This is a sketchy preliminary account and discussion of classes particular types of buildings at a particular "Old" or "First Empire" Maya ruin. The site is Piedras Negras, very well known for its sculptured monuments since 19 , though not for its buildings, which

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1. Teobert Maler; Researches in the Central Portion of the Usumacintla Valley,

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were reduced to mere mounds when discovered. The "palaces" at least are close kin to those at the famous site Palenque.

Piedras Negras, Palenque and Yaxchilan (Menche) are the three most important ceremonial centers or "cities" of the Usumacinta region, which is close to the western boundary of the lowland Maya area south of Yucatan. In this area are the buildings and monuments generally considered older than those of the peninsula. Specifically, our site is on the right bank of the Usumacinta river, about miles above (southeast) of the point where it ceases to form the boundary between the Guatemalan province of Peten and the Mexican State Chiapas, and enters the Mexican state Tabasco. It is the only site in this region where excavation over a period of years gives us assurance that we have at least some data from nearly every building of the classes considered, which escaped destruction or burial by the Maya themselves.

By the First, Second and Third Eldridge R. Johnson and two subsequent expeditions of the Univerisity Museum, University of Pennsylvania. The writer was priviledged to assist Dr. J. Alden Mason, who initiated the project, in 1931 and 1932, and to act as field director under his supervision in 1933, 1934 and 1935. The program is not yet completed.

The value of the paper to non-specialists in Maya culture must rest on the possible significance of suggested conclusions. Briefly these are as follows.

Apparently the vaulted masonry roof, a very important and wide-spread Maya trait, did not appear at this important but geographically peripheral site until the latter had become typically Maya in other respects. An attempt is made to date this appearance at about the middle of Cycle 9 of Maya Chronology, admitedly on weak and incomplete evidence. In any case, both pre-vault and vault periods seem to have been fairly long.

There is some evidence that the vault technic, or at least its concept, came here from the Central Peten region to the east. However, it was here generally applied to buildings of a differing and western tradition. Masonry piers, standing between series of adjacent doorways so as to give an open portico or collonade effect, have long been known to be typical of Usumacinta vaulted architecture. Apparently this was fully developed in the supposed pre-vault period.

Temples have been identified, we believe on satisfactory grounds, not only on high pyramids, but also on low platforms and directly on a plaza floor. These are non-vaulted. The identification is based on the presence of a peculiar temple altar, thoroughly typical of the site, but hitherto unreported from the region. Among the pyramid temples a buried example presents a single chamber very much larger than anything reported from the classical lowland region, a fact perhaps explained by the fact that nothing of comparable size was in evidence here when the city was abandoned.

Finally, some of the temple plans, both vaulted and non-vaulted, show previously unreported peculiarities; while the plans of "Type X" buildings, represented in our discussion but not here fully described, seem to be entirely new in some features, and to have known analogues only at Chichen Itza in northern Yucatan, among late "New Empire" buildings.

Most of the data used is unpublished. Plates 1, 2, and 3

Acknowledgement is made to Horace H. F. Jayne, Director of the University Museum, for permission to publish the plans, most of them for the first time. Free use has been made of notes and drawings of Dr, Mason, Fred P. Parris, David W. Amram Jr. and Francis M. Cresson Jr. The plates are prepared by Miss Tatiana Proskouriakoff.

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are intended to present representative samples only of temples and palaces, both vaulted and non-vaulted, of Type X buildings, and of important stratifications. However, at least as to temples and palaces, all known types are shown, with one important exception to be noted.

This is a sketchy preliminary discussion of buildings of particular types at a particular "Old" or "First Empire" Maya ruin. The site is Piedras Negras, very well known for its sculptured monuments since 19 , though not for its buildings, which were reduced to mere mounds. -

Researches in the Central Portion of the Usumacintla Valley

~~Templ~~
Temples

J-7-Sub-3 – followed by four periods involving ~~4~~ 6, probably 7 episodes. Ending with Throne 1 (9.17.15.0.0.)

K-5-3d – followed by 2 periods, ending ~~before or at 9.~~ with or before "Lintel" 7 (9.12.15.0.0?) – D.S. 9.9.8. ?? plus long illegible inscription.

R-3-1st – Surface; contemporary with True Lintel 11, illegible but same style as Stela 29 placed before temple on the top of the pyramid (D.S. 9.5.5. ??)

thickness to room width (the vault span). That is, the wall(or pier) thickness of Str. J-29 is 79 per cent of the span, that of R-5 only 50 per cent. The important wall height is not reflected in this index, but since all vault supporting walls are close to the same height, this ommission is here immaterial. Where other factors apart from ability to span a given room on a desired wall thickness, are involved, arrowed indicate in which direction those factors should, if at all, correct the index. Thus, if piers had been used in 0-13-2nd ~~of~~ F-3 and J-13, walls might have been thicker or rooms narrower. The same is true if the walls of the P-7 cenyral chamber had been of normal height, which they are not, or if F-4 had not been buttressed with staggered partitions. On the other hand, restructions of space may have narrowed the rooms of the palaces J-10, Room 1 and Room 6; a roof comb may have done the same for J-23 and a weak special pier design for J-11.

