

DISCOVERY OF CLIFF DWELLINGS IN THE SOUTHWEST.

BY GEORGE WHARTON JAMES.

It was recently asserted that all the cliff dwellings of Arizona and New Mexico were so well known that they were platted and recorded with fidelity and accuracy. This statement is one that no reliable writer and explorer of that region could make, for ruins are being discovered continually, the very existence of which no one had ever imagined.

The cliff dwellings to which my attention for some years past has been directed are those as yet unreachable and untouched ruins known to exist in the upper reaches of the Shinumo, an exquisite and beautiful mountain stream that flows from the north slopes of the Kaibab Plateau and empties into the dirty red waters of the Colorado in the Granite Gorge, a mile or so below the foot of the Mystic Spring Trail. The region is the most wonderful and stupendous canyon yet discovered in the world. To the east is the Point Sublime of Capt. Dutton, its pine-clad summit silhouetted against the clear Arizona sky; and to the west is the even grander and more sublime point of Powell's Plateau, which I have named after the great geologist and brilliant writer, Dutton Point. The Shinumo has two upper forks, both of them difficult to reach and portions of which are inaccessible. The great amphitheater which extends from the two before-mentioned points is named by Dutton the Shinumo Amphitheater, and he spent months in exploring the region. Yet he never mentions these cliff dwellings, nor does Major Powell, to whom also the world owes much of its knowledge of this country.

Mr. W. W. Bass, the owner of the Mystic Spring Trail into the Grand Canyon (which is located about some forty-five miles west of the old camp reached from Flagstaff), has, for years, been endeavoring to

reach these cliff dwellings. At great expense he has constructed miles and miles of trail leading toward them, and each year sees him nearer. A number of dwellings have already been reached, but the main collection is, as yet, inaccessible.

Starting down from the head of the trail on the south wall of the Grand Canyon, a ride of about a

rocks, and the sweet, glistening, clear purity of the inflowing Shinumo. Before us is a colossal basic pillar that stands guard at the entrance and which positively forbids admittance to the secret precincts of the sweet-watered creek except to those who are willing to cast off all clothing, and, naked, advance into the mystic shrine.

The crossing of the river is attended with no little danger. In a rude lumber boat, rudely constructed, rowing with rude oars, and aided by my Mormon guide, Mr. R. M. Bleak, I braved the dangers and defied the rapids which roared above and raged below us. It was only a few weeks before that a poor fellow, attempting to cross with a companion a few miles higher up, was thrown into the swirling waters and, alas! was never seen again. Whether he was drowned, or dashed to pieces against the cruel granite walls, or escaped from both these deaths, only to suffer the more cruel death of starvation in these prison walls, the day of revelation will alone tell.

On the other side, with heavy packs on our backs we wearily trudged over the burning rocks and finally clambered down a wall of broken rock to the very side of the restful and inviting Shinumo. On our way, however, we passed over a most interesting prehistoric trail, where it was plainly to be seen the aborigines had removed the rocks from the pathway. This trail led to a wild chaos of fallen boulders and rocks, over which it seemed, at first glance, as if no one could ever find a way that could be followed a second time. To Mr. Bass' great surprise he discovered here a well laid out and worn trail, the key to which was made by a rude "blazing" of the rocks all the way across this "rocky river." The Indians had evidently taken their rude hammers or axes and pounded the stones on



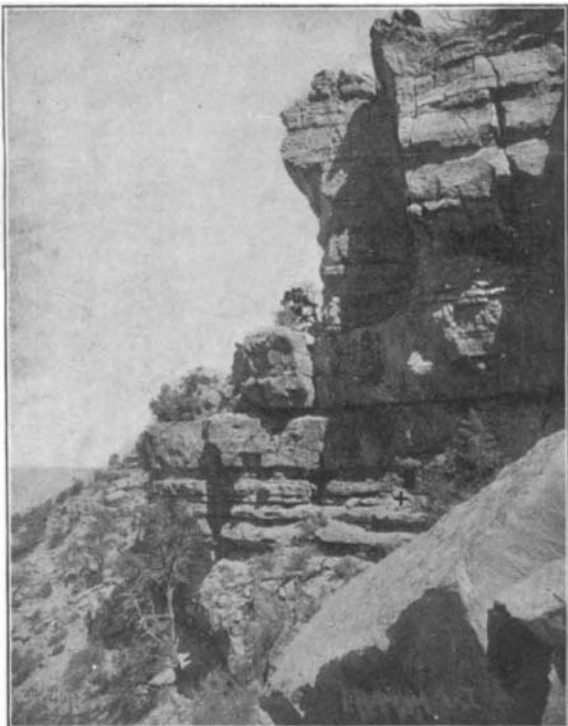
CAVE DWELLING NEAR FLAGSTAFF, ARIZONA.

