these regions unless we except the rough example from Poona, India, where the tegula is wide.

ANCIENT GREECE.

A general idea of the roofing-tiles of ancient Greece may be gleaned from the article "Tiles" in the *Encyclopædia Britannica*. Under this title the terra-cotta and massive marble tiles used on monumental buildings are briefly described and figured.

In a memoir entitled *Terrakotten am Geison*, etc., by Dörpfeld, Graeber, Borrmann and Siebold, a minute description is given of the terra-cotta roofing-tiles, ridge and terminal ridge-tiles, antifixæ, etc., of certain ancient Grecian temples. Of particular interest is the description of the roofing-tiles found on the site of the Temple of Hera at Olympia. This temple is one of the earliest ex-

amples of Greek architecture dating back, at least, eight or nine centuries before the Christian era. It will be noticed that this earliest known roofing-tile which Graeber designates as the normal tile, has a wide curved tegula, and a narrow semi-cylindrical imbrex (fig. 5) being identical with the Oriental one (compare fig. 11). The size of the tegula was 1.50 metres in length by .50 centimetres in breadth. Graeber says that this tile, common in the Middle Ages, is still much used to-day; it is particularly associated with convent roofs. I have before remarked that this normal tile of Graeber's differs from the normal tile in that region to-day in having a wide tegula and narrow imbrex. The nearest approach to this in the Middle Ages is the one seen on the old cathedral at Athens.

Graeber states that these early roofing-tiles of the Temple of Hera were covered with a black glaze; he also says that glazed tiles have been determined from Argos and Mycenæ. The tiles, however, on the Temple of Hera at Argos were not glazed. It is also stated that a few monumental buildings in Sicily, Italy, Peloponnesus and Athens reveal the use of roofing-tiles. Besides this primitive normal tile described by Graeber, there is another form of tile which must be regarded as an outgrowth from the normal tile, inasmuch as a narrow imbrex covers the line of junction between two adjacent tegulæ. In the last mentioned form the tegula is rectangular in shape, flat, with lateral edges turned upward as shown in fig. 37. Graeber describes two varieties of these, one found in Greece in which the upturned edge stands at right angles to the flat portion as shown in fig. 38. In the earlier forms of this variety the reflexed edge is low and is accompanied by a semi-cylindrical imbrex. At a very early date, however, the angular imbrex makes its appearance, and from the time marble tiles were adopted from the terra-cotta form, this becomes the definitive shape of the

imbrex. The other variety is peculiar to Sicily: in this the upturned edge preserves a convex surface; this form is also found in lower Italy, but is not exclusive, as other varieties also occur in that region. Fig. 37 represents the Sicilian form.

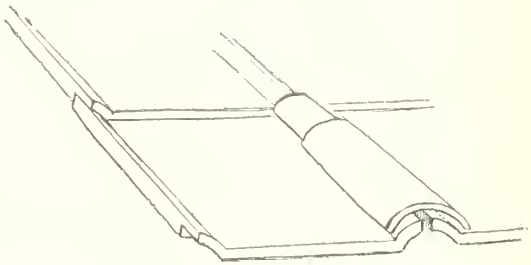


Fig. 37.

In the Boston Museum of Fine Arts, are fragments of tiles from Assos, Asia Minor, dating not farther back than the Roman epoch. The following figure (fig. 38) is a restoration showing the appearance of this tile in position.

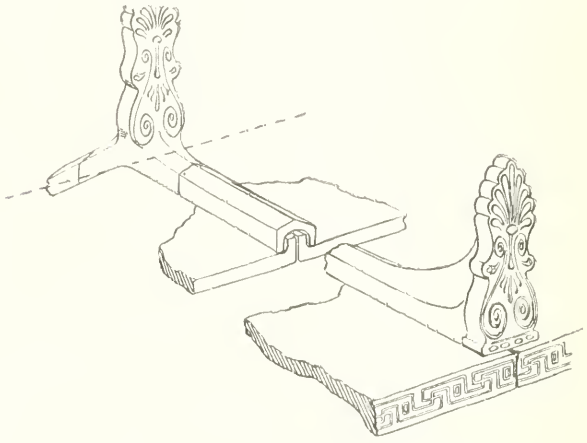


Fig. 38.

It will be seen that the eaves tegula has its margin turned down and bears upon its face an ornamental design in re-

lief. The eaves imbrex has its end closed, not by a circular disc, but by a broad ornamental piece standing erect with anthemion decoration in relief. These designs vary greatly in different fragments, but are all of the same general nature. The roof imbrex continues the same width over the ridge spanning it like a saddle, and has a similar process projecting upward at the crest with decoration in relief on both sides. A ridge-tile of the form of a plain imbrex probably covered the junction of the tegulæ at the crest. This treatment of the ridge-tile has no parallel in the Orient so far as I know. In another form the ridge-tile is semi-cylindrical bearing a leaf-like crest decorated in polychrome: on the lower edge a portion is cut out to admit the ends of the semi-cylindrical imbrices as they approach the crest (fig. 39). This figure is copied from

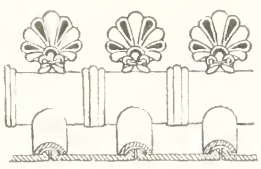


FIG. 39.

Boetticher's work on Olympia (p. 207) and represents a tile from the treasury of the Geloans (Sicilians) at Olympia. In the minute investigation of this subject made by Graeber, he often alludes to the great variety in the minor details of the roofing-tiles seen on these ancient sites. Referring to Olympia, he says: "still more striking than the diversity of the clay material is the multiformity of the kinds of construction presented by the antique roof in Olympia. The terra-cotta roofs there offer such a wealth of forms that one has well-nigh to doubt that all of them sprang from a handicraft native to Olympia, or to the district of Elis, and to believe rather that they repre-

sent an aggregation similar to that in a museum of all the constructions customary in Greece, Lower Italy and Sicily, and this supposition has verified itself, for further studies showed that at the places in Greece and Italy, which we visited, certain particular kinds of construction are used almost exclusively, and that the variety and multiplicity of forms found at Olympia occurred nowhere else to the same extent."

Speaking of the marble roof, Graeber says: "The general system and scheme of the antique marble roof is well known through many publications. This system, however, has not been invented for the marble roof, but had its prototype in the clay-tile roof. The antique roof had to pass through centuries of evolution till it attained that perfection which we admire in the Parthenon of Athens, and the Zeus Temple of Olympia and many other edifices. As regards elegance, one may even say subtility of perfection, the Greek tile roof ranks even above the marble roof."

I cannot forbear quoting further from this valuable memoir of Graeber's. He says in regard to the attachment of tiles on the roof: "A securing of the tiles on the rafters by means of nails did not take place; only the lowest tile, next to the gutter, was always secured by iron or bronze nails to the rafter. All tiles with nail-holes, therefore, belong, without exception, to the gutter, and just so little did the tiles have projections for hanging them to the laths as it is assumed erroneously of the marble roofs, but they rested directly on the rafters, and maintained themselves in their position in part by their weight, in part by supporting themselves through the next lower tile by means of the cutting on their lower surface. This may have occasioned, under certain circumstances, a heavy strain; for instance, a sliding down, involving even the lowest gutter or moulding tiles." And he refers to the

condition of things at the Zeus Temple at Olympia as due to the sliding down of the tiles in this manner.

Graeber presents a restoration of the edge of the roof of Temple C. Selinus, Sicily (fig. 40). Here the elevated process or antifixa of the eaves imbrex is now detached, and forms a separate piece, which is nailed to the stone coping, and the turned margin of the eaves tegula is also separate, and is nailed to the face of the coping-stone. These various elements were moulded in relief and beautifully decorated in polychrome. This temple is supposed to date from 600 B. C.

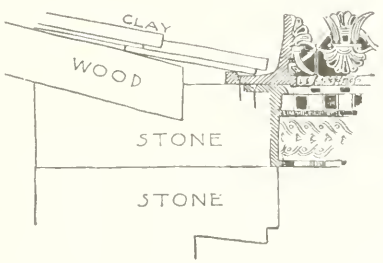


FIG. 40.

Reference has been made to the marble tiles following the form of the later terra-cotta tiles. It has also been shown that the pan tile of Europe has been derived from the normal tile by combining in one piece the upper and lower elements. It is interesting to observe that in the marble tiles of ancient Greece the same combination is shown in some, where the imbrex and flat tegula with upturned edge are combined, and, curiously enough, the lap is to the right, as followed by the pan tile of Europe.

ITALY.

Throughout Italy, the usual covering for house roofs is the normal tile (*imb.*). The tiles vary somewhat in size. In Pavia and Ravenna the tiles are quite large, and in

section somewhat angular. In Verona, the tiles appear quite long. Photographs of Parma, Milan, Pavia, Bologna and other cities reveal minor peculiarities in the manner of tiling. In some cases courses of imbrices are close together, and the tiles are often crowded in the courses from eaves to ridge. There is no alignment of the tiles, as in Chinese, Korean and Japanese tiling, and the work always seems slovenly done.