The table includes all vaulted units of th city known. ~~It-is-not~~ Its purpose is not to indicate the chronological position of the buildings in each group, but ~~to-indicate~~ the actual degree massivity of each in relation to the others. With this before us,

it is submitted that vaults going back toward the beginning of the site must appear near the tops of the lists, since the indices drop so rapidly.

The first, second and fourth temples and seventh unit, an addition to the second follow prior activity with absolutely certainty, as we have seen. The thrid, fifth and sixth are identical in plan with the fourth. Further, the 6th and seventh probably follows a monuments which are not early. Among the palaces the first, second, ~~prebably~~, deigth, ninth, 11th, 13th and 15th certainly follow prior building activity, and so proably does the sixth. In addition the ninth was designed to is dated late by its throne. The completely and also semi-vaulted Type X buulding follows prior building activity. Both unidentified types are medium to very "light".

The table covers all known vaulted units. All stratigraphical and monument association evidence to date points in one direction - the heavier buildings are preceded by prior activity. Further work is not likely to reverse this direction. All the vaulted temples are on large high pyramids while we know that two large and one small pyramid have grown by piling later ones on earlier. ~~The third palace in the list rest on a platform known~~

Structure K-5-1st dates at or after "Lintel" 7 , probably somewhat later than the 17th hotun, unless it was applied to or carved on building or pyramid after erection of the temple. On the same assumption, temple R-5 is not earlier than "Lintel 4", 27th hotun , and the addition called O-13-1st is not earlier than Lintel 3 (46th hotun).

The only defintie tie-in with monuments is Room 1 of palace Structure J-6, but it is an important one. The room was obviously designed to receive Throne 1, completely legible at ~~the~~ at hotun 51, close to the end of the series.

Vault Span Proporations: The existence of a pre-vault period can be attacked from another angle. If any of the vaulted buildings go back to the foundation of a city with so early and long a dated series of monuments, we may legitimately assume that the very early ones put least weight per square inch on the walls, (thick wall and either kept outward thrusts to a minimum (narrow rooms) or used thick outer walls to resist them. The eraliest buildings must have been massive, though the converse is not necessarily true. The buildings in Table 2 are arranged, under each type, in a descending series of ~~"heavies"~~ massivity, as indicated by the relation ~~to~~ of outer wall to

Uniformity of Plan. If the vaulted buildings extend in a long chronological series going back to the foundation of the city, we should expect more or less marked differences in plan. The two heaviest temples differ from the others, one radically (O-13-1st) the other only in the apparent provision for a heavy rear roof comb. (J-29) The other four differ only in proportions. But we know that the first two are not initial efforts here. The palaces are not so uniform, but do conform closely to the fundamental plans illustrated.

Although the museum's excavations at this site are by no means complete it seems to the writer that the amount of stratigraphical, and inscriptional evidence already justifies the conclusion that most if not all of the known non-vaulted temples and palaces precede the vaulted ones in date of construction. Careful surface examination, combined with trenching of nearly all doubtful mounds assures us that few if any unknown vaults remain on the surface, while four deep cuts distributed among the three principal pyramid groups and the vaulted palace group have failed to show them below the surface. Unless they do appear there later, a pre-vault period seems established.

This
~~The present paper~~ is a brief and sketchy discussion ~~of~~

of buildings ~~of a certain~~ at a particular ~~Maya~~ "Old Empire" site,
Quatemala, in the or western region of the Maya area.
Piedras Negras, ~~on the~~ Usumacinta ~~river, in Guatemala, with the~~

~~Mexican state Chiapas immediately across that stream~~. It is primarily

concerned with buildings of a particular technological type, defined

vaulted or
by the absence of ~~of~~ the masonry/roof ~~formed by the~~ "Maya Arch", and
their relations to vaulted types.)
It restricts itself to buildings of great ceremonial importance -

~~"temples"~~ and "palaces", together with some consideration of another

, variety, considerable
functional ~~type~~ "Type X", surely here of ~~great~~ importance, ~~and~~

probably ~~a~~ sweat-houses. the value of the discussion to known specialists
must rest on the value of suggested conclusions. Most of the data covered is
unpublished.[1]

The reason for grouping ~~these~~ non-vaulted buildings together

is two-fold. First, a perusal of the literature on architectural develope-

ment - one hesitates to say evoluation - might easily give the

to workers in other fields
impression/that Maya buildings of importance were roofed with the

vault at all times, and everywhere.[2] This is surely not the case at this

important site. Second, the use of the vault technological imposes certain restrictions

on plan and ~~dioms~~ dimensions which other available roof structures

did not.