mile, cutting through the cherty limestone, brings one to the cross-bedded sandstone. Here, near the point of contact of the two different rock formations, are some cliff dwellings, one of which is reasonably accessible, and, not far away, Mr. Bass found three immense natural cisterns, eroded out of the sandstone, and which the Havasupais tell us were used centuries ago by their ancestors, who dwelt in the cliff dwellings of this portion of the Grand Canyon.

After crossing Le Conte Plateau, upon the red sandstone, the trail twines and twists around points and over ledges, dodging back and forth, ere it descends to the marble. Here the canyon narrows for a mile or so, ere it opens upon a large but uneven plateau over which the trail descends to the granite. From this point we look across to the massive rock structures of the north side of the river, two of which are boldly outlined against the cloud-flecked sky. These are Bass Tomb and Dox Castle. Between these two the Shinumo wends its winding way to the great Colorado.

At last the river is seen, and, as we stand upon the upper cliffs and look down into its muddy and turbulent depths, we are lost in amazement at the daring of Major Powell and his brave band of men, who fearlessly explored this then unknown and much dreaded river of cataracts, whirlpools and rapids. The water seems smooth and easy flowing at this distance, but as we approach, its dangers are more manifest. Immediately below where we stop for awhile with our horses begins a fierce and roaring rapid, while to our right up the river, the water is churned into reddish creamy foam as it comes through the dark and cruel fastnesses of the Granite Gorge.

But before we cross we ramble down, more often it is a scramble, over the granite rocks for a mile or so, until we stand almost opposite the narrow chasm through which the Shinumo flows into the Colorado. Here are diverse elements of interest in the muddy, red waters of the Colorado, the glowing colors of the



CLIFF DWELLING ON THE MYSTIC SPRING TRAIL.



RUINS ON THE LITTLE COLORADO.



A RAPID IN THE GRAND CANYON.



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WA-LU-THA-MA'S NEW CLIFF DWELLING SITE.

either side, just as in later days the pioneers with ax in hand chipped off the bark of the trees, and blazed their way through the trackless forests.

But what a delight the clear, cool, pure water of the Shinumo was to one who for days had been drinking the lukewarm nastiness of pool water, or the muddy and silty water of the Colorado. Not far from where we camped I found two tiny cliff dwellings, securely sheltered in the rocks above a large level area which undoubtedly had been used as a garden in years long passed.

These cliff dwellings were of that diminutive character that led the early day explorers and writers to speak of a pygmy people—dwarfs, doubtless, who alone could have dwelt in such limited space. From the Havasupais, however, I learn positively the hitherto only conjectured use of these small houses. They are not and were not dwellings in any sense of the word. They were merely used as storage houses for their corn and vegetables, and were so constructed that their produce could be safely placed therein, sealed up, and thus kept secure from the depredations of animals. A number of these small "meala-hawas" were found, and several real dwellings, but only one of the latter was accessible, and an unfortunate fall of my horse broke the plate from which I hoped to secure a good photograph of it. For ten miles we were able to follow the winding Shinumo on the trail already made, and then we came to a full stop. The old Mormon trailmaker calls this great "exclamation point" "the devil's elbow," and surely it seems a very devil of an elbow to get around. Dynamite will have to be used ere it can be passed and the upper dwellings (which can clearly be seen from walls above) reached.

