THE CASA GRANDE RUIN, SOUTHERN ARIZONA.*

By COSMOS MINDELEFF.

SITUATED near the Gila River, in Southern Arizona, is perhaps the best known specimen of aboriginal architecture in the United States, and no treatise on American antiquities is complete without a more or less extended description of it. Its literature, which extends over two centuries, is voluminous, but of little value to the practical scientific worker, since hardly two descriptions can be found which agree. The variations in size of the ruin given by various authors is astonishing, ranging from 1,500 square feet to nearly five acres or about 200,000 square feet in area. These extreme variations are doubtless due to difference of judgment as to what portion of the area covered by remains of walls should be assigned to the Casa Grande proper, for this structure is but a portion of a large group of ruins.

The earlier writers generally state that the Casa Grande was in ruins at the time of the first Spanish invasion of the country, in 1540, and quote in support of this assertion Castaneda's description of a ruin encountered on the march, Castaneda saying, "The structure was in ruins, and without a roof." Elsewhere he says that the name "Chichilticale" was given to the place where they stopped because the monks found in the vicinity a house which had been inhabited by a people who came from Cibola. He surmises that the ruin was formerly a fortress, destroyed long before by the barbarous tribes which they found in the country. His description of these tribes seems to apply to the Apache.

In 1694 the Jesuit Father Kino heard of the ruin, and later in the same year visited it and said mass within its walls. His secretary, Mange, describes it as "a large edifice, the principal room in the center being four stories high, and those adjoining it on its four sides three stories, with walls two varas thick, of strong avgamaso y baro (adobe), so smooth on the inside that they resembled planed boards, and so polished that they shine like Puebla pottery." Mange also states that there were in the immediate vicinity the remains of twelve other buildings, the walls half fallen and the roofs burned out. There have been many subsequent descriptions, among the latest being those of members of the Hemenway southwestern archaeological expedition.

The ruin is about half a mile from the Gila River, directly on one of the stage routes from Casa Grande station, on the Southern Pacific Railroad, to Florence, Arizona, and about nine miles below or west of the latter place. The name has been usually applied to a single structure standing near the southwestern corner of a large area covered by mounds and other debris, but some writers have applied it to the southwestern portion of the area and even to the whole area, the name Casa Grande ruin being, perhaps, more properly applied to the single structure with standing walls. It occupies a position near the southwestern corner of the group of ruins, and its size is magnificent as compared with that of the entire group, or even with the large structure in the north central part of the group.

For miles about the Casa Grande ruin, a general view of which is given in one of the illustrations, the ground surface is so flat in every direction that from the summit of its walls an immense stretch of country is brought into view. The area covered and inclosed by standing walls is about 43 by 59 ft. The building comprised three central rooms, each approximately 10 by 24 ft., and two other rooms, each about 9 by 35 ft. Except the central room, which was three stories in height, all the rooms were two stories above the ground. The northeastern and southeastern corners of the structure have fallen, and large blocks of the material of which they were composed are strewn upon the ground in the vicinity. It is not likely that the main building originally stood alone, as at present, and the area immediately adjacent, now covered by mounds, probably carried buildings

* Condensed from an exhaustive paper in the Thirteenth Annual Report of the Bureau of Ethnology, Washington, D. C., J. W. Powell, Director.

CASA GRANDE RUIN—SQUARE OPENING IN SOUTH ROOM.

of the same time with the main structure. The exterior walls rise to a height of 20 to 25 ft. above the ground, and in the middle space the walls are now 25 to 30 ft. above the ground level. The exterior of the walls is rough, but the interior walls of the rooms are finished with remarkable smoothness, this fine finish being apparent in the illustration showing a square opening in the south room. The walls at the base are from 2½ to 5 ft. thick, and at the top are reduced to about 2 ft. The building was constructed by crude methods,

thoroughly aboriginal in character, and there is no uniformity in its measurements. The walls, even in the same room, are not of even thickness, and the floor joists were seldom on a straight line. The adobe of which the building is constructed is not the usual moulded brick dried in the sun, but the walls are composed of huge blocks of clayey earth, probably formed in place in a box or trough held in a framework of canes or poles. The material, when dry, became almost as hard as sandstone, and practically indestructible, in the clim-

GENERAL VIEW OF CASA GRANDE RUIN.

ate of the region. The damage done by relic hunters in the last twenty years has been probably much greater than that wrought by the elements in the preceding two centuries. The writer has been reliably informed that as late as twenty years ago a portion of the floor or roof in one of the rooms was still in place, but at the present day nothing is left of the floors except marks on the vertical walls, and a few stumps of floor joists, deeply embedded in the walls, and so high that they cannot be seen from the ground.

