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## THE OBSIDIAN MINES OF HIDALGO, MEXICO

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A recent visit to Mexico afforded the writer an opportunity for studying two great sites representing the ancient peoples and their culture—the ruins of the city of Xochicalco, the “Hill of Flowers,” in the state of Morelos, and the obsidian mines of Hidalgo. These studies have confirmed his previously formed notions respecting the remarkable achievements of the pre-Columbian tribes of the southern part of the great plateau of Mexico, and have enabled him to form a still more vivid and complete conception of their unique and remarkable culture than was possible without such observation.

The obsidian mines alone will receive attention in this place. Mining operations by native tribes in various regions have been recorded in a casual way by early writers, but have been brought much more forcibly to our attention by recent archeological researches. At various points, from Lake Superior on the north to Argentina on the south, traces of mining and quarrying<sup>1</sup> have been noted, and no doubt many other sites in Central America and South America remain to be located.

<sup>1</sup> The terms *mining* and *quarrying* are here used as synonyms, but the former has generally been applied to the obsidian workings.

Obsidian was extensively mined by many of the native peoples of America. It is a brittle stone—a natural glass—fused in Nature's mighty furnaces and poured out in sheets or thrown out in fragments from the craters of volcanoes. Cooled under proper conditions, the glassy rock is homogeneous, breaking up in columnar form, or otherwise in irregular masses. In Yellowstone Park and in Oregon and California there are numerous great sheets of this glassy product. In Mexico the volcanic formations of the southern end of the continental plateau furnish extensive deposits from which the energetic tribes derived the raw material for making their implements and ornaments. When good qualities of the stone were discovered, quarrying was resorted to, and the requirements of the great Nahuatl peoples were such that in course of time extensive mining was necessary in order to supply the demand.

The uses of obsidian are somewhat limited, owing to its glassy character, but it is readily shaped by fracture into implements of certain classes, such as knives or razors, spearpoints, arrowheads, and scrapers. Less frequently the shapes were elaborated by pecking and grinding, and some remarkable results were achieved; round and oblong beads were fashioned, wonderful labrets, ear ornaments, and even vases, masks, and animal forms were executed and exquisitely finished.

Artificial distribution of obsidian has been very wide. Hardly an occupied site in all Mexico and Central America can be found that does not furnish examples of obsidian implements or fragments. The flake-knife is the simplest and most universal of the flaked forms, and occurs in great numbers in and about the valley of Mexico. The immense refuse deposits of the ancient city of Tenochtitlan, now the City of Mexico, are in places literally black with the broken knives, and San Juan Teotihuacan furnishes an apparently inexhaustible supply of these and other forms of implements. The latter place, however, has its supply of the raw material immediately at hand. The bed of the Río San Juan,

which runs through the ancient city, and even the plains about, furnish boulders and irregular masses practically without limit. The people of the valley did not depend on the scattering local supply. It is certain that they explored up the obsidian-producing slopes and streams, finding the deposits in place, and that they engaged extensively in the arduous work of quarrying. Among the several localities reputed to show indications of mining operations, that situated on the Guajalote estate, some twenty miles northeast of Pachuca, in the state of Hidalgo, has been most frequently referred to. The writer considered it great good-fortune to have been able to make a visit to this place.

Forty-three years before the date of my visit Prof. E. B. Tylor, of Oxford, examined the Guajalote obsidian deposits, and in his *Anahuac* has graphically recorded his experiences and observations.<sup>1</sup> In appendix I, he gives a free translation of Torquemada's account of the flaking of obsidian by the Aztecs. This account, unfortunately, is so vague that little is to be learned from it, save perhaps that the flaking was done by pressure with a wooden implement. It is not impossible, however, that some serious misapprehension existed in Torquemada's mind, and that one or more of the vital features of the process have been omitted.