Besides the vault, two other roof-types were available to

Maya architects. One of these - plaster-surfaced concrete of very low pitch, supported on wooden beams, is known from late Maya times,[3] but its Old Empire occurance is hardly proved as yet. Its considerable weight and its inflexibility probably justifies the assumption that it was placed only on stone walls. The other is the high-pitched roof covered with thatch, supported on wooden trusses. This type, ~~which is~~ light and flexible, could in theory be placed either on stone walls ~~and buildings~~ or piers or on wooden posts, either piers or posts without walls or with non-weight-supporting walls of ~~xxxxx~~ sticks, or wattle-and-daub (mud or plaster applied to a stick wall). Thatch roofs are placed on both ~~wall-types~~ stone walls and on posts by modern Maya, and there is no reason to suppose both combinations were not known to early Old Empire architects. Wattle-and daub walls, and post construction were surely known at Piedras Negras, ~~as we shall see~~ and in an early period there, but all plans here discussed involve ~~stone~~ masonry walls or piers.

Either ~~kyyxx~~ non-vaulted roof type (-thatch or beam-and-concrete-) differs from the masonry vault in two particulars. The weight is very much less for the same span. Neither introduces outward thrusts on the outer walls, while the vault does. Either the weight or the component of ~~side~~ thrust - probably both together, must increase as the ~~span - the~~ distance between the vault-supporting walls, ~~must~~ the span, increases.

Or, if the span is kept constant but the walls made ~~thnner~~ thinner they are less able to bear the weight. More important perhaps, outer walls are less able to resist the uneven loading caused by the thrusts; and this observation is also true if they are made higher. Changes in vault design may ligthen its actual weight, but in doing so will increase the thrusts on the outer walls.

For these reasons, masonry vaulting discourages wide rooms, or thin or high walls, particularly thrust-resisting outer walls. It also discourages weakening the latter by the introduction of multiple doorways, separated by piers or columns. Either non-vaulted roof construction, being by comparison much lighter and imposing no outward thrusts, allows an architect with given wall materials and knowledge of his problems, wider spans, or thinner walls, or higher walls, or narrower piers or columns; or combinations of these. He need make no distinction between interior and outer walls.

With such ~~structural~~ differences in structural limiations inherent in the roof type selected it seems tothe writer that comparionons of Maya buildings should be first made within groups of the same roof-type.

Piedras Negras is an excellent site for such comparisons, since vaulted and non-vaulted ceremonial buildings were, at the end of its history, of about equal numerological importance. There were then on the surface 12 temples placed on high pyramids, six of each roof type. So far as known to date two more (probably three), non-vaulted, had been buried. Four more, non-vaulted, were on the surface but not on pyramids. Thus we have the plans of eighteen temples, ~~ten~~ twelve of them non-vaulted.

At the end there were only four out of fifteen so-called palaces which lacked the vault, but further excavation will surely reveal more, and not improbably others ~~to~~ were removed in Maya times.

There are eight "Type X" buildings. One of these used both complete vaulting and a combination of vaulting and beam-and conrete construction which we call "semi-vaulting"; another used the latter (probably) in combination with thatch, ~~or beam and concrete~~ if our reconstruction is correct. Complete vaulting is probably absent in all the others, but this is not known definitely as yet.

Before turning to the plans we should state that investigation of the site is by no means complete, nor are all buildings discussed completely excavated. However, all plans are surely correct so far as

Insert A

Most vaulted buildings ~~are~~ at the site are recongnized by remnants of vaulting actually in place. ~~Nonvaultedzxxxmrixxxxx xxxxxxxxxx~~ The vaulting is faced with thin slabs of limestone laid in mortar, with specially worked ~~specialised~~ long slabs placed as a cap across the gap between half-vaults. A ~~half~~ fallen vault leaves a deep deposit of debris containing cap-stones and many slabs ~~and much mortar, cap-stones,~~ numbers of these ~~many slabs~~ being in actual contact with the floor; and there is a great deal of mortar. The deep debris deposit masks the walls or piers unless they remain standing above its level. Non-vaulted ruins are identified by shallow debris deposits, paucity of thin slabs, their failure to reach the floor as a regular thing, absence of cap-stones; in many cases also by the debris contours which reveal the positions of hidden walls and piers; and in two ~~some~~ cases by a layer of fine material underlying all building stone, ~~in which~~ from which circumstance beam-and-concrete rather than thatch may be suspected. In two cases discussed the debris was removed in Maya times and the special bases for inferences are indicated.

they go; and while non-vaulted palaces and perhaps temples will be added to this series, the vaulted series are probably complete. All mounds in the ceremonial areas have been ~~eref~~ carefully examined, and all which might contain ruins of vaulted temples or palaces have been at least trenched.