In Verona, fragments of tiles are inserted in the inter-spaces between the ridge-tiles and their junction with the roof-tiles, as shown in fig. 41. At Certosa and Milan rows of imbrices with their concave faces uppermost are placed between the rows of imbrices in their normal position. In other words, after the roof is tiled in the ordinary way, an additional layer is put on in an inverted position between the rows of imbrices. The roofs are low pitched and this extra layer probably offers an additional security.

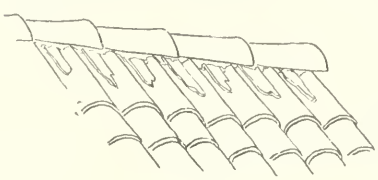


FIG. 41.

Beside the normal tile there is often seen a broad flat tile, with lateral edges turned up accompanied by a semi-cylindrical imbrex. This tile is used in Rome, Florence, Sienna, Pisa, Ravenna and doubtless in other cities of Italy. An examination of a large series of photographs shows it to be more common in central Italy. On the roof slopes the broad tegula may be seen in certain courses used as an imbrex (fig. 42).

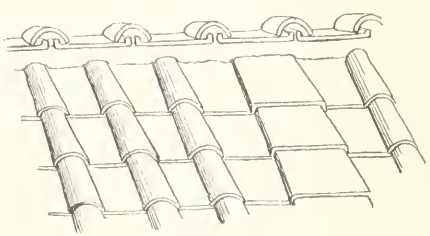


FIG. 42.

This broad tile bedded in stucco is also used as a ridge-tile as shown in the last figure (fig. 42). This tile is a direct survival of the ancient Roman tile which in turn has been derived from the Greeks, unless both Greeks and Romans were indebted to the Etruscans for it. The modern tile is much smaller and thinner. It is often represented in the pictures of old Italian masters (fig. 43). (From a painting by Botticelli in Dresden gallery.)

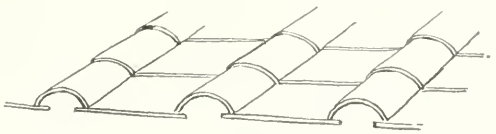


Fig. 43.

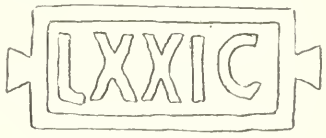
A modern tile, probably interlocking, quite small in size, but made somewhat after the style of the tile last described, is occasionally seen. The tegula tapers much more abruptly and is used as an imbrex.

ANCIENT ITALY.

The ancient Roman tile consists of a large flat rectangular tegula with lateral edges turned up, and a narrow semi-cylindrical or angular imbrex, both tegula and imbrex being heavy and massive.

At the Antiquarian Museum at Zurich are a number of ancient Roman tiles; these have the lateral edges abruptly turned up, the imbrex is angular in section (fig. 44). On the exposed and lower edge of the tegula are a few curved marks as if made by the fingers. As these marks are seen on similar Roman tiles at the Royal Antiquarian Museum at Brussels and elsewhere, it would seem to be a special furnace-mark of the maker, or possibly to indicate the lower end of the tile. On the under surface of each tegula,

inclosed in a rectangular panel is impressed the Roman characters LXXIC. This was the mark of the 21st Legion, showing that the Roman soldiers were accompanied by tile-makers, as well as by those pursuing other trades. At the museum last named are some ancient Roman tiles resembling those mentioned by Graeber in the memoir previously alluded to. In these tiles the turned edges differ slightly from those figured by Graeber; the



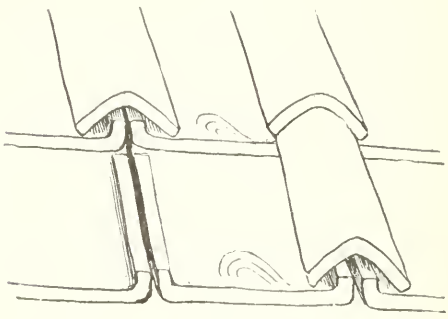


Fig. 44.

lower corners were recessed, however, to fit on the tile below, and the turned edge ceased within a short distance of the top of the tile (fig. 45). There were no perforations for pegs or nails to hold the tile to the roof as is described in similar tiles figured by other authorities.

In the ancient cemetery of Marzabotto, near Bologna, the contents of which have been figured and described with great fidelity by Count Gozzadini, a number of terra-cotta

roofing-tiles were found. These were made after the flat Roman pattern, but were remarkable not only for their massive size, but for certain structural peculiarities, not seen in the typical Roman form. The tegula measured 1.07 metres in length by .80 centimetres in width (fig. 46A). In some examples the upper inferior margin was turned at right angles, and this was strengthened by a thin brace as shown in the fragment (fig. 46D). On the superior surface of the tegula a rounded knob was present (fig. 46E). This was perforated for the admission of a bronze nail having a thin concavo-convex head (fig. 46F), which conformed to the shallow and lenticular knob on the

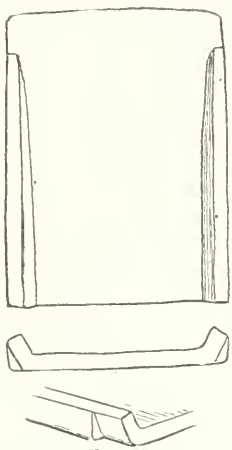


Fig. 45.

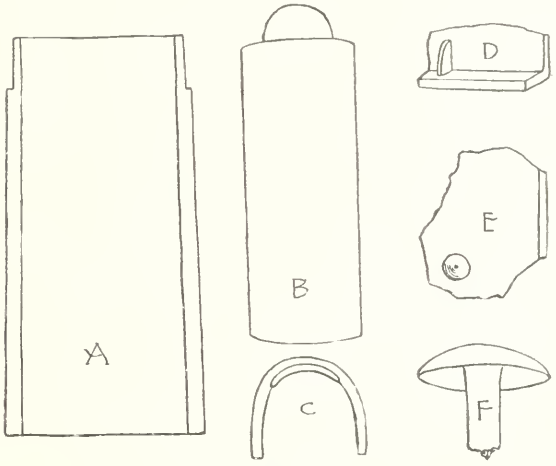


Fig. 46.

tile; by this device the rain was more thoroughly excluded. The imbrices varied in length, the longest being .82 centimeters in length, with a width of .28 centimeters and a

height of .26 centimeters (fig. 46BC.) (The drawings as published do not show these proportions). Many of these fragments show traces of polychrome decoration on their exposed surfaces.

Concerning the age of the Marzabotto cemetery, George Dennis in his *Cities and Cemeteries of Etruria* (Vol. II, p. 543), says "we may safely refer the antiquities found at Marzabotto to the latest days of Etruscan independence, north of the Appenines, which came to an end on the invasion of the Boian Gauls, at the beginning of the fourth century B. C."

SICILY.

The normal tile (*imb.*) is the common form throughout the island. In one old building at Palermo, the tiles are crowded together, from the ridge to the eaves. At Taormina the eaves tiles are pointed with plaster.

SPAIN.

In this country the roofing-tiles everywhere seen belong to the normal tile (*imb.*). These are usually semicircular in section and much larger than the forms farther east. At Burgos the tiles are crowded on the roof, at the eaves the ends of the tiles are pointed with plaster. At Granada a similar treatment of the eaves tiles is seen. In one portion of the Alhambra, light and dark tiles are arranged on the roof in such a way that a clearly marked zigzag pattern is carried out. In another and older portion of the Alhambra, the tiles, instead of being roundly curved in section, are somewhat angular. At the eaves, the imbrices are doubled and, between the upper and lower imbrex, separated by the space equal to the width of a tile; a mass of white stucco or plaster is interposed. As there appears no break in the alignment of the tiles from the eaves to the roof, the lower course of eaves tiles probably rests horizon-

tally on a projecting cornice, the plaster diminishing in thickness backward for a few courses as shown in fig. 47. An evidence that this is so is shown in an end view of another portion of the building, where a cornice or shelf, projecting below the eaves, has settled by the weight of plaster and tiles above.

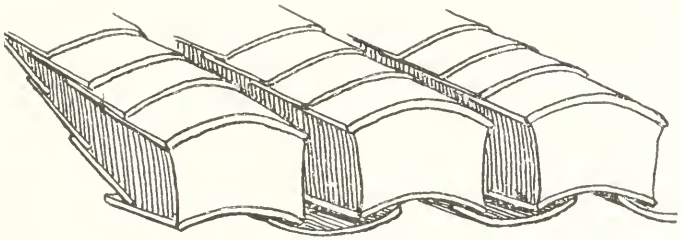


FIG. 47.

At Seville, Alcazar and other places, the courses of tiles are slightly separated at the eaves and the spaces enclosed by the tiles are filled with white stucco, as shown in fig. 48.

In a picture of the Church of S. Maria de L'Antigua at Valladolid, Spain, published in the *American Architect* for December 10, 1887, the typical Spanish tile is shown.

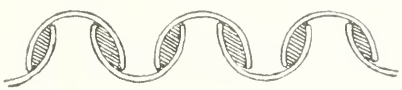


FIG. 48.

The tower of this church seems to be covered with a pointed flat tile.