Reaching Pachuca by rail, the party, consisting of Prof. G. K. Gilbert, Mr W. W. Blake, and the author, took a conveyance by way of Real del Monte to the estate on which the Jacales, a group of escarped hills, are situated. The highway led gradually up the sinuous contours of the mountain slopes, and as far as Real del Monte, situated on the northern side of the range, it was in excellent condition; but beyond the stone quarries, a little to the east of that village, it became exceedingly rough, and for several miles was barely passable for the horses and empty vehicle. Late in the afternoon the hacienda was reached. Presenting our letter of introduction, we were received and entertained by the

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<sup>1</sup> E. B. Tylor, *Anahuac*, p. 14.

proprietor, Señor Don Rafael Amador, a gentleman of most excellent local reputation. During the evening we searched the fields in the vicinity for relics of the ancient time, everywhere finding fragments of obsidian, flakes, worked pieces, and implements.

Early in the morning we were supplied with guides and saddle-horses, and conducted to the mines, some three miles farther on. The trail led through the forest, over rising ground, to the lower slopes of the Sierra de las Navajas, or Mountain of the Knives, which rose to the northeast in a lofty ridge. Beyond are the rugged buttes called *Jacales*, from their hut-like appearance.

At Pachuca and Real del Monte we had made inquiries respecting the obsidian mines and their situation, and heard some interesting and curious stories. We were told that it was a volcanic region, in which were many craters and sink-holes of ancient origin and unexplored depth. Some were called blow-holes, and were said to be set with crystals of glass so sharp that no one could descend into the openings, for the reason that the ropes used in the descent would be cut by the projecting edges.

Reaching the site, we found the broad ridge covered with open pine forests, in places overgrown with tall grass, and, on the steeper parts, with underbrush. Everywhere were scattered fragments of obsidian, and presently we came upon groups of mounds alternating with depressions and pits extending indefinitely up the forest-covered ridge. We were cautioned by our guides to beware of the pits, as they were scattered everywhere through the glades and were hidden by the rank grass. This caution was indeed necessary at first, but we soon learned to recognize the various features of the site. The pits and depressions are the ancient mines, while the hillocks are the heaps and ridges of *débris* thrown out from them.

The writer was prepared to expect just these phenomena, for the flint quarries of the north are in most respects identical; but the work was more extensive than he had anticipated, although perhaps no more extensive than on the two great quarry

sites of the United States,—one on Flint ridge, near Newark, Ohio, and the other near Hot Springs, Arkansas. The enterprising peoples of the valleys below must have operated the mines vigorously for centuries to have thus worked over hundreds of acres of the mountain side, and so fully and profoundly, moreover, that the deep pittings and heavy ridges of excavated *débris* are practically continuous for a mile or two in length and cover a width reaching in places possibly half a mile. It is not unlikely that there are other worked areas in the vicinity, not reported to us. No outcrops of the obsidian, or, in fact, of any other rock, are to be seen on this part of the mountain, and it is apparent that the ancient miners had exploited the entire slope in search of deposits lying at varying depth beneath the surface.

Notwithstanding the fact that more than four hundred years have passed since active operations in these mines were suspended, evidences of work are perfectly distinct, and the pittings and their accompanying ridges of *débris* are as pronounced in outline as if they had been made but ten years ago. In the main, the diggings are irregular in arrangement and of no great depth. Many isolated excavations are scattered about, while others coalesce, connecting one with another in irregular order over acres of ground.

The depth of the wider depressions usually does not exceed six or eight feet, but some are deeper, and many take the form of wells from three to ten feet in diameter and often fifteen or twenty feet deep, with vertical or overhanging walls. Many of these must have been much deeper, for the *débris* thrown out is more extensive than the present openings would warrant, and there can be no doubt that in numerous cases tunneling was continued horizontally or obliquely for considerable distances along productive layers. The heaps and ridges of *débris* thrown out are rarely above ten feet in height, but they are well-pronounced and abrupt, and the total irregularities of the site are so great that exploration is tedious and difficult. Very generally the

débris is intermingled with broken obsidian, and in many cases it seems to consist almost exclusively of broken fragments and flakes left by the workmen engaged in roughing-out the forms desired. In places there are large heaps of flakes where the choice fragments of stone were brought from the mines and placed in the hands of the flakers to be worked.