Insert A →

Temples

Two vaulted temples are shown in Plate 1. Structure K-5-1st represents the typical Piedras Negras ~~pixam~~ vaulted temple plan. There is one room, three front doorways, a low sill along the rear wall, and a niche. In this a plain stone "column altar" is set on end in the floor. This plan accounts for four of the six vaulted ~~pyramid~~ temples, all on pyramids. (K-5-1st, O-12, J-4, K-5).

Structure J-29 is shown in perspective, as if cut in two ~~along~~ on the center, (axis) from front to rear. The ~~chamber-plan~~ chamber is identical with that of K-5-1st, but the rear wall is replaced by a thick mass of fill, probably to support a roof comb. This mass is pierced by a ventilator leading back from the niche. The ventialtor ~~was~~ so far as we know, may have been present in the others, which are all fallen below this level. (All column altars show evidence of burning, in many cases quite positive.) The remaining vaulted temple, Structure O-13, is not illustrated. It originally ~~(we believe)~~ consisted of two narrow chambers, one before the other, each entered by a single doorway on the center axis. (O-13-1st-a). ~~In~~

~~Later was added, we believe, a final form, there was an additional~~ A front gallery, with five doorways, (was, we believe, added later (O-13-1st, 15).
and small chambers on either side of the original unit. This ~~entirely different temple~~ is the only vaulted example lacking the triple doorway, the low rear sill and the niche, and having more than one room.

~~The remaining plans on Plate 1 were all non-vaulted.~~
One of the typical vaulted temples, orginally built on the plan of K-5-1st, was later divided into three ~~ee~~ tiny rooms or cells by secondary partitions running back from each pier. (5-4). These six buildings are all indentified as temples by their isolation on high pyramidal substructures, ~~and~~

The remaining plans of Plate 1 are all of non-vaulted temples.

Structure K-5-3d, like the vaulted K-5-1st two levels above it, has three doorways and the column altar. But this is placed in the center of the chamber, theniche being absent. The small rear sill is absent, but in its place is a full sized bench. The room is very much larger, With an interior length of 18.50 meters and width of ~~five~~ 5.00 meters it is probably the largerest single room known from the ~~southern lowland~~ "Old Empire" region. Nothing ~~like it~~ approaching it in size remained when building ceased, but others may be buried in pyramids as yet not investigated. The ~~remarkable~~ remarkable span, combined with poor masonry at an early level is the basis for deducing the roof type. Debris had been removed. The stratigraphical position of this temple is shown in plate 3.

~~The [illegible]~~ although roofless, all debris was removed by the ancients. But since the greatest vault-span known is less than this,

not

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the wall masonry is poor, and it occurs on an early level of an early site, we may be sure the roof was not a vault. Its stratigraphical position may be seen in Plate 3.

Structure R-9 is on the surface of its pyramid. Very badly ruined, only its two piers and the column altar are certain. There is some, but not entirely certain, evidence in the debris for the side and rear ~~wall~~ masonry walls shown in ~~dotted~~ broken lines. ~~The~~ A rear sill may have been present. The column altar was in semi-position in the center of the room. ~~T~~This plan may be taken as representative of one other pyramid temple (R-16), even more completely destroyed. In these cases we must allow for the possibility that stone piers were combined with ~~wooden~~ walls of perishable materials, or of masonry only at the bottom.

Structure R-3-1st, on the surface of its pyramid, also badly ruined, surely had masonry walls, and only a single doorway. It has the low rear sill, apparently no niche. The altar was found in the center of the room, but lying on its side. ~~This plan~~ Two other non-vaulted temples (Structures R-1 and R-10) were apparently one-doorway affairs. The altars had been moved. We can say nothing as to presence of the sill, nor are masonry side and rear walls certain. The plan of structure J-7-Sub-2 (J-4) was unusually large, and probably displaced. ~~Structure J-7-Sub-2~~

The temple from the buried complex known as J-7-Sub-2 is the smallest thus far known. Its identification as a temple rests on the fact that it apparently rests on a substructure at least analagous to a pyramid, and that it was divided into three tiny cells, as was secondarilly ~~done~~- done in the vaulted temple J-4. (the column altar and bench or sill are absent.) The partitions, plainly indicated by plaster work and differences in floor level,

were only five centimeters or so thick. We therefore assume they were of wattle and daub construction, a technic known to occur at this horizon. The whole front was destroyed in subsequent building operations. In the reconstruction shown we attach the partitions to wooden posts at the front (also known in nearby contemporary buildings) because of the small space available for masonry piers. The non-vaulted character of the roof is inferred not from positive evidence, but from the presence of the wattle and daub partitions (which in known vaulted buildings are of masonry); and from the thinness of the walls, when found at such an early level. ~~The~~ Its early stratigraphical position is shown in Plate 3, where it is marked "x".

