

PECULIAR SPIRAL ARCH OF THE ESKIMO SNOW HOUSE.

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There is a type of dome that can be built without a scaffolding and that requires a man to be immured within the vault to insure proper construction. It is the invention and sole property of that most ingenious of savage races, the Eskimo, and contains several principles new to civilized architecture.

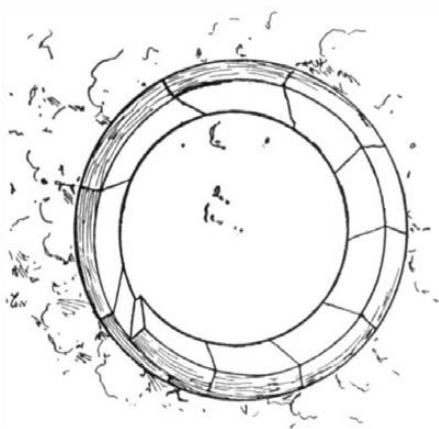
There are four fundamental types of arch and dome, of which one is the Eskimo peculiarity. The simplest and least used, because least effective, is of the simple lean-to type—illustrated by, and to-day chiefly employed for, the house of cards. Next comes the false inverted-step arch, where each block or brick projects beyond the one below, and is held from toppling in by the weight of the material above and behind it. This type of gateway and chamber was invented independently by the architects of Agamemnon more than 3,000 years ago in ancient Greece, and the precursors of the Aztecs in Mexico at nearly as early a period. This construction inherently demands a vast amount of backing, or fill, in proportion to the vault of the arch. It is feasible for a gate in a long wall, or for an underground hall or drain, but cannot stand alone, and is a *false arch*. A free portal, or a dome rising into the air, cannot be built on this principle, which is consequently but little employed to-day. Our true arch embodies the third method, its essential feature being the use of wedge-shaped blocks. When the last and central one of these pieces—the key-stone—is dropped into place the whole mass supports itself. The top cannot fall inward unless the supports are toppled outward. The primary thrust is therefore always not in, but out, and buttressing of some sort is requisite. Another inherent defect of this arch, though we are so accustomed to it that we do not usually note the fact, is that until the key-stone is fitted into final position, a temporary structure must be erected to hold up the parts already in place. The last type, the Eskimo vault, is a true dome, exerts no outward thrust, and requires no temporary scaffolding. It is also unique in that its material is not brick or stone, but *snow*.

The construction is used for the beehive-shaped winter houses of these so-called savages, and is spiral in plan, as shown by the diagrams. A row of blocks is first laid on the ground in a circle—or more exactly a polygon. Each of these has a slightly slant top, and each thus raises its surface a little beyond the last, until when the circle is completed, the gap in height between the last and first blocks gives the thickness for the following courses. In these the upper and lower surfaces of each block are parallel, as in a brick, but the gradual upward trend given by the first course is of necessity maintained.

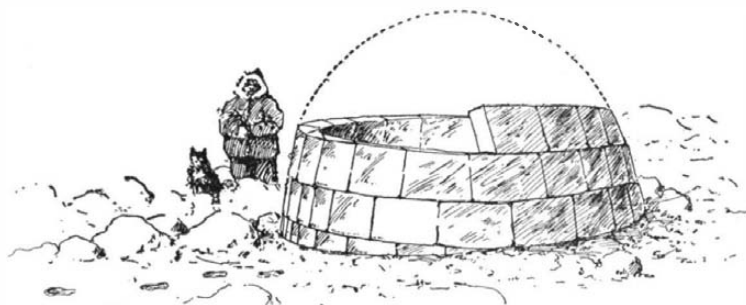
In each successive round the snow-bricks are leaned inward more, by having their lower surfaces sliced off to a bevel. If set squarely end to end, they would before long lean inward so far that they would tumble. For this reason the end of the block last laid is cut at an angle. The next following block has the joining end slanted at the reverse angle. Thus it fits in behind the preceding, and is prevented by it from slipping inward. As the house grows, the circles become smaller, until at last only an irregular polygonal opening is left. This is filled with a wedge-shaped block cut to shape. It is however not a key-stone, as the remainder of the structure supports itself.