MEDITERRANEAN BORDERS.

A rapid examination of a collection of photographs of places bordering the Mediterranean, from the Isle of Rhodes to Tangiers, shows the universal use of the normal tile (*imb.*). A picture of the mosque of Tangiers shows a wall, or a house with unperforated wall, having a very steep

pitched-roof covered with somewhat smaller tiles than those cited from Spain. The ridge is covered with the ordinary ridge-tile elevated to a considerable distance above the roof, the interspace apparently filled with white stucco or plaster, giving it an appearance in the photograph, of a high and narrow vertical ridge. The tiles are very unevenly laid, and it will be noticed that in the photographs of Spain, Italy and other countries bordering the Mediterranean, the tiling seems always to have been done in a slovenly manner. This appearance is probably due, in many cases, to the buildings being old and the tiles having being thrown out of alignment by the wind and other agencies. The thorough and accurate way in which the Asiatic roofs are tiled stands out in marked contrast to the loose manner of tiling of western nations using the normal tile.

MEXICO.

I am indebted to Mr. Sylvester Baxter and Mr. Denman W. Ross for photographs and descriptions of the roofing-tiles of this country. Mr. Baxter observed on some roofs a large flat tile either plain or corrugated, the corrugations being quite near together. These were usually coated with a golden-green glaze. Around the City of Mexico and in the high table-lands the flat tile was used. Photographs of buildings at Orizaba, taken by Mr. Ross, show a large tile identical with the Spanish form. Mr. Baxter observed that in some cases the lower tile was painted white on the upper surface, white lead being apparently used, and presumably to make the roof water-tight. He also observed at Cuantla, Morelos, in the tierra caliente, a large flat tile with upturned edges and semi-cylindrical imbrex. A similar form to this has already been described from Central Italy, and, as before remarked, is a survival of the ancient Roman tile. The modern form is much thinner. The tiles bordering the eaves differ in no re-

spect from the others, though the under course of tiles may be laid double.

Chili, Peru and other South American countries have the normal tile (*imb.*) and this runs up on the west coast to California.

BELGIUM AND HOLLAND.

The pan tile is the dominant form in these two countries. That it was also the common form a few hundred years ago is shown in pictures of the old Dutch masters.

In Holland, one may often see roofs thatched half-way down and tiled the rest of the way to the eaves. In the better class of houses in the country the entire roof is tiled. At Utrecht, large, slightly-bent tiles are used for ridge and hip. The pan tile is often made with a square opening in it in which glass is fitted. The tiles are often glazed either red, gray or blue. In Belgium, they appear either black or bright red. On very old churches the normal tile (*imb.*) is seen.

It is interesting to observe that in those portions of Germany, bordering on Holland and Belgium, the German flat tile is supplanted in a measure.

The pan tile, *pannen tegchel*, as it is called in Holland, evidently originated in Holland or Belgium. In England it retains the Dutch name *pannen*, anglicized to pan. It is also called the Fleming tile. In Poland, it is called the Holland tile.

NORWAY, SWEDEN AND DENMARK.

The pan tile is in universal use in these countries. In Norway, away from the larger cities, wooden shingles painted red form the ordinary roof covering. The pan tile is often a bright brick-red in color, or glazed a dark brown. The red-painted wooden roofs would seem to be an imitation of the red tiled roof. In Christiania, an old

house with the date 1662 was covered with pan tiles. In Bergen, the pan tile is commonly seen.

Mr. Ipsen informs me that in Copenhagen the normal tile (*imb.*) is sometimes found on old churches, and is commonly known by the name of monk tile; this name indicating that in Denmark, as in Germany, this form of tile was introduced by the monks from the South.

JAVA.

At Buitenzorg and other towns in the interior of Java a pan tile is seen. The tile is well made, very light and

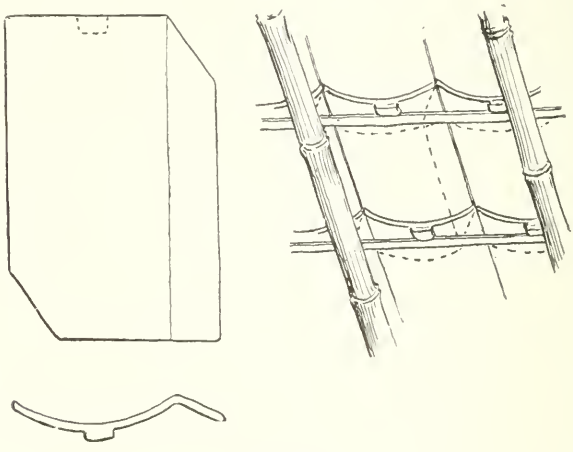


FIG. 49.

thin, and having a length and breadth respectively of 28 centimetres by 18 centimetres. The covering edge is flat, and not curving, as is usual. The upper edge of the tile has a nib which holds it to the battens fixed to bamboo rafters (fig. 49).

I do not recall seeing an eaves tile with turned margins.

There are many Chinese in Java, and their buildings present the type of the Southern Chinese. On these buildings the normal tile (*imb.*) probably occurs, but I made

no note of this matter during my visit there. The pan tile has probably been introduced by the Dutch, or possibly by the English before the Dutch. Fig. 50 is reproduced from a photograph showing the appearance of

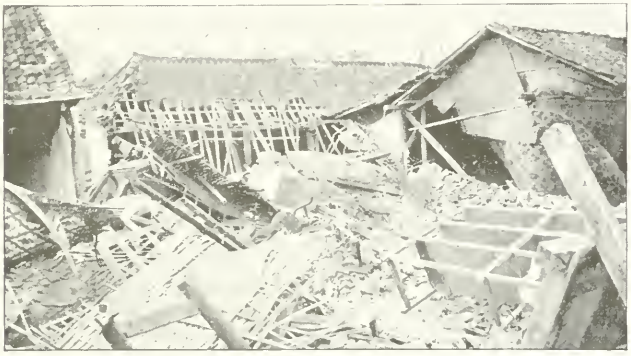


FIG. 50.

Java houses after a shock of earthquake. In this is shown the light structure of the roof supporting the tiles.

GERMANY.

Throughout Germany the flat tile is the common form. When the lower border of this tile is slightly rounded it

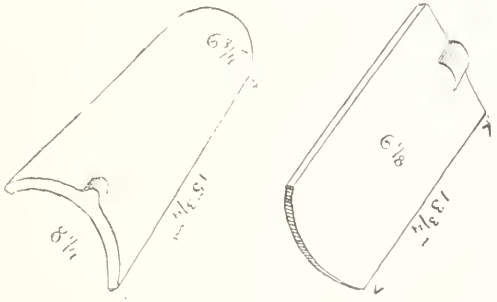


FIG. 51.

is called, in certain portions of the country, "beaver-tail" (fig. 51A). In Berlin the lower border of the tile is

usually rounded (fig. 52), in Weimar it is square at the end, in Nuremberg it is pointed (fig. 53). Occasionally the tiles are laid in a double layer as shown in fig. 54. The flat tile not only extends throughout Germany but runs south to Switzerland, west through France,

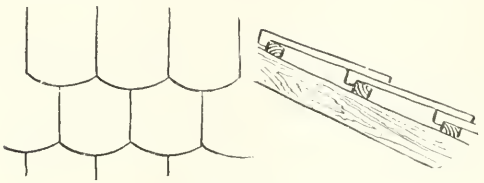


Fig. 52.

at least through the central and northern portions, and southeast through Austria to Hungary and Poland, and, probably, northeast to Russia. As one approaches Belgium and Holland, the home of the pan tile, this tile frequently takes the place of the flat tile, as seen at Dusseldorf, Bonn, Cologne, Bremen and Hamburg. This tile is commonly red or glazed black. The pan tile is also occasionally seen farther south. At Freiburg it is known by the name of "Jumping hound," from its fancied resemblance, at the eaves, to the movements of jumping hounds. In the country around Bremen and Hamburg the roofs are often

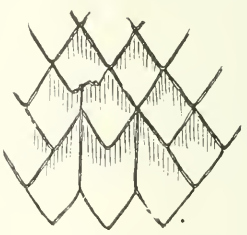


Fig. 53.

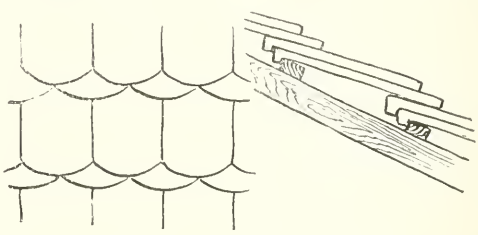


Fig. 54.

thatched, but in these cases a square area about the chimney — which looks odd thrust up through a thatched roof — is covered with pan tiles. In many of these pan-tiled

roofs the eaves, ridge and ends of the roof are often finished with a few courses of slate, as shown in fig. 55. In Bremen a heavy ridge-tile of the ordinary form is used (fig. 56).