~~All~~ The all but universal occurence of the column altar in the temples thus far discussed seems to establish it as a piece of temple furniture. If this is a legitimate inference, Structure 0-16 (Plate 1) is a temple, though it rests directly on the plaza floor. The altar was displaced slightly, but is former position is marked by a sub-floor cache such as have been found under several undisturbed altars. The single doorway is very wide. The side and rear walls may be thicker than our restoration shows. The sill or bench is absent, as far as we could make out.

~~-Structure-U-3-may-be-misidentified-as-temple.~~

Structure R-2 (not shown) was probably similar to this, but placed on a low substructure, next to pyramid temple R-3. It had a masonry rear wall (at least), the rest being hopelessly obliterated. Two column altars were found on it (as was the case with the vaulted Structure K-5-1st).

Structure U-3 (also on a low substructure,) may be misidentified as a temple. We have not excavated for the altar, which ~~surely~~ should appear in the rear room, if at all. We do not know whether the front gallery is a secondary addition or not. ~~This is also on a low platform substructure.~~

Structure O-15 is on a similar low substructure, but its plan is unique. The front gallery, at a lower level, is a later modification. There (were originally) ~~are~~ two doorways; the altar is placed in a niche in the front, not the rear wall; a rectangular bench is against the rear wall. The indicated thickness of side and rear walls is not entirely certain. the secondary front gallery had one front doorway and apparently narrow doorways at either end, which were still later filled up.

Palaces.

"Palaces" is ~~here~~ used as a term of convenience for buildings never isolated on high pyramids, usually occuring in groups, usually long, nearly always with multiple doorways (often more than three). There are two principcle types - double ranged and single range.

The ~~double-range~~ parallel galleries or rooms forming the main body of the double-range variety are always suplemented by ~~transversely~~ additional ~~placed~~ rooms placed transversely at one or both ends. Otherwise they are very similar to the famous palaces of Palenque.

Note.

Stucture J-12 (Plate 3) is the only extant non-vaulted double-range palace, possibly a survival of many. The plan is so typical of seven vaulted examples (J-9, J-2, J-13, J-21, J-23, J-18, J-11) that none of those are shown. Two of the latter duplicate this plan in every particular, apart from size, proportions, and interior fittings. Piers and walls here shown as reconstructions are plainly marked by the debris contours. ~~There are two parallel long narrow galleries, so open as to resemble porticoes . These communciate with each other and the end rooms, the latter having exterior doorways also.~~

Single range vaulted palaces (J-2, J-6, J-8, J-10, J-22) differ from all other Piedras Negras buildings in being built against masses of fill, ~~on rising ground~~ as an adaptation to the acroplis hill. Like the Temple J-29, (Plate 1) there is no free-standing rear wall. ~~For this reason, apparently,~~ they lack the transverse end rooms, presumably because the building is only one vault wide. A Portion of the composite vaulted palace J-6 is shown in Plate 2. The whole building had ~~nine~~ eleven doorways separated by eight piers.

There are four other vaulted palaces of single range which conform to this description except in details referable to the exigencies of space. (S-8, J-10, J-22, Rooms 5+6 of J-2). ~~Structures J-8 and J-22~~ Two turn corners to follow ~~terraces~~ platforms against which they are built, while one is ~~Rooms 5 and 6 of Str.~~ ~~J-2 are~~ tucked into a very small space where multiple doorways were impossible. Structures J-6 and J-22 are composite buildings made up of similar ~~elements~~ units. These considerations aside, the single range vaulted palace units, (apart from secondary modifications,) are essentially like one gallery of a naturally double-range unit, minus communicating doorways to non-existent other rooms.

(Plate 2) Structure S-18 is non-vaulted, and answers the above description for vaulted single range palaces except that it ~~is not built against rising fill to the rear, and therefore~~ has a free-standing rear wall, as required by its position. Hatched piers and walls are very plainly marked by humps and ridges of debris. Str. S-17 (not shown) is similar ~~in all respects, except that~~ but the number of doorways is ~~only~~ seven, instead of nine, and piers are Surface examination indicates several others of this ~~time~~ type in the same neighborhood, though they are shorter, with probably but three doorways.

(Plate 2) Structure O-18 is classed as a palace, perhaps on

insufficient grounds. The ruin consists only of the floor and piers, very widely separated. Piers shown by hatching are plainly marked by small mounds of debris. ~~If there were any~~ Walls, if any, ~~they~~ were of perishable materials, perhaps wattle-and-daub. If we restore a ~~tach~~ thatch roof this building would differ little from modern Maya buildings after substitution of masonry piers for wooden posts.