Nor are these the only cliff dwellings that have not yet been explored. In one branch of the wonderful Ha-va-su Canyon (commonly known as Cataract Canyon) are scores of these dwellings and meala-hawas that no white eyes but my own (according to the statements of the Indians) have ever gazed upon. The weary work of reaching these precluded my taking the camera on my first trip beyond a certain point, where I was glad to leave it, but near here is a dwelling I hope some day to explore. It is so high up and so far within the hollowed-out walls that at present it is inaccessible.

An interesting fact about these dwellings is that the Havasupais have positive traditions as to their occupancy by their own ancestors, and, furthermore, on my last visit to this most interesting people, in July and August, 1899, I found my host, Wa-lu-tha-ma, about to go back to the cliff dwelling houses of his ancestors. Our engraving shows the site on edge of a forty or fifty feet high precipice where he was just beginning the erection of a cliff house. Though he has two wicker "hawas" in the valley, he prefers a stone house, where, as he himself informed me, he expected to be able to keep dry when it rained. Nor are these all the recent discoveries. Engraving No. 4 shows one portion of a large house near the banks of the Little Colorado which has never been explored, described or platted, and in the region of the Grand Falls and Black Falls, both on the Little Colorado, I have had the Mokis and Navahoes take me to ruins and cliff dwellings that they assure me they themselves have only recently discovered.

There is also an interesting ruin on the summit of a vast isolated rock mass, just above Willow Spring, which the Navahoes pointed out to me as I was journeying once to Lee's Ferry. This has never been described or explored. It is inaccessible, and I had to climb up the steep walls of Echo Reef ere I was able to secure a view of it.

It may be a matter of interest to show here one of the many Caveate dwellings found near Flagstaff, Arizona, and which were doubtless occupied by the same people as the cliff dwellings. The caves are either natural blowholes enlarged by rude methods or were hewn out of the softer lava deposits. Many of these caves have been explored, and the relics found are of the same character as those of the cliff dwellings.

I am satisfied there are scores of cliff dwellings in Arizona and New Mexico yet to be found, and I am glad to

have the opportunity the wide and thoughtful clientage of the SCIENTIFIC AMERICAN affords me to urge upon all travelers into this region the most thorough and careful search for places and dwellings of the prehistoric peoples regardless of the assertions made that such search will be in vain.

THE ARMAMENT OF OUR LATEST WARSHIPS.
We present illustrations of our latest long-caliber

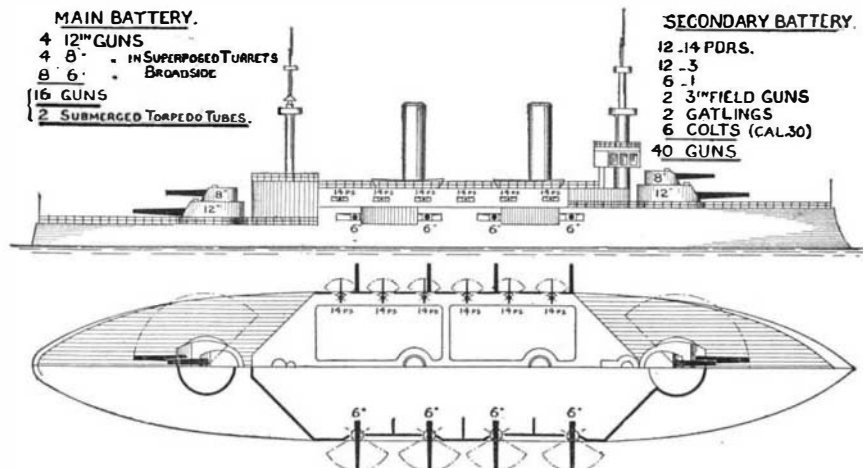
of various patterns in use during the past fifteen years, is to be found chiefly in the qualities of the powder. The old black powder of the civil war was a quick powder—the charge being almost instantly converted into gas at the instant of firing; the brown powder used in the Spanish war was slower burning than the black powder, but quicker than the smokeless powder, which burns, for an explosive, at a very slow rate, and gives off enormous volumes of gas. The slow combustion of smokeless powder necessitated a longer bore, to give the powder time to be completely consumed, and it is by the large powder chamber, big charge, slow combustion and sustained acceleration in the long bore, that the modern long-caliber gun achieves its wonderful results, the projectile of the new 6-inch gun leaving the muzzle with a velocity of 2,900 feet per second.