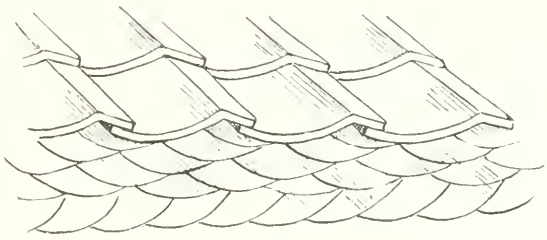


FIG. 55.

In very old buildings throughout Germany, usually on old churches and convents, the normal tile (*imb.*) is often seen. Professor Virchow informed me that this tile was introduced into Germany by monks, from the Rhine, in the twelfth century. As before remarked, this tile is known as the monk tile in Copenhagen.

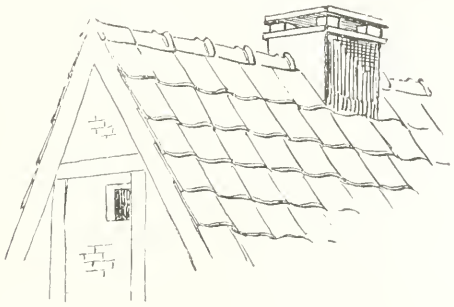


FIG. 56.

The appearance of a flat tiled roof, as seen from within is shown in fig. 57, sketched in the attic of an old house in Nuremberg. Here the manner of propping up a tile with a stick, for the purpose of letting in light is shown: this is done for light and not for ventilation, as the roof is

sufficiently ventilated by the loose adjustment of the tiles. Other means for admitting light to the attic are shown in

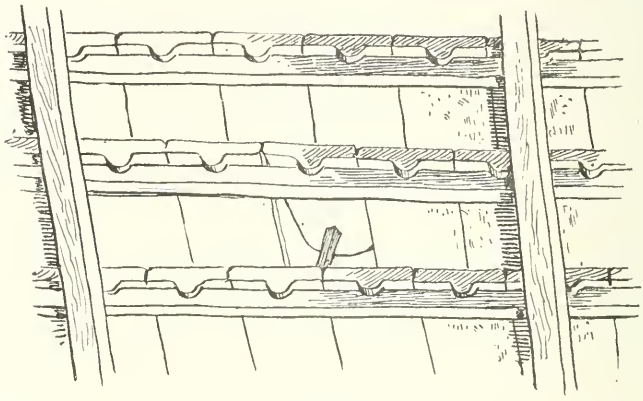


Fig. 57.

fig. 58 (Freiburg) and 59 (Weimar). These hoods or dormer windows are made out of a single piece of terra-

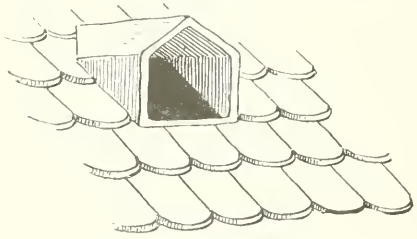


Fig. 58.

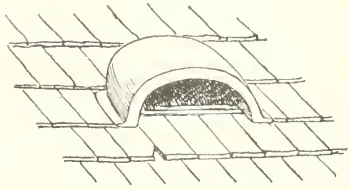


Fig. 59.

cotta ; they are secured to the roof by a broad flange around which the tiles are fitted.

Fig. 60 shows the manner of finishing the end of a roof; the battens upon which the tiles are hung project through the wall and the tiles are cut longitudinally to continue the alternate adjustment of tiles to the edge.

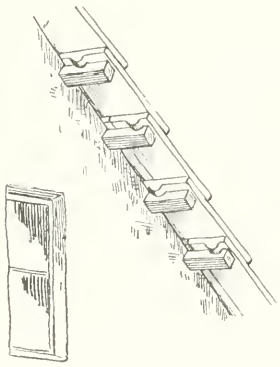


Fig. 60.

At Nuremberg the flat tile is everywhere seen Fig. 61 is reduced from a photograph of Nuremberg houses showing how deftly the tile is handled in covering dormer

Fig. 61.

windows and various projections. In some cases the lower border of the tile is rounded, in others pointed. Other

forms of tile are seen in this picturesque old city. On the old Roman tower of the castle may be seen a large, thick, coarsely made semi-cylindrical tile, being much larger at the upper end, measuring .51 centimetres in length, and a width at its widest end of .15 centimetres. This tile has a thick nib to hold it to the battens. The

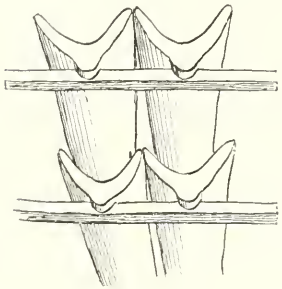


FIG. 62.

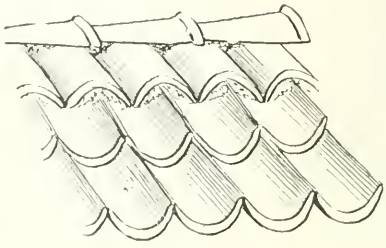


FIG. 63.

spaces between the tiles were thickly plastered though greatly out of repair, as gleams of light were coming through various chinks. Fig. 62 shows the appearance of this tile from within the roof, while the appearance from without is shown in fig. 63. This sketch is taken from the castle wall tower which is supposed to be nearly 400

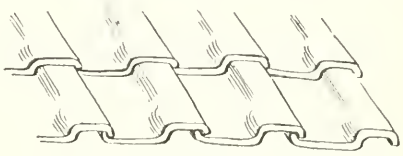


FIG. 64.

years old. The ridge is seen covered with ordinary semi-cylindrical tiles, while a single course of tiles next to the ridge shows the roof-tile used in the form of an imbrex. All the interstices were thickly plastered. The tile was accounted the oldest form used in Nuremberg, and may be regarded as the normal tile. A recent form of tile, which may be looked upon as an extreme modification of

a pan tile, is seen on certain portions of the city wall (fig. 64). At Urfurt (fig. 65) and Wurtzburg (fig. 66) a tile is often seen with a slight ridge turned up on one side, and a recurved edge on the opposite side which laps over the slight ridge on the next tile. This form is certainly a modification of the pan tile, and curiously enough laps

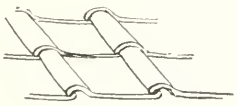


FIG. 65.

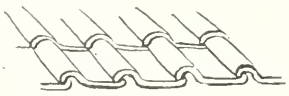


FIG. 66.

to the left, as in the case of the Japanese pan tile. At Hildesheim old houses are covered with a similar form of tile lapping to the left.

POLAND.

I am indebted to Mr. J. Adamowski for information concerning the roofing-tiles of Poland. An architect friend of his, Mr. Kozlowski, of Czenstochowa, writes that the most common form of tile in Poland is the flat tile with rounded end, differing in no respect from the ordinary German tile, and usually laid in a double row, as shown in fig. 54. The dimensions, in English inches, are 7 by 14.

The pan tile lapping to the right is also seen in old buildings and churches. It is no longer made in Poland. This tile is known by the name of Holland tile, and its introduction to Poland may have been by way of the Baltic.

RUSSIA.

An examination of photographs and numerous inquiries show that the tiled roof is not common, but, when seen, it is composed of the flat tile. Dr. Berlin, a Russian physician, and her brother, stated to me that formerly an

angular tile, in form like the ridge-tile, was used as a roofing-tile. These tiles were placed in rows running from the ridge to the eaves, with the crest uppermost, no under tiles being used. The tiles were simply bedded in cows' manure. Repeated questioning failed to modify this statement. It is recorded that in other regions in the east it is customary to plaster the house with manure.

Photographs from the Caucasus show the normal tile (*imb.*) in use.

SWITZERLAND.

The flat tile is everywhere common in Berne, Zurich and other parts of northern Switzerland. In very old houses the normal tile (*imb.*) is occasionally seen (fig. 67), but even in these cases the newer additions to the roof are covered with a flat tile. In some instances the ridge is finished with wood or metal, instead of the usual ridge-tile. The tiles are often seen aligned instead of breaking joint; in this case the roof is first shingled. An elaborate structure of brick, stone and roofing-tile, held together by mortar, forms the top of most of the chimneys, and suggests the idea of a bird-house, or such an affair as a child might build with blocks.

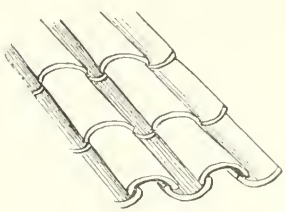


FIG. 67.

They are certainly picturesque and apparently durable, as none of them seem to be dilapidated. Fig. 68 is reproduced from a rough sketch of a few chimney tops in Berne.