The industry must have been conducted for long periods, as extensive areas are covered with these deposits of pure black ringing flakes and fragments. One great heap which lies upon the mountain slope is over forty feet in vertical extent and many feet in depth, comprising perhaps 20,000 or 30,000 cubic feet of flakage. Plate XV shows our party at work digging into this remarkable deposit. No headway could be made, however, for there was no earth to hold the flakes together, consequently the holes dug were immediately filled by the sliding, tinkling slivers of glass, every piece of which is as clean and incisive of edge as when struck off by the workmen hundreds of years ago.

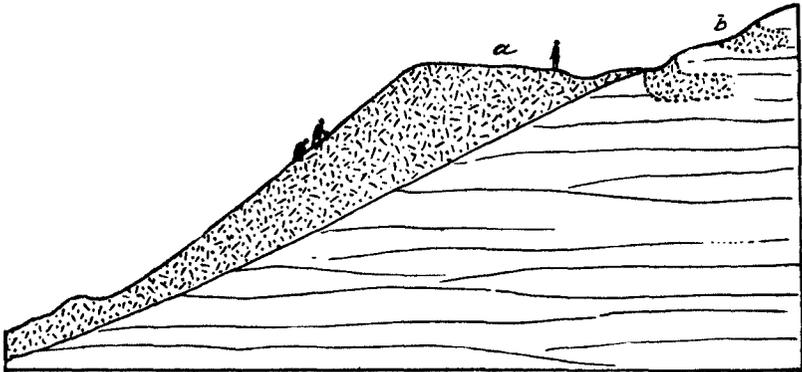


FIG. 42.—Section of great deposit of obsidian flakage on the mountain side.

The top of the deposit, as shown in the section (figure 42, *a*) is quite level, and is perhaps 20 by 40 feet in extent. Here, no doubt, the workmen sat and conducted their labors while the miners brought the stone painfully extracted from the pits, the nearly closed mouths of which are scattered over the slopes



Photo by G. K. Gilbert

EXAMINATION OF THE GREAT DEPOSIT OF OBSIDIAN FLAKAGE ON THE MOUNTAIN SIDE



above (*b*). At one side and a little above this heap the remains of a small stone house were found, the remnants of walls indicating an original structure only 12 by 13 feet and of no considerable height. In other places, especially near the lower end of the worked area, are the remains of much more considerable dwellings, but none of these appeared to have been important structures, being irregular in plan and grouping. They probably served for the use of the mining community, assembled at this point for limited periods at least. The walls, of small, irregular stones, are so much reduced that their thickness and surface character could not be determined without excavation. None is over two or three feet in height.

As already stated, the excavations and ridges of débris are often continuous over large areas, and there is general irregularity of form and arrangement. But where an extensively operated mine has been somewhat isolated, the ridges of débris usually encircle the pit on three sides, and extend outward on the fourth side, in a rough way like the arms of the letter U, as shown in figure 43.

There was thus left an open approach to the mine on the level of the general surface. The section of an ordinary group of mines is shown in figure 44.

The obsidian must occur in considerable bodies, as the fragments left upon the surface are of large size and are homogeneous in texture. The color is usually black or blackish, but in places there are varieties of pale greenish cast and having a satiny play of color due to a peculiar form of crystallization known as chatoyancy.



FIG. 43—Map showing mines and refuse heaps.

Being without appliances for descending into the deeper mines, we learned little of the subterranean phenomena, and discovered no traces of the implements used in the mining operations, save a

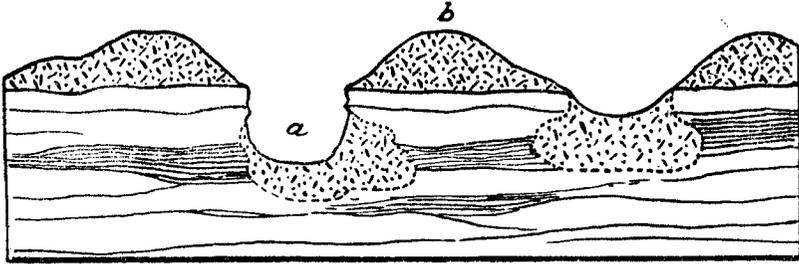


FIG. 44—Section through mines and refuse deposits.