"Type X"

This type has not been investigated thoroughly, except in two of eight examples. Structure N-1 (Plate 2) is here included because it adds to the known wall technics of non-vaulted buildings. The central chamber (which encloses a still smaller one of similar plan) was probably "semi-vaulted", the inner ~~xxxxx~~ sides of the walls sloping toward each other at a steep angle. If these ~~angles are~~ walls were ~~are~~ projected upward to nearly meet (as in complete vaulting) the mass of debris on collapse would have been much greater than that found. We assume ~~relatively~~ a lower chamber, with cap-stones replaced by longer wooden beams, the whole supporting a concrete roof surface. Positive evidence of this we were unable to find, but we are sure of it elsewhere.

Turning to the large outer room in which the above

is placed, the side and rear walls consist of small masonry piers, joined by very thin masonry walls. The manner of placing suggests that they supported no weight, and they may have been secondary to the piers. It is highly probable that the central chamber is also secondary to the piers. If there was a roof it was probably of thatch, covering both outer and central chambers, with two or more wooden posts in the front facade. We failed to look for postholes here, but piers were certainly absent. It appears possible if not probable that the piers originally belonged to a building structurally like O-18, all walls being later modifications.

Structure P-7 is illustarted only in composite section and perspective (Plate 3). Its plan is fundamentally the same as that of N-1. Here the central chamber is completely vaulted, while the wide outer rooms are semi-vaulted. The presence of this combination of vaulting with beam-on-mortar roof rests, in this case apart from paucity of debris, on positive evidence, and is as certain as can be, short of actual preservation ~~in situ of part of the beam-and-mortar element~~ or of the beams themselves in the debris. The detailed evidence cannot be set forth here.

Conclusions and Suggestions.

It appears to the writer quite certain that the selection of roof types in these temples and palaces was not due to differences in function. The column altar, its fire, its position as the center of interest, the rear sill, the triple doorway, the placement on pyramids, even the association with carved stelae of the typical vaulted temple can be found among the non-vaulted examples. They are not only all temples, but the rites celebrated in them involved a common and evidently all-important element, a peculiar altar and its fire. The double-range non-vaulted palace completely duplicates in plan vaulted examples crowding about the same court. The single range cases differ more, but for obvious reasons, and maintain the essential character of more or less long open galleries.

As to Type X buildings, function is more likely to have played a part. If the wide spans of the outer rooms in our known cases were necessary, a non-vaulted roof technic, or at least a semi-vaulted one had to be selected. There appears to be no functional reason

for selcting one or the other of these (two) however, as we have ~~both~~ each on a single well-defined/specialized type of plan.

It seems highly improbable that differences in importance dictated the selection of roof type. As may be seen on the plan of the site, ~~five~~ four of the non-vaulted pyramid temples (R-3, R-4, R-9 and R-10) together with another on a low platform (R-2) share the same courts with a vaulted temple (R-5). The non-vaulted K-5-3d occupies the same spot as did later the vaulted K-5-1st. The non-vaulted double range palace J-12 rubs elbows with vaulted palaces on the same court (J-9, J-10, J-11, J-13). Structure O-18, and the Type X Structure N-1 face the same great plaza as the vaulted palace J-2 and vaulted temples J-4 and K-5-1st.

Considering (sic) the fact that neither differences in function nor importance satisfactorily explain the ~~differences in~~ varied roof construction, differences in dates of construction ~~must be considered.~~ become more probable. It seems to us highly probable that most or all of the non-vaulted temples and palaces are to be referred to an early period when vaults were either unknown, not desired, or beyond the resources of the local hierarchy; while the vaulted buildings belong to a following period when many

but by no means all outmoded buildings were replaced. The evidence for this may be briefly summarized under several heads. The problem is to ascertain how far back in time thevaulted series goes, since the vault is known to occur fairly late in the dated ~~history~~ series of monuments, and non-vaulted buildings are known to occur fairly early.

Horizontal distribution: All non-vaulted pyramid temples on the surface are segregated on or near the South Group Court; ~~except those in other groups~~ but one all vaulted temples in West and East groups and the Northwest Section. This distribution is paralleled by that of dated monuments found in situ: all early monuments are in the South Group and adjoining plazas, all later ones in East and West Groups. All vaulted palaces are segregated in the West Group, and on the Acropolis; non-vaulted palaces are scattered ~~between~~ in the West Group (only one on the Acropolis), the Southeast Section, and probably in the South and East Groups. Type X buildings are also widely scattered but we do not know enough about their roof types to use them in this connection. this distribution is explainable if activity ceased after a partially completed campaign of replacement. But if the non-vaulted temples and palaces are not survivals, the distribution is puzzling.