The accompanying diagram shows four patterns, from the 30-caliber, 4.8-ton brown powder gun, as originally carried by our earlier ships, to the new 50-caliber smokeless-powder weapon, which is to be mounted on the "New Jersey." The earlier gun of 1883 was 16 feet 3 inches long and fired a 100-pound projectile with a muzzle velocity of 2,000 feet per second and a muzzle energy of 2,773 foot-tons. Following this came the 35-caliber 5.2-ton gun, which was 18 feet 8 inches long, and gave a muzzle velocity of 2,080 foot-seconds and a muzzle energy of 2,990 foot-tons. This is the gun originally mounted on the "Oregon" and class, but since replaced by the 40-caliber, rapid-fire gun, which is 21 feet 3 inches long, and has a muzzle velocity of 2,150 foot-seconds, and a muzzle energy of 3,204 foot-tons if fired with brown powder. The 50-caliber gun is 25 feet long, and when using the new smokeless powder it will develop a muzzle velocity of 2,900 foot-seconds and a muzzle energy of 5,838 foot-tons, which is more than double that of the earlier, 30-caliber 6-inch brown powder guns of the "Boston" and "Atlanta."

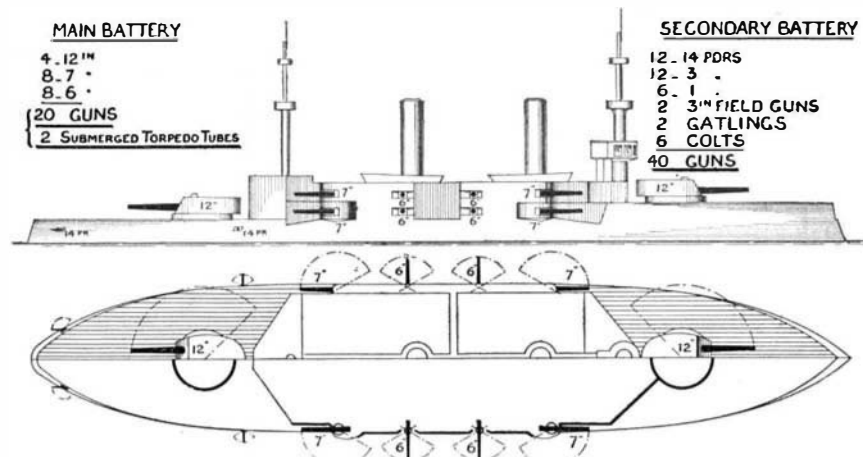
A study of the diagrams shows that the construction of our guns has been greatly simplified by the reduction of the total number of parts of which they are composed. The 30-caliber gun consisted of twelve separate pieces, whereas the new 50-caliber piece, although weighing nearly twice as much, contains only half that number. The difference is due chiefly to the improvements which have taken place in the manufacture of gun steel, assisted by the experience which has been gained in the assembling of built-up guns. The Ordnance Bureau of the navy has always claimed that it could build as efficient a gun on the built-up or hooped system as could be secured under the wire-wound system, which finds great favor in the British navy, and the behavior of our guns, coupled with the high ballistic results achieved with the latest gun, proves that their confidence was not misplaced.

The built-up gun of 1883 consisted of an inner tube extending from breech to muzzle; a jacket and a set of chase hoops shrunk on over the tube; and a set of jacket hoops shrunk on over the jacket, while over these was a ring carrying the trunnions. In the 40-caliber gun, the many chase hoops have given place to one long hoop or two, while in the 50-caliber weapon the construction is simplified to an inner tube, a single, long jacket and three jacket hoops. The substitution of a long jacket and a few long hoops for the many short hoops of the 30 caliber gun not only cheapens construction but adds greatly to the transverse strength of the piece.