number of hammerstones, which are identical in shape with those used in our northern quarries. The larger specimens, four or five inches in diameter and somewhat discoidal or cheese-shaped, may have been used in breaking the obsidian in the mass, but the smaller examples, many of which are globular in form, must have been used in the hand simply, or with a light haft attached, in the work of breaking the fragments and trimming them down to the desired contour. It does not seem likely that these implements were used in the more refined operations of flaking and knife-making. The stone is usually a tough lava, and the peripheries show the usual evidences of battering.

Long before reaching the mines the writer had speculated upon the probable character of the shaping work done and the nature of the rejectage to be expected. As the ancient dwelling sites of the general region are strewn with countless knives derived by fracture from nuclei of approximately uniform shape, and as the exhausted nuclei are also found in great numbers, evidence of the roughing-out of these nuclei was to be expected on the quarry site. Examination developed the fact that the rejectage is literally filled with the abortive forms resulting from the roughing-out of nuclei which were rejected because lacking in some of the characters necessary to successful blade-making. It was

requisite that the material should be fine-grained and uniform in texture; the shape had to be rudely cylindrical, and it was essential that one end should be smoothly squared, so that the flaking tool would have exactly the right surface for receiving the stroke or other form of impact. Of course the flake-knives were not made upon the quarry site, as the edges of the blades were so delicate that transportation would have subjected them to injury; therefore the selected nuclei were carried away and the knives made whenever they were required.

As indicated by the rejectage, the nuclei produced averaged four or five inches in length, and two to four inches in diameter. The largest nucleus that has come to the writer's attention is now preserved in the Field Columbian Museum, and is about eight inches long and six inches in diameter. Although from Mexico, the exact place of its origin is not known. It has been roughed-out by a few dexterous strokes, which probably determined the flaking capacity of the piece and gave it the desired rudely cylindrical form. The specimens found in the quarry-shops are of course such as did not lend themselves readily to manipulation and were thus not worth carrying away.

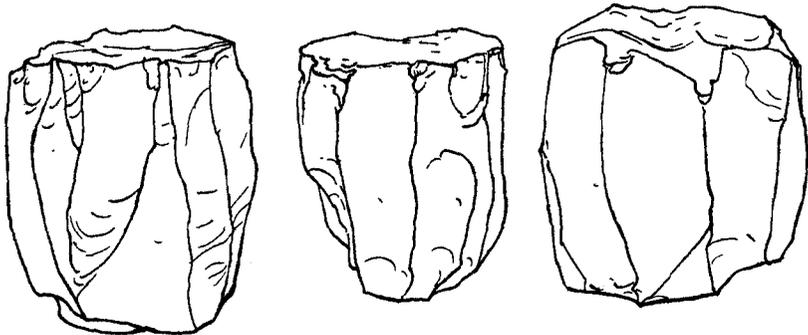


FIG. 45--Typical rejects of nucleus-making, from the quarry-shop débris.

Typical rejects are shown in figure 45. They are irregularly cylindrical or polygonal, and show a few of the facets or flutings made in testing the texture and in shaping the form. The

majority of the specimens are less symmetrical than these, and many are broken or otherwise manifestly defective.

It is impossible to form any reasonable estimate of the number of successful nuclei carried away, but the product of the vast work on this site must have been enormous.