At the Historical Museum at Berne, I found an interesting collection of roofing-tiles. I learned that the curator of this department was an architect, and this accounted for the extent of the collection, which was the best one that I saw anywhere in Europe. Among the tiles was one

from the Castle of Trachselwald with the date of 1300 on the label. This was a flat tile with pointed end. It was 34.2 centimetres long and 19 centimetres wide. A rude

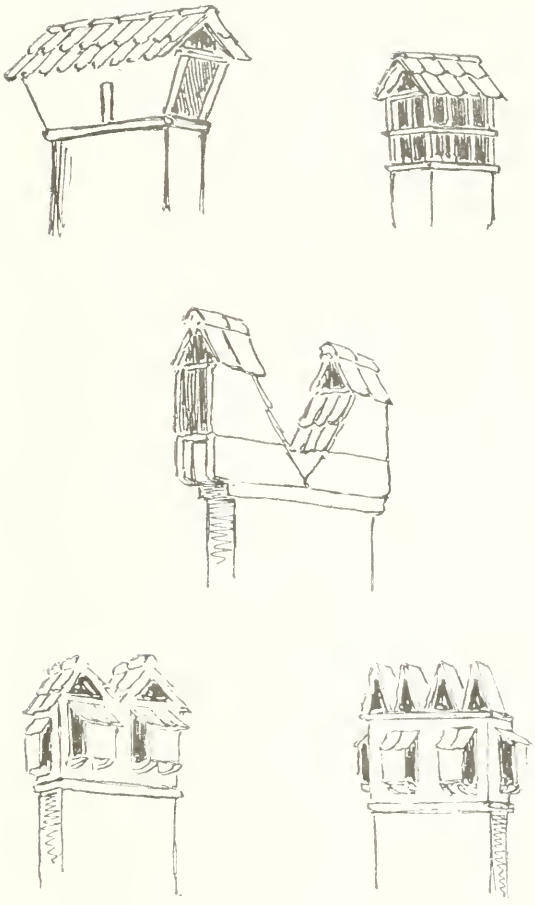


Fig. 68.

figure of a bear with rough bars below and above, enclosed in a circular panel, was impressed upon the tile near its

lower end (fig. 69). Another flat tile, also pointed at the lower end, had two many-rayed stars impressed upon it. The date 1666 had been incised with a small point across the middle of the tile, and at the square end the same date had been marked with the finger (fig. 70). This tile was

Fig. 69.

Fig. 70.

36.8 centimetres long and 19.3 centimetres wide. In this collection was a curious glazed tile, evidently made for the top of a stove, but representing a sloping roof. This had alternate squares of brown and straw-colored glaze, representing the pointed flat tile. Its date was supposed to be

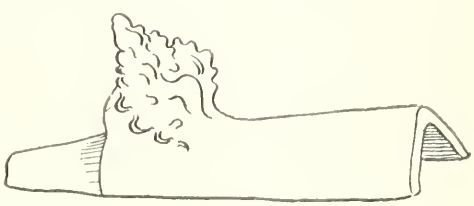


Fig. 71.

1300. In the collection were also ridge-tiles with foliated ornament (fig. 71). These were green glazed, and labelled Castle Thurgau, Canton of Thurgau, city of Arbon. The specimen figured was 37 centimetres in length.

At the Antiquarian Museum at Zurich were preserved a few old flat tiles (fig. 72). These far exceeded the dimensions of the other flat tiles described, one specimen measuring 46.8 centimetres in length and 17.2 centimetres in breadth. The nib was large and broad, and the lower end of the tile was roundly pointed. Another specimen of the same length, and having a breadth of 23.5 centimetres, was pointed, the pointed end being cut off square.

The lower exposed portion was coated with salt glaze; the nib was small and recurved. These tiles were about 350 years old.

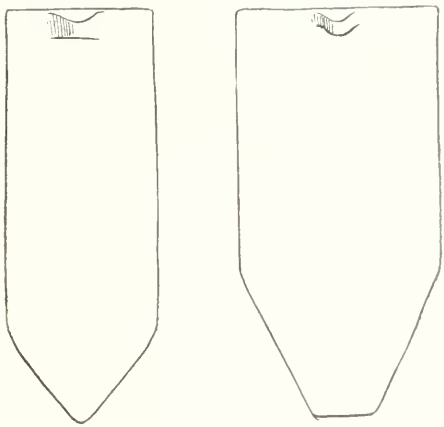


FIG. 72.

At Basle the buildings were somewhat mongrel in their appearance, partially losing their Swiss character without assuming their German character. The tiles were flat with rounded ends. On the old cathedral in this town the tiles were glazed green, red and white and in the rebuilding of certain portions of the cathedral new flat tiles, glazed the same colors, were being used, the bright glaze of even the old tiles forming a startling and disagreeable contrast to the time-stained stone and other material of the structure. Some interesting ridge-tiles with green and brown glazes

were found in a local museum. These had Gothic scrolls and leaves springing from their crests; in one case the finial was held to the tile by an iron rod, as a dowel. (The height of this tile was .67 centimetres.) These

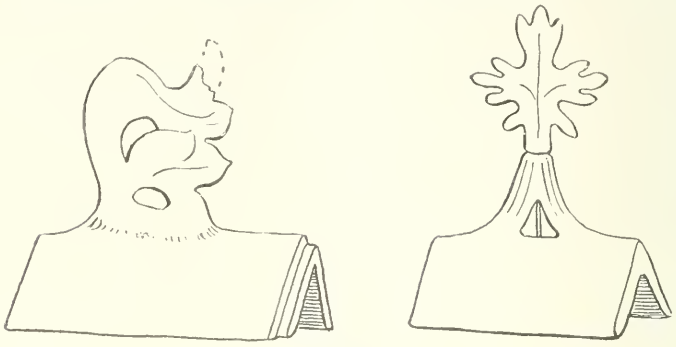


Fig. 73.

tiles were labelled Nicholas Chapel, fifteenth century (fig. 73). At Interlachen, the flat tile was seen on some of the older buildings, the modern structure being roofed with modern forms of tiles, which seemed to have certain merits in securing a tight roof (figs. 74 and 75).[1]

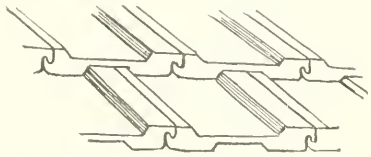


Fig. 74.

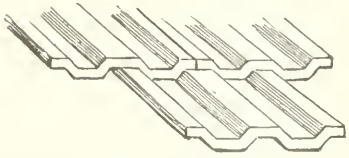


Fig. 75.

[1] A modern interlocking tile is made at Allkirch village, Canton of Berne, by Gilardoni Brothers. I found it on many houses at Berne, and, if I remember rightly, it was the tile used on the new arsenal at Berne.

The new arsenal at Berne had a tiled roof resting on battens, each tile so loose that it could be easily pushed up from within. There was no sheathing beneath, and here and there glints of light could be seen. Indeed, it was blowing a gale and snowing at the time I was there, and a little snow had blown in. That the roof was waterproof was implied by the fact that a new building filled with polished weapons had only this kind of a roof-covering for protection. From the behavior of certain tiled roofs in our country, we have certainly not yet learned the secret of a good tile.

FRANCE.

My information concerning French roofing-tiles is very meagre, being chiefly based on hasty notes made in Paris and vicinity, and observations from the main railways from Paris to Brussels and Calais respectively, supplemented by the examination of a few photographs.

The flat tile appears to be the dominant form throughout central and northern France, while the normal tile (*imb.*) is common farther south, and especially along the Mediterranean. The flat tile is usually square at its lower end and smaller than the German or Swiss form. At the Paris Exposition many forms of roofing-tiles were exhibited from French tileries, among which were large numbers of flat tiles.

The introduction of roofing-tiles among the peasantry must have been comparatively recent. Leslie (*Essays on Moral and Political Philosophy*), writing of Puy-de-Dôme, a central department of France, says: "I saw many instances of a change which is the precursor of an elevation of the standard of habitation, namely, the substitution of tile for thatch roof." In Spenser's Sociological Tables a number of references are conveniently accessible concern-

ing the roofing material in France in early centuries. Vitruvius, the famous Roman architect, in the first century of our era says: "The Gauls to this day build their houses of boughs, reeds and mud, with roofing of oaken shingles or of straw. Even at Massalia we may observe roofs made without tiles, of earth kneaded, as it were, with straw." "It appears from Orderic's narrative (1090 A. D.) that the roof of the castle was covered with shingles of wood instead of slates or tiles. This is still the case with respect to many of the towers of the country churches in the Lieuvin and the Roumois."

"The working of plaster quarries, the use of tiles for roofing houses and afterwards the discovery of slate . . . entirely changed the appearance of houses. It was only in the fifteenth century that slate was used. In 1465 it was just begun to be known of." (Chérul, *Dictionary of Institutions, Manners and Customs of France.*)

GREAT BRITAIN.

In England two kinds of roofing-tiles are in use: the flat tile, which is the form most commonly seen, and the pan tile, which is found widely distributed. This tile is also known as the Flemish tile, this name implying that it was first introduced from Flanders.

The cheapness and excellent quality of slate and its almost universal use have evidently checked the development of the roofing-tile. One sees no attempt at architectural effect in the treatment of the roof, but the tiling is done in that durable manner which characterizes English work in general. The head of the pan tile has two nibs instead of the usual single one, and the tiles are adjusted with greater care to the roof.

