Fairy chimneys in Peru - by Amelia Carolina Speravigna

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The erosion of water and wind on the rocks is able to create beautiful landscapes. Some places are well-known and have been declared natural heritage sites by UNESCO; some others are in desert and hostile regions, hard to visit. But a large part of these landscapes is known just by the local population. In this paper we will see that the simple action of some users of World Wide Web services, such as the Google Maps, in uploading their pictures, allows the discovery, study and perhaps future preservation of some of them. We will see in particular the case of some fairy chimneys in Peru, in the district of Pampachiri, Apurimac.

Before talking about this Peruvian landscape, let us discuss briefly the nature of these rocky structures, tall and thin cusps of rock protruding from the land. They are named in several manners [1]. These pinnacles are considered as "tent rocks", "fairy chimneys" or simply "pyramids", according to their shapes. Another name is "hoodoo": at first sight, this name seems to be derived from "hood" because of the structure looking like a sort of "dwarf hat", but probably its etymology is different [2]. Hoodoo is the common term used to describe the rock chimneys found in the western United States and Canada.

The fairy chimneys consist of a relatively soft rock. Some of them have on the top a harder stone, less easy to erode: the result is a geological structure resembling that of a chimney. These structures typically arise within sedimentary rocks or volcanic formations. The height of these chimneys can be of tens of meters. Their shapes are affected by the existence of different and alternate layers of materials having different strength. In some regions, there are the freeezing of water and the gravity that are creating these structures. A term that is known as "frost wedging". The water, that percolates in the cracks of rocks, freezes and then expands, acting as a wedge and breaking the rocks apart [1,3]. This is the same action chiseling the landscape of Dolomites, the mountain range located in northeastern Italy [4]. During the night, when the temperature goes below the freezing point, the water into the fractures of rock turns into ice. The corresponding expansion of ice volume increases the distance between the sides of fractures. During the day, the sun warms the rocks and water melts. So separated from the bulk, some parts of the rock fall for gravity. In the case that the fairy chimneys are made by tuff rocks from volcanic eruptions, the erosion is due to wind and rain. In Italy there are several areas with gullies (calanchi) and pinnacles, chiseled by water and wind. Well-known are the Calanchi di Volterra in Tuscany, but several other interesting places are in Abruzzo [5]. Among the best-known landscapes having fairy chimneys, there is that of Cappadocia, Turkey [6]. Besides the importance of this geophysical area, the region is quite interesting because Cappadocians carved their homes into the soft rock (see Fig.1). During the medieval era, this area becomes a refuge for Byzantine Christians. The people established monastic settlements and churches inside the pinnacles. According to [6], the Gereme Open-Air Museum in Cappadocia has the best-preserved collection of chapels and houses, most dating about the 11th Century [7]. The life in Cappadocia was even more complex, because, due to the persecution, the local Christians often had to hide themselves. It seems that, alarmed by the hoop beats [6], the would abandon the caves in the pinnacles to find a refuge in the underground. Beneath the ground of Cappadocia, archaeologists found a network of subterranean villages, the largest discovered is almost 10 levels deep, with narrow passages among them [6-9].

Not only Cappadocia has some houses inside the natural chimneys. We can find them also in Peru, near Pampachiri and San Larcay. This is a region having several interesting places for geophysical and archaeological researches. In fact, there is the archaeological site of Wallpa Wiru, having structures of Incas age [10,11]. Moreover, this region possesses a large structured system of carved stones, used as landmarks for agricultural purposes, system created in the Late Horizon period of Peruvian prehistory [11]."
limited resolution. However, Google Maps has an interesting feature: it is possible to drag the icon of the street view on the map and see if there are photos of the landscape uploaded by users. Doing this dragging, the location of the pictures appears as blue dots on the map (see Fig. 3). In this manner, anybody using the map can have some information on the landscape corresponding to the specific location. There are no photos of the quacas of San Pedro, but many pictures of nearby locations, uploaded by Max Altamirano Moler [13]. Besides being very beautiful, the pictures display the existence of a forest of fairy chimneys. The location in the Pampachiri district is given in the map of Fig. 3.

To the author’s knowledge, the pictures by Altamirano are the best existing documentation of fairy chimneys in Peru. In fact, among the pictures that Altamirano has collected on a site (see Fig. 4 and directly at [13]), several images are showing that some dwelling places have been obtained under or inside the fairy chimneys. It seems, as far as it is possible to gain from his pictures that a supporting structure of stones had built to reinforce the chimney (Fig. 5). Only a local survey and analysis can tell how many and how old these structures are. For me, a physicist, it is also interesting to model their thermodynamic behavior, such as that of the chimneys in Cappadocia, to see if there are some thermal benefits in using them as houses.

In conclusion, we have seen that a fairy chimneys landscape exists in Peru, where some of the chimneys seem used as dwelling places. Moreover, the documentation of these remarkable structures is due to the activity of a Google Maps user, demonstrating that each user can help in the process of spreading the knowledge of existing cultural landscapes.

References
1. Frank R. Spellman, Geography for Nongeographers, Government Institutes, 2010
2. www.scienceclerified.com/landforms/Ocean-Basins-to-Volcanoes/Plateau.html
4. In August 2009, the Dolomites were declared a natural heritage site by UNESCO.
8. Lyn Rodley, Cave Monasteries of Byzantine Cappadocia, Cambridge University Press, 2010
13. Photos by Max Altamirano Moler, in the Google Earth (KML), see also Panoramio, http://www.panoramio.com/user/4345310

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Photos by Max Altamirano Moler... : on the map, in Google Earth (KML)

Figure 4

Figure 5
Figure captions

Fig.1. Fairy chimneys in Cappadocia (picture by Zeynel Cebeci, of a site at Ürgüp - Nevşehir, Turkey).

Fig.2. Qochas near San Pedro. The average size is about 100 metres.

Fig.3. The position of San Pedro de Larcay, Peru, in the district of Pampachiri is given by the green arrow. The location of the fairy chimneys is given by the blue dots corresponding to the photos.

Fig.4. The image shows a part of the very interesting set of images by Max Altamirano Moler. To see them, the reader can visit [13].

Fig.5. This image is adapted from a picture by Max Altamirano Moler, to show the importance of the pictures he collected. Note how the fairy chimneys had been transformed in a dwelling place.