FLUID AIR FOR INDUSTRIAL USES.*

LIQUEFYING air is not a new thing; it has been performed by exerting enormous pressure or by freezing air to an unusual degree, or by a combination of pressure with refrigeration. There are so many uses to which liquefied air can be put that scientists hardly know where its usefulness will end if it can be produced at a low rate of cost in commercial quantities. This a new method and machine has accomplished.

Among other advantages, air in the portable, cheap form of a liquid, as it passes back to its ordinary state, can be used for illuminating purposes by mixing its escaping gases with atmospheric air in certain definite proportions. Moreover, as a driving force in the way of detonators or explosive material to drive engines, liquid air is obviously a power that can be, under given conditions, profitably applied.

Hitherto the classic example of a method to liquefy air and obtain oxygen has been that invented by Beatty and Cailletet in 1877. With their machine, one began with carbonic acid gas. By means of a pump this gas was condensed in a tube, round which lay water at 10° to keep the tube cool. The carbonic acid gas, being reduced to a very low temperature, passed from the first tube into another chamber with a tube in it, and in so doing fell to a lower temperature. Into this second tube was pumped at high pressure ethylene gas, which in turn fell to a low temperature, owing to the coldness of the carbonic acid gas bathing the tube. The ethylene gas was then passed from the second tube into a third compartment and fell further in temperature in so doing. The third compartment had likewise a tube with an air pump attached. Into this third tube was pumped oxygen gas and from the ethylene gas bathing it the oxygen gas reached a temperature of 192° below zero. Finally, the oxygen was let out into a fourth compartment, in which was a fourth tube. The air pump attached to this fourth tube having filled it with condensed atmospheric air, the latter was so reduced in temperature that when it in turn was released from the tube, its cold was 273° below zero, and it appeared in the form of drops like water.

This product, which is called liquid or fluid air, has a milky appearance from the presence of some carbonic acid gas, bubbles constantly, and from its enormous cold emits a smoke or cloud like the top of a very high mountain, and will only gradually resolve itself again into air when exposed to the ordinary atmosphere.

Fluid air costs about 10 marks (say \$2.25) for five cubic meters reduced. The new method is the invention of Professor Linde, of Munich. It produces the liquid for 10 pfennigs (say 2½ cents) for five cubic meters, and it yields the product either as a gas or fluid, as one wishes. This is one of the most ingenious pieces of mechanism recently known; its chief feature is its economy of working, for it uses air to refrigerate air. After the pump has worked for a certain time, one turns a cock and the liquid air runs out at a temperature of 273° below zero.

In Professor Linde's method an air pump of five horse power condenses air to a pressure of 200 atmospheres; this air passes down a spiral tube and is let out in a chamber, causing great cold; then it rises and passes on the outside of the spiral tube, bathing it and thus cooling the new air that has been pumped into the tube to take its place. This cooled air follows on into the chamber, expands and again lowers its temperature, then passes on up around the same spiral tube; but as its temperature has become much lower, the new air in the tube is still further refrigerated. This circulating process goes on, until the new air pumped into the tube reaches the expansion chamber at a temperature of 273° below zero, when it drops into the chamber in the form of liquid. Thus the air, steadily cooled, is made to refrigerate the newly pumped air more and more, until the necessary degree of cold is attained.

Another idea, which may or may not be an improvement, is to have the pump and all parts of the machine kept very low in temperature.

Air in the cheap, portable form of a liquid rich in oxygen can be used for many purposes in manufactures and the trades. The discovery of a cheap method may be of importance to American manufacturers.

CHARLES DE KAY, Consul-General.

Berlin, March 11, 1897.

BEEES IN MEDICINE.

WHEREVER the bee has had a home honey has almost invariably been used both for food and medicine. From the papyrus we know that the honey played not an unimportant part in the composition of many of the Egyptian medical potions, and H. H. Sir Bhagvat Singh Jee, M.D., has told us in his recently issued "History of Aryan Medicine," the role which honey took in the native pharmacopoeia of India. Among the medical writers of the past who have alluded to its use may be mentioned Hippocrates and Galen. In the current issue of the St. Bartholomew's Hospital Journal Mr. John Gutch gives some interesting gleanings from old writers who have mentioned bees and honey in a therapeutic connection. Although honey has been used as a medicament, it is not perhaps generally known that not only the sweet product of the bee, but the bee itself has been used in therapeutics. According to the author of the article quoted above, bees drowned in honey have been recommended for clearing the eyes, for staying vomiting, and as useful also for deafness. The curious injunction is given when using the medicine for clearing the eyes that the patient is to be bound, for such is the violence of the medicine that he cannot otherwise patiently endure it. The following remedy is given by Celsus: "The bodies of bees taken newly from the comb and powdered and drunk with Dierretick wine powerfully cures dropsy."—Lancet.

* United States Consular Reports.

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