In the collection of building material at the South Kensington Museum may be seen a great variety of roofing-

tiles. In the catalogue of this material, published by this museum in 1876, these roofing-tiles are variously recorded as plain tiles, red, green and brown: plain tiles colored to match old tiling; terra metallic; single, double and treble channelled tiles; flat or Roman ornamental roofing-tiles; ridge-tiles with ornamental crests, and many others. As most of these tiles are modern productions (many of them the result of England's awakening which followed the World's Fair of 1851, and the renewed impulse of the French Exposition of 1855), their consideration does not properly come within the scope of this paper. One tile, however, figured in the catalogue above referred to, appears interesting as well as serviceable (fig. 76). It is a French tile known as the tile Courtois, from the name of its inventor. It seems to have the merit of simplicity and but little of the tile is concealed in the lap. In 1856–57, this tile was made at Stamford, England, and used on a number of buildings. In 1876, a tile somewhat similar to this was made near Hull. Many of the tiles mentioned in the catalogue failed to come into general use. An example of the treble channelled tile I saw at Cambridge, England, and, curiously enough, at Stockholm. This tile might be regarded as a variety of the pan tile with three equidistant folds, the side lap being made as in the pan tile.

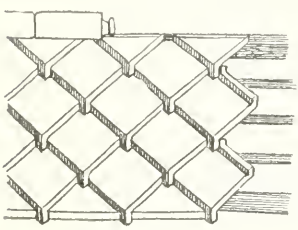


FIG. 76.

From various sources one may gather a continuous history of the introduction and successive appearances of the various forms of roofing-tiles in England. The early British houses were circular, with low stone walls and conical shingle roofs. With such a form of roof the use of terra-cotta roofing-tiles was well nigh impossible, and a square

house with the ordinary sloping roof must have preceded the use of roofing-tiles.

Before the introduction of pottery tiles, rough stones were used for roof coverings. "In localities which supplied laminated stones such as Gloucestershire and Hampshire in Britain, the Romans often roofed their buildings with stone tiles fastened on with iron nails" (see tiles, *Encyclopædia Britannica*). Lieutenant-general Pitt-Rivers in a communication on an ancient British settlement excavated near Rushmore, Salisbury (*Journal Anthropological Institute*, Vol. XVII, p. 190), records that "tiles of Purbeck shale, with nail-holes to fasten them by, were also found more frequently in the rich quarter than elsewhere and terra-cotta tegulæ were also found there, but only in fragments and used as pavements, for which purpose these tiles were frequently employed elsewhere. The absence of imbrices which are a necessary adjunct in the formation of a Roman tiled roof confirms the opinion that the roofs of the Romano-British village were not tiled in this way. Although the fragments of the tiles show that they had certainly been originally constructed for roofing, their use for a second-hand purpose conveys the impression of poverty, although too much stress must not be laid upon the circumstances."

It would be interesting to ascertain whether any fragments of these tegulæ had traces of cement upon them, for we have seen that in Japan, the tegulæ well bedded in clay or pointed with mortar may be used without imbrices.

It was customary in the Middle Ages and up to within recent centuries to use rough-stone tiling. At Broadway, near Worcester, England, one may see a village in which many of the cottage roofs are tiled with small flat stones of the roughest description. These are held to the roof by oaken pins which suspend them on the battens placed

across the rafters for the purpose. Fig. 77 shows the appearance of one of these cottage roofs and the manner in which even the small roofs of dormer windows and hips may be neatly covered by this rough material.

Fig. 78 shows the appearance of a portion of the roof from within. The stone tile (fig. 79) used for this purpose measures, roughly, .22 centimetres in length by .14 centimetres in breadth, with a general thickness of .02 centimetres. It is made of some fossiliferous limestone. I learned that these houses were over three hundred years

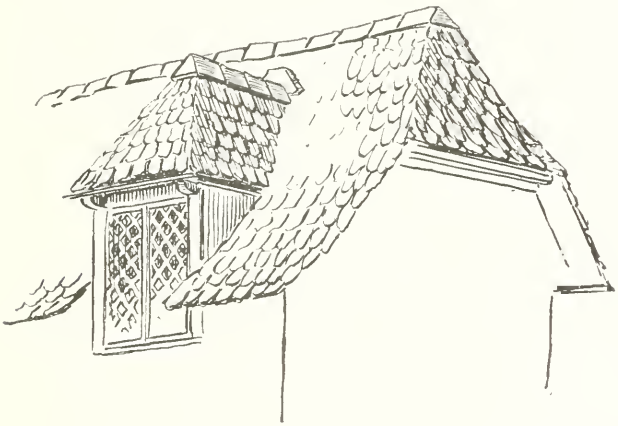


FIG. 77.

old. I also observed on one of the oldest houses in Oxford similar rough-stone tiles, and doubtless, they occur in many other places.

Mr. Ross Turner informs me that in Bermuda a rough, flat tile is cut from the coral sandstone rock, and cedar pins are used to hold the tiles to the roof after the manner of the rough, stone tile just described. An old house at St. Georges, over two-hundred years old, and St. Peter's Church, St. Georges (1630–40) were covered with this tile and they are in use to-day.

In an interesting work by Thomas Wright on the *Homes of Other Days*, many reproductions of old drawings of Saxon and Norman times are given, from which some hints of the kinds of roofing tiles in use may be found. From the Harleian MS. dating from the ninth century, a picture is given of an Anglo-Saxon house; in this picture a variety of roofing-tiles are shown, the most conspicuous of which is the normal tile. The flat Roman tile is also given, and another form resembling round-ended flat tiles, though these may be wooden shingles. Flat Roman tiles again

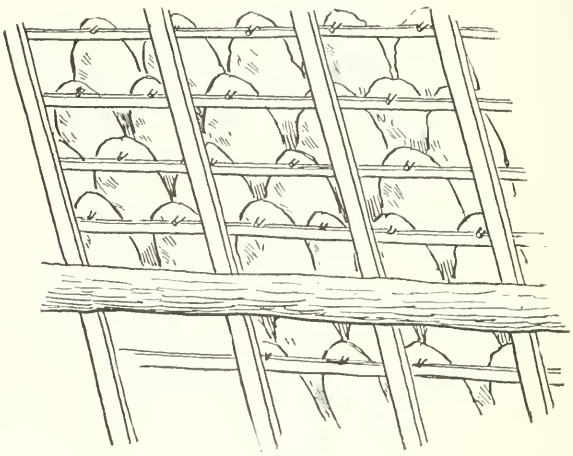


Fig. 78.

appear in another drawing of the tenth century, and in another picture of this epoch the flat tile, with round end, and the normal tile are represented. A picture of a town of the tenth century shows only the normal tile. In an Anglo-Saxon MS. of the Psalms, the normal tile is indicated, and what appears to be an imbricated ridge of tiles. In a roof shown in the Bayeux tapestry, the normal tile is seen. In an early Saxon illumination, a large normal tile is shown. In early Norman times, the normal tile is de-

picted in the drawings. In all the above cases the normal tile (*imb.*) is the one indicated. A complete view of a house is shown in a MS. of the fourteenth century, and this represents the flat tile rounded at its lower end. In the same MS. flat tiles are shown arranged in a form often seen in the arrangement of slates in England to-day, where an interspace of an inch or more is left between contiguous slates in an horizontal line. From this time on, the flat tile is the only one shown in the various drawings given. It would seem by this that the pan tile was introduced from Belgium within recent centuries.

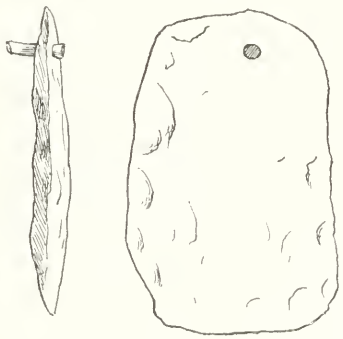


FIG. 79.

In consequence of the frequency of fires it was enacted in the first year of Richard I (1189) that the lower story of all houses in the City of London should be built with stone and the roofs covered with slate or tile (*Pictorial History of England*, Vol. II, p. 230). In the fourteenth century, London houses were generally roofed with tiles.

"In taking down part of a late Norman building in Southwark some years ago, to make the approaches to the present London bridge, some tiles were found built into the wall and may have formed part of the original structure. They were thirteen inches by eight inches and varied in

thickness from five-eighths of an inch to an inch. Half of one side, which would have been exposed upon a roof, was glazed, and they were made with pin-holes in them, as is still the custom in some districts." (*Glossary of Architecture*, Vol. 1, p. 463). In the work above cited it is stated that, in the fourteenth century, "the manufacture of tile was one of sufficient importance in England to require regulation by statute . . . whereby the dimensions of plain tile are fixed at ten by six and one-fourth and half an inch and half-quarter thick, at least. Roof or crese tile at thirteen inches long, thickness same as other." Also that, in the Middle Ages, tiles were extensively employed in covering buildings though they seem always to have been considered an inferior material to lead. In the same work are given some remarkable ridge-tiles with figures, crosses, etc., modelled upon them. These were found at Great Malvern and London; the statement is also made that flat tiles only were used at that time.

From the above data, we venture to suggest the following historical sequence in the introduction of the various forms of roofing-tiles into Great Britain: First, the large flat Roman tile and the same time the rude stone tile probably devised by the Romans while in England. Second, the normal tile, probably introduced by monks. Third, the flat tile introduced from Normandy, and, finally, the pan tile introduced from Belgium.