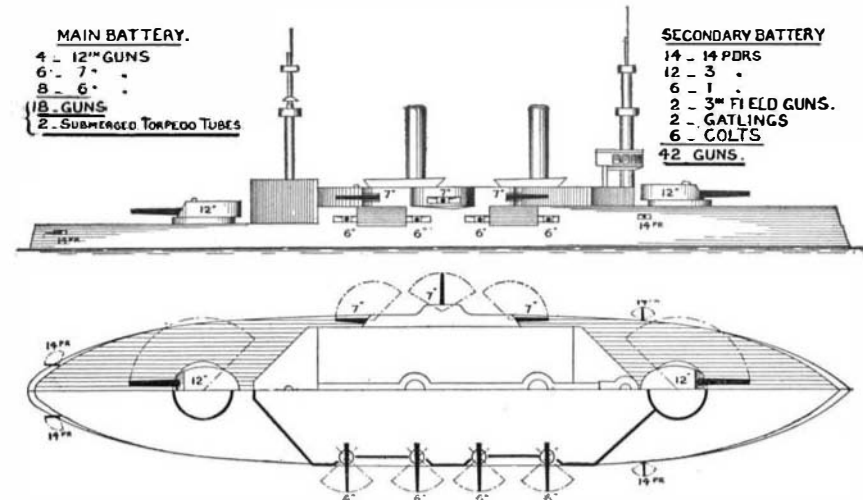
By the courtesy of Rear-Admiral O'Neil we are enabled to present the accompanying table, showing the ballistics of the new naval guns (1899 model). They are all built, according to the improved principles shown in the 6-inch 50-caliber gun, and it is safe to say that as they stand on paper the results are generally equal, if not superior, to those obtained in foreign navies. The 14-pounder, 3-inch gun will form a conspicuous feature in the armament of our future ships. While by its rapidity of fire it will be suited, like the 6-pounder which it displaces, to repelling torpedo-boat attack, its power and range will render it very effective against the unarmored and lightly armored portions of an enemy's ship. The 4-inch gun



Design 1.—Armament and $\frac{1}{2}$ Ammunition 951 tons—7.03 per cent of 13,500 tons.

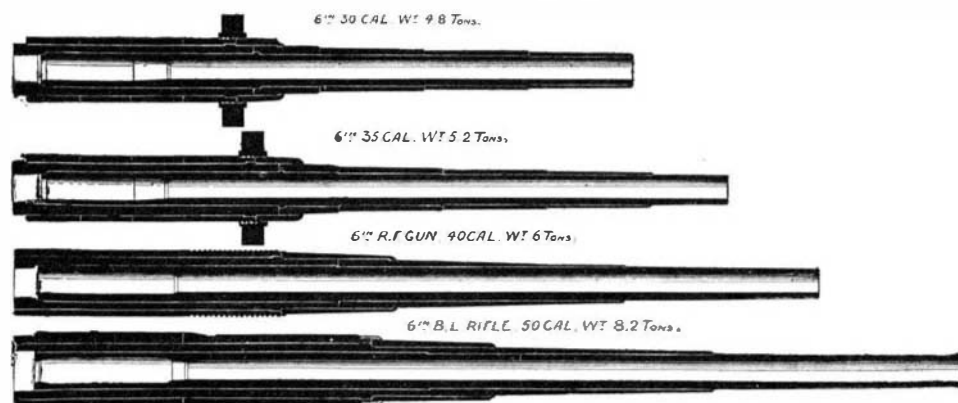


Design 2.—Armament and $\frac{1}{2}$ Ammunition 1,043 tons—7.72 per cent of 13,500 tons.



Design 3.—Armament and Ammunition 989 tons—7.32 per cent of 13,500 tons.

PROPOSED ALTERNATIVE ARMAMENTS FOR NEW 13,500-TON UNITED STATES BATTLESHIPS.



COMPARISON OF FOUR PATTERNS OF 6-INCH GUN FROM 1883 TO 1899.

guns, and also of the proposed armaments of the three first-class battleships, "New Jersey," "Georgia" and "Pennsylvania," authorized by the last Congress. In the last report of Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, reference was made to the new ordnance which is being constructed for the batteries of future warships. These guns are to use smokeless powder, and develop vastly greater energy, gun for gun, than the old brown powder guns, which were so largely in use during the war with Spain.

The explanation of the remarkable changes in our navy guns, as shown in the accompanying comparison