Stratigraphy: A trench through pyramid R-3 showed three buried levels without signs of vaults, the surface structure being non-vaulted. This has negative ~~vaults~~ value only, as masonry had undoubtedly been removed. (See Plate 3).

A similar cut ~~through~~ below vaulted temple O-13, though not to bedrock, showed a buried platform apparently without any building. Another below vaulted temple K-5-1st showed first a floor with column altar but no remaining masonry walls, and below this, non-vaulted temple K-5-3d (See Plate 3). Trenches below Str. J-7, which is a platform, and connecting tunnels below the vaulted palaces J-6 and J-9 showed no evidence of vaulting; but revealed ~~and on the lowest level~~ the supposedly non-vaulted temple on the J-7-Sub-2 level (marked x in the section, Plate 3) This was contemporary with a wooden post building on which was wattle-and-daub debris (marked z in the same drawing). Thus in four deep cuts (the only ones yet made) no evidence of buried vaulting has appeared; in two of them non-vaulted constructions have appeared, and below vaulted buildings. Against this we know of only one vaulted unit which was partly destroyed and partly buried in the course of rebuilding on the same level (Str. J-6-2nd).

Other minor operations have shown that the vaulted palace J-11 has replaced an earlier building on the same substructure, and that that vaulted palace J-2 overlies an earlier floor; this is probably true also of Str. J-9; ~~further~~ that Str. P-7, (Type X) which is partly vaulted, partly semi-vaulted, follows

at least ___ modification s and additions to its substructure.

So far as we have gone with stratigraphy (which is not as much as it should be) we have failed to encounter buried vaulted buildings, but we have found non-vaulted ones .

Associations with dated monuments These must be used with caution, but ~~with such caution they~~ may form legitamate evidence. The mere presence of dated stelae at the base of the substructure is here disregarded. More definite associations with non-vaulted temples (all we now have) are set forth in Table 1. According to Morley, the monuments series of the city runs from ~~9.5.0.0.0~~ 9. 5. 0.0.0. to 9.18.15.0.0 with certainty. Most monuments mark the end of a hotun, a period of of 1800 days or a little less than five years. The above sure limits define a period of time equal to ~~51~~ 55 of these approximate five year periods, (or hotuns.) If we number the hotuns for this particular series we may avoid the Maya notation, ~~No~~ the first hotun being at the beginning. the 20th at ~~about the middle~~ the middle of the Maya Cycle 9, the 22nd at about the ~~end of the~~ middle of the known local series, the 55th at its end.

Refering to the table, non-vaulted temple J-7-Sub-2 is ~~six or~~ (more probably) seven building episodes ~~before~~ very much before the late hotun 51, which is marked by Throne 1 in Structure J-6. ~~(in Maya notation~~ 9.

K-5-3d ~~is~~ was deeply buried twice by the time "Lintel" 12" could be placed on the final pyramid or its building. (note. it was found high up on the final pyramid.) Unless the illegible inscription carries the legible beginning a long way into the future, the monument, which can hardly be earlier than the 17th hotun, is not later than the 30th, a ~~suggested~~ reading suggested by Morley. R-3-1st must be contmporary with, or precede the carving of its lintel, which seems roughly contemporary with Stela 29 on stylistic grounds. (This monument stood on the top of the pyramid, not at the base.) This is not much later than ~~hotun the~~ the second hotun of our series, unless a short but missing part of the inscription carries the calculation well forward in time. The style of this monument, still according to Morley, makes this very unlikely. Where non-vaulted buildings can be related definitely to monuments, they seem fairly early.

Turning to vaulted buildings (Table 2) it is certain that temple ~~Oxi~~ J-29 follows an illegible monument incorpoated in its masonry. ~~The temple~~ It does not go back to the beginning of monuments, whether or not other buildings lie below. The temple addition called O-13-1st, left debris containing "Lintel" 3, placed by Morley at the 46th hotun. But ~~contemporaniety~~ time relationships cannot be proved. It was probably not a lintel.

In respect to these two most important types of building, where non-vaulted examples are not buried by vaulted ones, their distribution suggests ~~that~~ survival in areas where new vaulted ones were replacing ~~the pre-vault period probably did not overlap the vaulted. All the~~ them, or in areas made unimportant by the growth of the city. ~~All the non-vaulted temples are clustered about the Soiuth Group with its early monuments, or buried below vaulted ones. Only one vaulted temple intrudes itself among the non-vaulted. It (Str. R-5) is the least massive, which raises a presumption/that it is not the earliest, It may mark the beginning of a never-to-be completed modernization of th the South Group. All the/palaces are clustered about three integrated courts~~

at least

vaulted

To fix a date when the shift to vaults occured is not so easy. If we allow for many probably buried non-vaulted temples, they far outnumber the vaulted ones. This is probably true also for palaces. Further most of the rock fill forming the substructures of vaulted buildings was placed for non-vaulted ones. A latest pyarmid is not much more than a thick shell or cap over an earlier one. On the other hand vaulted buildings reguire more stone, more lime-burning and more labor to erect. It is difficult to account for the remarkable variations in the "weight" index except on the theory of progressive mastery of vault-building technic, which presuppposes a period of appreciable length.