The flat tile is not only used for roofing but is also used in finishing the vertical walls of a gable end. In this case the tiles may be cut pointed, or otherwise shaped, as in fig. 80. Dobson's hand-book of *Tiles and Tile-making* says that pan tiles were formerly made with holes in them for the reception of the tile-pins by which they were hung on the laths. The common method now is to turn down a couple of nibs at the head of the tile, which answers

the same purpose. The roofing-tile is used for other purposes besides that for which it was originally designed. In flower-gardens the flat, round-ended tile is found very serviceable in separating beds or bordering paths, the tiles being partially buried in the ground vertically, forming a much better dividing line than do strips of board, which soon decay. As a coping for brick walls the roof-shaped ridge-tile forms a good and picturesque top. The same form of ridge-tile placed in an inverted position may often be seen on the steep slopes of grass-covered railroad enbankments, as cheap and useful water-conductors.

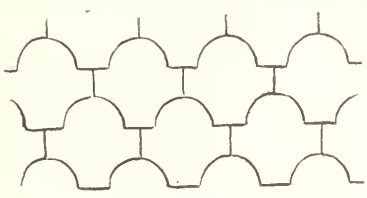


FIG. 89.

UNITED STATES.

We have seen in the course of this paper that in all parts of the world, outside of savage areas and under all climatic conditions, people shelter themselves beneath roofs covered with terra-cotta tiles. With this wide dispersion of roofing-tiles, however, there still remains a territory extending from the Atlantic to the Pacific, embracing Canada and the United States, which is virtually destitute of this ancient form of roof-covering. It is a curious fact that a material so cheap, durable and picturesque, and one so widely distributed throughout the world, should not have effected a lodgment in this country. It seems all the more singular when it is considered that the early colonists —Spanish, Dutch, French, English, German—all came from tile-using countries. This curious condition of things can only be accounted for by the fact that, at the outset, wood was so much cheaper than any kind of baked clay that it was used in the form of clapboards and shingles to

the exclusion of other material, and thus the habit finally became ingrained.

That early attempts were made to use tiles in this country is attested by Mr. E. A. Barber, in his interesting article on the "Rise of the Pottery Industry in the United States" (*Popular Science Monthly*, December, 1891). In this article he shows that the flat roofing-tile was used in Lancaster County, Pennsylvania, as early as 1769, as tiles bearing the date scratched upon them have recently been discovered there. I am indebted to Mr. Barber for the following cut of this tile (fig. 81). As the form of this

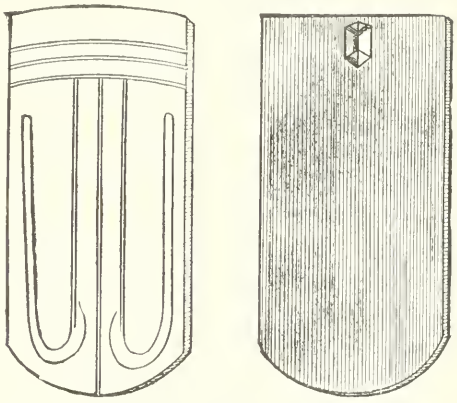


Fig. 81.

tile and its dimensions correspond to the average flat tile seen in Germany, it is almost certain that the tile was introduced by the early German emigrants to that region. I am also indebted to Dr. Charles C. Abbott, of the University of Pennsylvania, for information regarding some pan tiles discovered by him on Burlington Island, Delaware River, New Jersey. These tiles were found associated with rudely made red and yellow brick, on the site of a house built by the Dutch in 1668, and shortly afterwards destroyed by the Indians. The outline of the specimen

sent me by Dr. Abbott shows the typical Dutch pan tile of the roughest description.

Within recent years, pan tiles and flat tiles have been manufactured and used in this country. Their use has been mainly confined to large structures, not for the sake of economy or utility, but for architectural effect. Such roofs have been far more expensive than similar ones in Europe, and judging from the trouble many of these roofs have given, it is quite evident either that the right kind of tile has not been made, or that it has not been properly applied to the roof. From the frequent breaking of the tiles, it has been supposed that our climate, with its rigorous changes, was the cause of this. I have observed, however, in Europe, that tiled roofs are quite as common in regions north of the line of frost and snow as below that line. In England, the effect of frost is spoken of as being unfavorable to tiled roofs. Despite these drawbacks, it would seem that the terra-cotta tile, when properly made and adjusted, is one of the cheapest and most durable of roof-coverings, as it is certainly one of the oldest and most widely distributed.

Acting as a non-conductor, the upper portion of the house is warmer in winter and cooler in summer. Slate roofs absorb and transmit a good deal of heat. Shingle roofs are a menace in times of conflagration. With the best tile clays in the world and an abundance of the rude labor usually employed in tile-making, there is no reason why roofing-tiles should not come into common use in this country, as they have in all other parts of the world.

INTERLOCKING TILE.

At the present day there are a great many forms of tiles made in Europe, especially in France and Switzerland, some of which are very ingenious. The object to be at-

tained in an interlocking tile is to devise a form which shall, by a series of ribs and corresponding depressions, more thoroughly exclude water. In the United States, tiles of this kind are being made besides the ordinary pan and flat tile. It is not within the purposes of this paper to speak of these in detail, as there are many kinds each possessing certain merits.

I cannot forbear, however, alluding to a remarkable exhibition of this material at the late Paris Exhibition which suggested what an extraordinary industry might spring up in this country if the merits of terra-cotta roofing-tiles could be made more widely known. In this exhibition there were not only a great many displays of the ordinary flat tiles, but there were pan tiles as well as interlocking tiles made of pressed glass, by the use of which dark warehouses and attics might be made light. The tiles were made precisely like the terra-cotta ones, so that here and there they could be introduced thus letting in gleams of light in usually dark places, or the entire roof might be covered with these glass tiles. There were also terra-cotta tiles perforated to admit little squares of glass. Graeber has called attention to ancient Greek tiles in the temples at Phigalia, Athens, and other places, in which the large flat terra-cotta tile was perforated for the purpose, as he believes, of admitting light in dark places under the roof.

TILE-MAKING.

In the course of this paper it has been shown that throughout the world with the exception of our country and Canada the use of terra-cotta roofing tiles is universal. There is no reason why they should not come into general use in this country. There are large regions in the United States, like Arizona, New Mexico and certain

western states and territories where forests are scarce or altogether absent, yet having an abundant supply of coal suitable for the baking of tiles, and the best clays in the world. With the rapid destruction of our forests and the consequent increase in the price of wood, shingles and clapboards, the tile-making industry should spring up in many parts of the country.

A few brief notes, concerning the making of tiles, are here appended to call attention to the simple appliances and the rude character of the labor employed in the manufacture, in the hopes of encouraging the industry. If we have brick-kilns everywhere we should be able to sustain tileries also.

Edward Dobson's *Hand-book on Bricks and Tiles* in Weale's series, gives illustrations of the various machines used in the making of flat and pan tiles. From this we learn that in Staffordshire a workman may produce 1,300 to 1,500 flat tiles in a day. In Gwilt's *Encyclopedia of Architecture*, it is stated that "clay from which tiles are made will make good bricks—the converse does not hold good, it requires tough clay to make tiles, on account of the thinness of the tiles. Much care is required in baking; if the fire be too slack, they will not burn sufficiently hard, and if too violent they glaze and suffer in form."

It is observed also that glazed tiles are not so much affected by frost. In Europe, as in Japan, old tiles are considered better than new ones. We learn from the same authority that an ancient custom was to bed tiles in hay or moss. When the roof is full pitch, this suffices without mortar; with less pitch, mortar is used to point the tiles in order to keep out snow or rain in a high wind. We have seen that in Japan and Korea, and probably in China, also, mud or clay is used in which to bed the tile, and in these as well as in all other countries mortar is used in

various ways to point the tiles, particularly at the eaves and ridge.

In Germany, the making of flat tiles, as I saw it near Wurtzburg, was of the simplest description. An iron frame having the outline of the tile to be made was the only important implement involved in the process. This frame represented the mould. The table upon which this rested consisted of a thick piece of plank, over which was spread a piece of woollen cloth, one edge of which was nailed to the lateral edge of the plank, while the opposite edge of the cloth had secured to it an iron rod, the weight of which kept the cloth drawn smoothly over the plank. The iron frame was now placed upon the cloth (fig. 82)

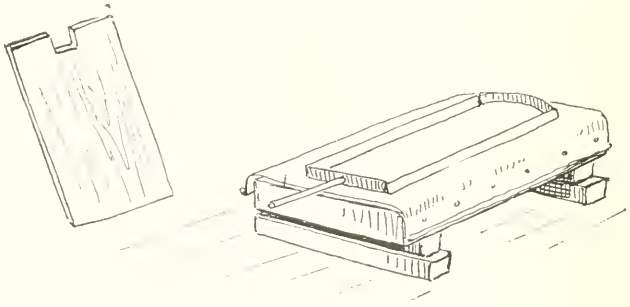


Fig. 82.

and clay was packed into it with the hands, and then pounded down with a wooden mallet such as a moulder might use. A straight-edge was used to scrape away the superfluous clay, a little mass being left at the head of the tile which was afterwards shaped into the nib which was to hold the tiles to the laths or battens. This being done, a square piece of board notched at one end to admit the nib was placed on the frame. The workman then grasped the iron rod attached to the free end of the cloth and, with the other hand holding the board in its place, lifted the cloth and inverted the whole thing, transferring the soft tile to the

board.[1] The iron frame was then removed, and the board with its unbaked tile was placed in the sun to dry. The workman informed me that he could make a thousand tiles a day. Fig. 82 shows the iron frame resting on the flannel in position to be filled with clay. The board upon which the unbaked tile is to be transferred is to be seen to the left. Fig. 83 is reproduced from a hasty sketch of a Wurtzburg tiler at work.