The post-quarry history of these nuclei may briefly be traced. They were distributed far and wide among the people, and no

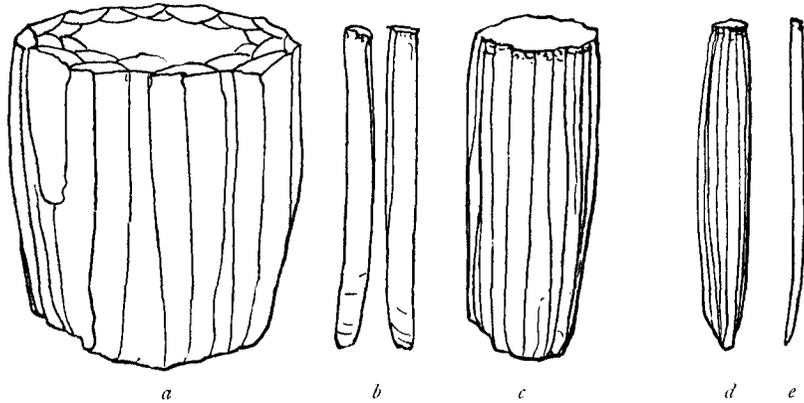


FIG. 46—The making of knives and the exhaustion of the nucleus.

doubt formed an important feature in trade. When knives were required, the nucleus was taken up and the necessary implements struck off, but whether by direct percussion or by pressure we are not yet able to say. The sketch presented in figure 46, *a*, indicates the order in which the flakes were removed. The size of the blade decreased as the work went on (*b* and *e*). This is shown also by the width of the flutings (*a*, *c*, and *d*). In *d* we have the exhausted nucleus after all the knives that could be made from it were removed. The upper end no longer had sufficient surface to permit of the necessary flaking impact. The flakes at this stage became so attenuated (*e*) as to be of little practical value, and the slender fluted shaft was discarded or reshaped into some form of implement or ornament. The exhausted nuclei occur very frequently on inhabited sites.

Besides the rejeitage of nuclei-making and the hammerstones already referred to, a few other varieties of artifacts were found on the quarry site. In some of the heaps of refuse there were found a number of scraper-like objects, made by taking a long, thick flake with one smooth, concave side, and removing a few chips around the convex margin of the wider end, giving a scraping edge. One of these is outlined in figure 47. Whether the specimens encountered are only rejects of scraper-making or are implements made and used upon the site, it is difficult to say. Resembling the scrapers somewhat in general form are numerous long, curved flakes of triangular section (figure 48), the convex sides of which have been roughly flaked off, as if for some definite purpose.

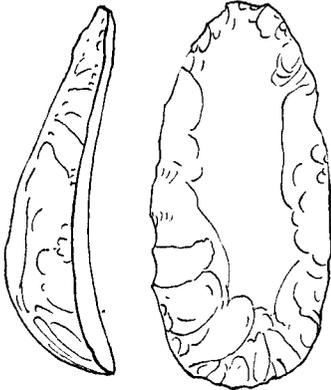


FIG. 47—Examples of the scrapers found in the shop refuse.

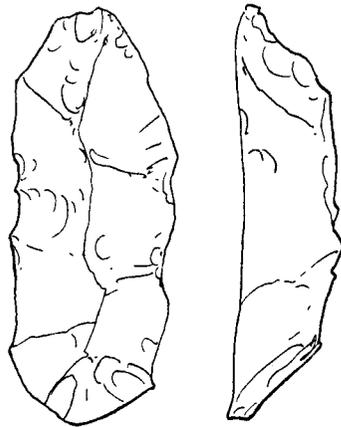


FIG. 48—Modified flakes of triangular section found in the shop refuse.

Strangely enough, there seems to be an almost total absence on this site of the incipient leaf-blade forms from which knives, spearpoints, and arrowheads were usually specialized. Long and patient search brought to light only one specimen, the fragment of a large reject showing the bilateral flakings characteristic of so much of the shop-work of the United States. In the vicinity of the quarry some large blades have been found, and spearheads and arrowpoints are common, indicating that the manufacture of this

class of implements was carried on somewhere in the general region.

It is to be expected that on a site of this class, where many workmen were assembled from time to time and doubtless for considerable periods, evidences of domestic life would be common. The occurrence of numerous remains of houses has already been noted, and it remains only to add that mingled with the débris of the shops are many fragments of earthenware—of vessels no doubt used for carrying water and preparing and serving food. The fact that this pottery is identical in paste, shape, color, and decoration with the ancient ware of Tenochtitlan indicates with sufficient clearness that it was the Aztecs who conducted the remarkable mining operations of the state of Hidalgo.