The blocks of firm snow are usually dressed outside, and handed for placing to the man on the inside. The last block he holds up with one hand, slices to shape with his ivory knife in the other, and drops into position. He is then entirely inclosed in the vault. Only after the house itself is entirely completed does he cut out the low door, which, to keep out the cold as much as possible, is only big enough to crawl through. A long, low tunnel is then built in front of the door, to break the force of the Arctic's icy blasts. Even a window is present. A small aperture is cut out over the door and filled with a pane of clear thin ice. All that is omitted is the flue or chimney. Whatever heat is produced by the seal-oil lamps is wanted inside, warmth being a more serious necessity in the climate than ventilation or freedom from smoke.

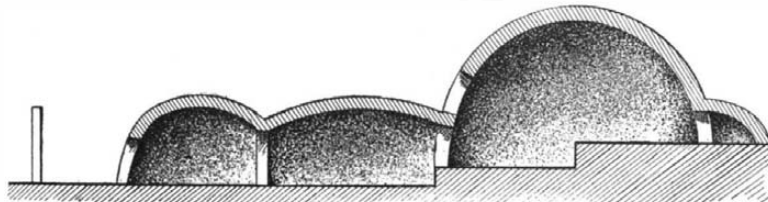
Whether the type is practicable in other materials has been doubted. The unsurpassed lightness of snow is certainly a great advantage. In heavier materials strength would, however, compensate for increased stress of gravity, and good mortar should make up



Plan view of partly built hut, showing how each block supports the next.



Eskimo hut partly built. The snow blocks are laid in a continuous spiral course.



Section through Eskimo snow house.

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for the inward slipping tendency that weightier materials would show.

The greatest difficulty in working in stone would be encountered in shaping the separate pieces of masonry. Owing to the spiral and leaning construction, no two blocks can be exactly alike in either shape or size, and in every succeeding course each block departs more and more from the right-angle in its proportions. To compute in advance exactly the proper angles for each piece, so as to insure true joints, would be a matter of much complex mathematical calculation.

It might however be practicable, once the calculations had been determined for a building of standard size, to draw up a table of the angles and dimensions required for each successive block. If the size of the structure were reduced or increased from the stand-

ard, each stone would only require to be diminished or enlarged by a fixed ratio.

It would take our ablest engineers longer to plan such a dome than an Eskimo would need to build a village; but the resulting simplicity of construction, due to the inevitableness and simplicity of the progress of erection, without any temporary supports, buttresses, or reinforcement, might more than compensate.

The spirally ascending bevel-locking Eskimo dome is the only true vault any part or the whole of which will stand entirely by itself.

A GASOLINE MOTOR-DRIVEN EARTH-BORING MACHINE.

BY WALTER LANGFORD.

The details of construction and method of operation of a unique gasoline motor-driven earth-boring machine are shown in the accompanying illustration. The device was recently designed in California by Charles L. Beltz, and the photograph represents it in working position in actual operation at Sacramento and near Selma, Cal.

It is stated that with one of these machines about 25 miles of holes were bored for use in fencing along the right-of-way of the Western Pacific Railroad between Marysville and Oroville, Cal. These holes were bored under particularly trying conditions as the ground was gumbo land with the exception of a short stretch of marsh soil, and so hard and so dry that every bit of it had to be broken with pick and crowbar when dug by hand. Part of it, in addition to the hard ground, had about 20 to 25 per cent small cobble, yet this labor-saving device bored through all of it and did the work of from twelve to fifteen men.

Such a machine is of great value for boring holes for posts, for numerous other uses for which shallow holes are required and for the purpose of lightening the labors of man. Experience shows that the harder the ground and the more difficult it is to work, the more earnestly a machine of this class is desired.

This entirely new, unique and practical engine-driven apparatus is a most remarkable device in its simplicity, and owing to its wide range of uses as a labor saver it stands unsurpassed. It will be seen that it is ex-

tremely simple, easily operated and entirely practical, and will be found a great economizer of time and money where post holes are to be dug, electric line, telegraph or telephone poles set, or where trees and vines are to be planted in holes uniform in size at top and bottom and of suitable diameter and depth.