Large dome-shaped brick ovens were used in baking

Fig. 83

the tiles. The structure was flat above, and leading down to the ovens below were small holes two or three feet apart. The fire, having been started, was afterwards fed by pushing into these holes at short intervals small quantities of fine coal or coal-dust. The utilization of coal-dust in this way struck me as an economical method of using this waste product. I was informed that ordinary bricks were baked in the same way.

[1] Many old Korean and Japanese roofing-tiles show on their lower side a cloth-mark impression, and doubtless similar methods were resorted to in their manufacture.

Mr. Howard Walker informed me that in France he had seen a tiler at work first shaping a flat piece of clay into the proper dimensions and then bending it over the upper part of his leg, at the same time pushing up a nib of clay at the head of the tile with his thumb.

In Japan the tiles are made in moulds, dried in the sun, and baked with pine fagots and twigs for fuel. Fig. 84 represents the appearance of a Japanese tilery near Tokio.

FIG. 84.

SUMMARY AND CONCLUDING REMARKS.

The older roofing-tiles of the world group themselves into three distinct types, the normal or Asiatic tile, the pan or Belgic tile, which is an outgrowth of the normal tile, and the flat or Germanic tile, which is an independent form. The normal tile, the earliest known form, covers by far the greater number of roofs to-day. With few exceptions it is the only form of tile used in Asia, Asia Minor, Greece, Italy, Sicily, Spain, the countries bordering the southern shores of the Mediterranean, and all the Spanish and Portuguese colonies and countries in both hemispheres. This tile is also found in areas contiguous to the countries above mentioned.

The treatment of the roof covered with this tile in the Orient and in the Occident differs widely. In China, Korea, Japan, and countries to the south of China the ridges are usually conspicuous for their elaborate structure. The tiles are aligned with great care, the eaves tiles have turned margins of graceful outline with ornamental designs upon them in relief. The roofs of the more important buildings have their ridges, hips and eaves in strongly curved lines and with this treatment the curved tegula is in harmony. In the Occident, one sees but little attempt at architectural effect in the treatment of the tile. The ridge is rarely more than a single course of semi-cylindrical tiles, though in certain Swiss and English glazed ridge tiles of a few centuries ago finials were moulded upon them. The eaves tiles differ in no respect from those of the roof and the only attempt at decoration was by the introduction of stucco or white plaster between the courses, as occasionally seen in modern Grecian houses and mediæval Spanish ones. In ancient Greece the ridge and eaves tiles, the huge discs terminating the ridges, the antefixæ, etc., decorated in polychrome, added greatly to the beauty of the roofs.

The discovery by Graeber, on the site of the earliest example of Greek architecture, of a fully developed normal tile with curved tegula, and disc-closed imbrex, identical with that of eastern Asia, compels one to believe that from the far East came the roofing-tile. The curved tegula would naturally harmonize with the curved lines of the Eastern roof, while a straight-edged tile would be more in accordance with the straight lines of the Greek roof, and as a matter-of-fact, we find the curved tegula soon yielding to the broad flat tegula, which ever after became the dominant form for the monumental buildings of ancient Greece, Italy, Sicily and Etruria.

Successive invasions of the Asiatic tile, in a measure, supplanted the normal flat type which seemed at the outset to be associated with monumental buildings, though this purely classic form has survived in the modern flat type seen in Italy to-day. The circular disc closing the imbrex points distinctly to eastern Asia, and the subsequent decoration of the eaves and ridge tiles, while strongly suggesting an Eastern origin, is no sure criterion, as to whatever the Greeks touched they imparted a charm derived from their own matchless instinct for the beautiful.

It seems curious to see the antifixæ attached to the eaves tiles, at Assos, as late as the Roman epoch, and yet 600 years before, at Selinus, these elements had already become detached from the roofing-tiles and were independent pieces, nailed to the top of the stone coping.

The historical sequence in the development of the early Grecian, Etruscan, Roman and Sicilian tile, and the source of the first form—the *norm* as Graeber describes it—so common in China to-day, must ultimately be cleared up. The material is indestructible and the character of a fragment, even, is easily recognized.

It has been impossible to find data indicating, even approximately, the first appearance of the pan tile and the flat tile, though it is probable that these data exist.

The geographical distribution of these three types of tile to-day is a matter easily ascertained and I venture to present the following map of Europe (fig. 85) upon which are indicated by conventional lines the regions where these various forms occur. These lines represent the appearances of the tiles in section and will be readily understood. The single curved lines represent the normal tile, the lines of double flexure the pan tile, and the short, straight lines the flat tile.

As the normal tile is almost universally distributed in

Asia, it was unnecessary to represent that region of the world.

Sources of information.—The preceding notes have been derived from personal observation in most of the countries mentioned, except in India and Persia and those countries immediately bordering on the Mediterranean. For these countries, particularly Italy and Greece, I have depended upon photographs. Many of these examined were of large size, and presented the most reliable details: even when of small

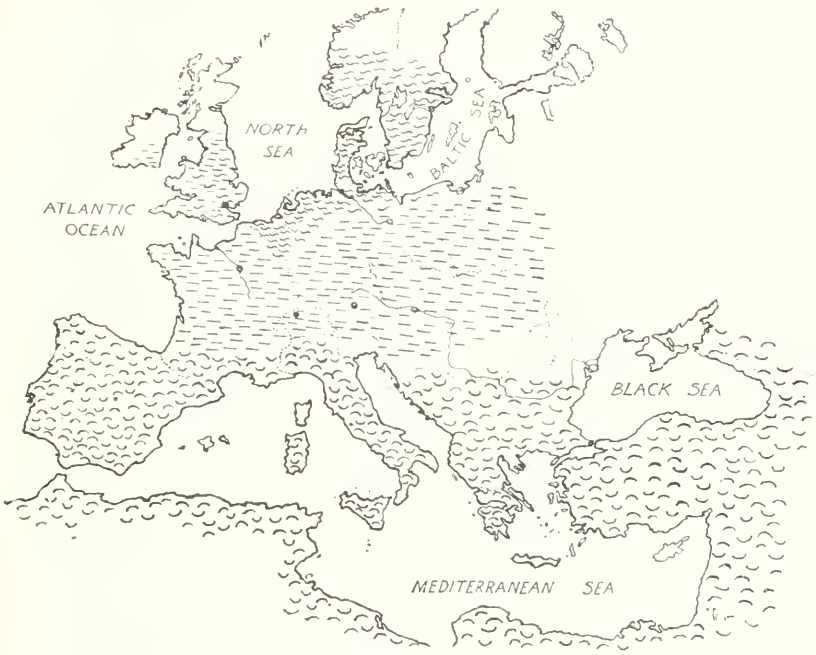


FIG. 55.

size, the type of tile could be easily made out with the aid of a lens. Reproductions from sketches illustrating architectural tours, etc., could not be depended upon, as the roofs in these drawings were usually represented by rough, shaded surfaces or formal lines. The art-galleries in Berlin, Dresden, London and other places were good hunting-grounds to fix the date of the use and distribution of the roofing tiles (as, for example, a picture by Botticelli in the Dresden Gallery, of the thirteenth century, showing the flat, normal tile of Rome;

a picture of the Sienese school, twelfth century, in the National Gallery, London, showed a similar tile. The old Dutch masters present the pan-tile, and Teniers shows the angular ridge-tile on a thatched roof).

Collections of photographs, however, furnish the best material when one cannot visit the country; the only drawback is that such pictures usually present monumental buildings, often roofed with metal, and it is only by chance that the roof or ridge of some common house comes into the picture. For the photographic and other material I am greatly indebted to the collections of the Boston Museum of Fine Arts, Peabody Academy of Science, Salem, Gen. Charles G. Loring, Mrs. Helen Abbott Michael, Mr. and Mrs. E. F. Waters, Mr. T. F. Hunt, Mr. Sylvester Baxter, Mr. Denman W. Ross, Mr. J. Adamowski, Mr. A. E. Barber, Prof. C. C. Abbott, Mr. Alban Andrén, Mr. G. E. Walters and others, whose names are mentioned in the text. My obligations are especially due to Mr. Edward Robinson for calling my attention to numerous memoirs on the Classical antiquities of Greece and for the use of his valuable Classical library.