A resonable guess is about the middle of Cycle 9 (9.10.0.0.0), the 20th hotun of the certain monument series. This is also the middle of a reasonble estimate (80 hotuns) for the total period of building, allowing on the one hand for known building activity preceding this monument series, and the probablity ~~that~~ in Morley's opinion that the series shereally ended with the end of the cycle and not at 9.18.15.0.0. This mid-cycle date for the shift is only a guess but ~~will~~ may serve a useful purpose until data from this and other sites is more precise than it now is.

Origin of the Vault.

The continuous distribution and fundamental similarity of all Maya vaults presuppose a single origen. The characteristically heavy vaults and the very early dated monuments of the Petén district, coupled with its central position, point to it as the center of dispersal. This is confirmed by the situation here. The two temples least characteristic of Piedras Negras are so by reason of Peten-like elements - the narrow, single doorways and ranked rooms of O-13 ~~2nd~~ 1st, with an offset or broad buttress at the rear - and the heavy mass at the rear of J-29, similar to typical Tikal temple design. Further, these two may be suspected as the oldest, for they are the most massive. Petén influence may be suspected in the transverse end rooms of the palaces,

but apparently made itself felt in the pre-vault period.

Despite the probable outside origin of the vaulted roof here, it is interesting to note that, with the single excertion of Structure 0-13-~~sub~~2, it was made to conform to pre-existing local traditions, apparently non-existent in the Peten, calling for light and airy rooms, whether temples or palaces. Multiple doorways separated by masonry piers appear to go back well into the pre-vault period. The vault at first thickned & and perhaps widened the piers, but it did not eliminate them. Neither, as might have been expected, did it make the doorways narrower or rooms very short. Perhaps here is the reason this site could borrow the monument complex from the central Peten at an early date, while refusing the vault until the art was sufficiently advanced to span reasonably wiide rooms and doorways, with ~~plenty of doorways~~ short sections of wall (piers) between them.

The data adduced gives some ground for supposing that the masonry pier here first evolved from the simple wooden post. The probable occurance of posts and wattle and daub in conjunction with masonry walls, and on an early horizon, may be cited (the temple on J-7-sub-2 level); and especially the all-pier building 0-18 and the pier and masonry wall outer room of N-1, with, perhaps, wooden posts also.

It has been suggested that perhaps the very slender piers and round columns ~~of~~ under late ~~Yucatecan~~-vaults in northern Yucatan may have a history going back to the pier developement of the Usumacinta. ~~If here in the Usumacinta piers developed directly from a wooden prototype~~ This may easily be a true conjecture; but the final reasoning must allow for knowledge of piers as such more early than the published buildings of neighboring Palenque; and must allow for the charcter of the supported roof in each example.

Finally, a word as to that school which derives Maya the stimulus of Maya culture from the other world and assures us that its history was one of steady degeneration. If this is true it should show here in sculpture and architecture. W must pass by the sculpture except to say what anyone may easily verify, that the finest pieces of the city, small or large, are late in the series, and they include some of the finest of the whole Maya area. For the architecture, all six vaulted temples are on substructures surpasing in height all but one of those of non-vaulted temples, The great size of the early K-5-3d temple was indeed not continued. It could not be, once the vault was used for its roof. This brought with it greater permancy, probably the

stucco decorated upper facade zone, and the roof comb; These are esthetic advances of the first order.

feautures borrowed from elsewhere in the area, but except in one (initial?) case they are not slavish copies of the models. They are made to fit an already well developed local style pair of plans not very suitable to them, Perhaps this was at some sacrifice of ree space (narrower rooms) and of light and air (thicker walls and piers). But Unless the (striking) variations of proportion reflected in our indices are meaningless, they local architects immediately began to regain these losses by progress in the new te roof technic; and they perhaps themselves invented a new one, up to now unreported elsewhere (semi-vaulting). We cannot suppose the heaviest temples are late degenerations from the lighter ones without cutting the early link with the Central Peten; and for another very good reason; we know by juxtapositions and overlaps that a number of palaces in our list followed those listed above them.

Piedras Negras was at first a thoroughly typical small Usumacinta Maya site in all respects except vaulted roofs. Its acceptance of that element increased buxldingxlaborxenoronsly problems of labor supply and management, design and skill enormously, along with the esthetic value of the resulting building. That These problems were successfully met

by a heirarchy which had already a long period of building in masonry as well as in perishable materials behind it, and which had achieved very imposing results.