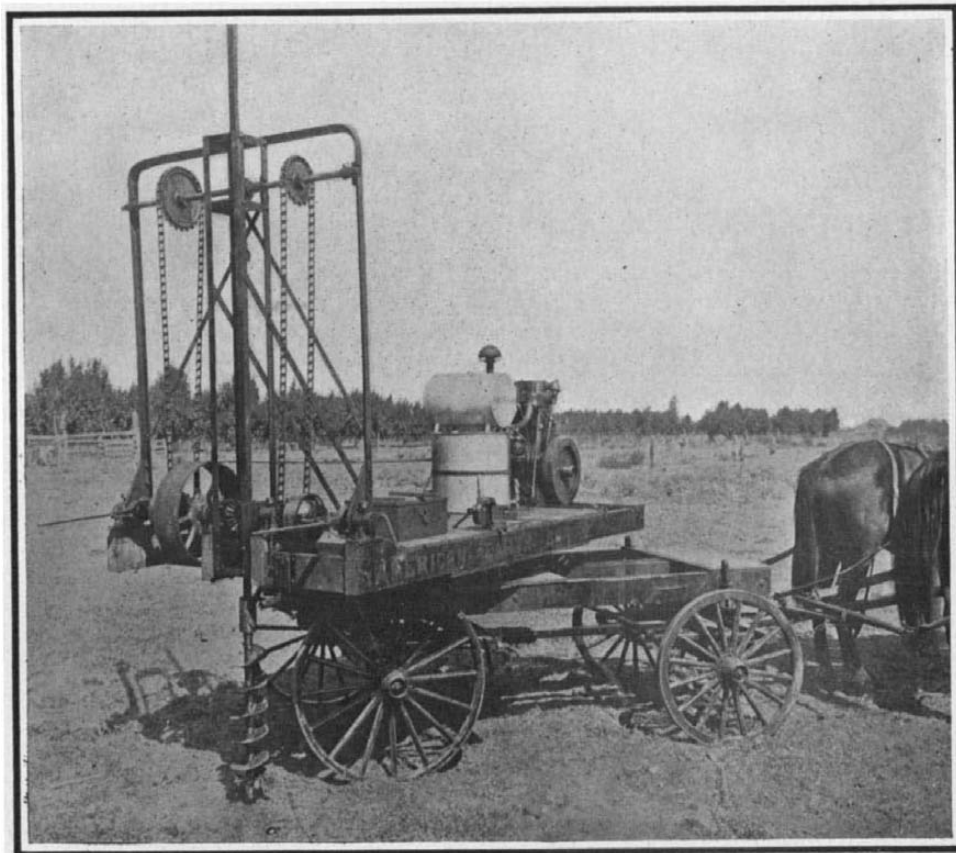
It is held to be practical for use everywhere, as by test the machine will work satisfactorily in either dry or wet soil or in any place where the machine can be driven, as it bores readily through hardpan and shale, soft sandstone and small cobble; and as it will bore at different angles and on either side or back of the truck, it will do equally good work whether on level ground, uneven ground or hillside.

Near Reedley, Cal., a great number of holes were bored in very hard hardpan for large poles, the machine being particularly successful in this work because the contrast between its efficiency and hand labor was so strongly marked. At Mendota, Cal., a record was made by one of these machines on large fence work in hard, dry earth, 90 holes being bored 33 feet apart and 30 inches deep in 60 consecutive minutes, the holes being 8 inches in diameter.

For use in boring small holes, a vertical engine of the double cylinder type is utilized that develops 7½ horse-power. In boring holes for large poles a machine of this type is fitted with an 18-inch auger, effecting a depth of 6½ feet. The power is supplied in this case by a double cylinder gasoline engine of 12-horse-power capacity.

This device is said to be inexpensive to operate, as a man and a boy only are required for its efficient working, the boy to drive the team, and the man to manage the machine. Its net earning capacity is said to be greater than that of a threshing machine costing five times as much. Its season of usefulness extends over the entire year, and in many instances in hard ground has done the work of fifteen men.

It is maintained that in cold countries where other farm work



WORKING POSITION OF EARTH-BORING MACHINE READY TO BORE A HOLE.