

# Underground living spaces in the Chinese loess

Constantin Canavas<sup>1</sup>

## Abstract

A particular group of cave-like constructions on the Loess Plateau across the Huanghe (Yellow River) in North-Central China is known under the Chinese name *yáodòng*. This group includes caves in a lateral cliff, built extensions of such cliff caves, but also underground caves around a sunken yard, and even standing-alone cave-like constructions. In some texts, these constructions are characterised as examples of vernacular troglodytic architecture. The typical soil that practically enables these constructions, loess, originates from yellow-grey wind-carried sediments and is highly subdued to erosion processes. Human use of the soil has a long tradition documented e.g. in Neolithic sites with “pocket-form” shelters dug in the loess. Digging or cutting dwellings in the loess continues in several forms and regions along the valley of the Yellow River till nowadays. The present study focuses on a certain type of these constructions – the sunken courtyard (or pit cave) dwelling in an approach combining perspectives of history of technology and social anthropology. It can be shown that the traditional processes of construction and maintenance of these underground dwellings presuppose specific forms of societal participation and labour organisation. Moreover, the present approach enables new modes of understanding e.g. the collective engagement of the community in the process of digging pits in the loess soil or of constructing rammed-earth walls from loess as *mise-en-matière* of collective memory. Further, the historical perspective shows how the specific construction of a living space has emerged in and is sustained by specific social conditions, as well as forms of land use (e.g. agriculture). Whereas in the past, images of “dwellings below and fields upstairs” were used for arguing in favour of the particular construction system, the rapid mechanisation of agriculture has turned against these underground constructions. Thus, current planning priorities of local and provincial authorities, as well as new societal orientations are unfavourable towards the construction of new sunken courtyards; moreover, they eventually undermine the preservation of existing ones. Even if cliff caves have entered into the focus of restoration and preservation projects, sunken courtyards are more exigent in technical support and more vulnerable when left out of use. It is precisely for these reasons that the sunken courtyards as examples of tangible cultural heritage are severely threatened. Without *enacting* the processes of construction, maintenance and use, the materialisation of collective memory in the sunken *yáodòng* practically loses its major witnesses.

**Keywords:** Loess, North-Central China, troglodytic architecture, sunken courtyard.

## The Loess Plateau across the Yellow River in North-Central China and the cave dwellings (*yáodòng*)

A particular geological formation of aeolian origin known under the term loess is found at several regions of the globe covering ca 10% of the Earth surface. The formation may follow a wide range of patterns (Pye, 1995) and can be found in areas such as the Danube plain in Europe (Evlogiev, 2007), in North America (Mississippi Valley), North Africa (Tunisia), Central Asia, and China. In North-Central China the formation is called *huángtǔ* (“yellow earth”) in Mandarin-Chinese, and originates from processes involving yellow-grey sediment sand presumably carried by dry winds from the adjacent desert regions of Gobi and Mongolia. Beside the aeolian deposit model further explanations have been proposed which account for secondary loess production through alluvial depositing or flooding (Pye, 1995). The beginnings of the formation of North-Central Chinese loess should go back to the Pleistocene epoch, the earliest stage of the Quaternary geological period. The formation process as such is still going on (Golany, 1992a: 14-18). The

material has proven particularly valuable for dwellings because of its thermic characteristics, as well as its solidity under dry weather conditions and the hard crust it forms under the influence of dry wind.

This hard crust is just a surface quality. More important is the quality of the loess ground as being highly subdued to erosion processes. This feature contributes to the relative easiness with which loess can be dug out in comparison to rocky soil – an aspect that has significantly facilitated activities of digging in loess and constructing dwellings known in (Mandarin) Chinese under the name *yáodòng* (pit, cave dwelling). Although several other Chinese terms are used to specify variations of the construction, as will be discussed later on.<sup>1</sup>

Geographically the loess area and the distribution of *yáodòng* dwellings cover the Provinces Shanxi, Shaanxi, Gansu, Henan, as well as the autonomous Region Ningxia following a large part of the valley of Yellow River in North-Central China. In these re-

<sup>1</sup> Several Western scholars (e.g. J.-P. Loubes) use the term “troglodyte” or “troglodytic” architecture.

<sup>1</sup> Hamburg University of Applied Sciences, Faculty of Life Sciences, Hamburg, Germany - costas.canavas@phl.uoc.gr

gions human working with this particular soil has a long tradition documented e.g. in Neolithic sites with “pocket-form” shelters dug in the loess.

The role and the typology of *yáodòng* dwellings in China has been an issue of the archaeological research since the beginnings of the 20<sup>th</sup> century. The most prominent finds till now are certainly those at the Neolithic village of Banpo, located to the east of Xi'an city, capital of Shaanxi, and attributed to the Yangshao culture that can be traced back to 6,000/5,000 – 3,000 BCE (Handbook 1994/2001: 92-106). A part of the dwellings excavated on the site are dug belowground, whereas others are built aboveground. Similar, perhaps even earlier belowground constructions were found also in other archaeological sites in the Yellow River Valley; they include vertical as well as pocket-form pits (Bodolec, 2005: 218-219; Golany, 1992a: 2-6). Although no vertical or pocket-form pits (as described in archaeological records) are in use as dwellings anymore, the archaeological record has considerably influenced the terminology perspective of looking on present-day *yáodòng* dwellings.

## Typology of traditional and contemporary *Yáodòng* dwellings

The typology of *yáodòng* cave dwellings appears more or less standardised in the literature (e.g. Golany, 1992a: 66, Fig. 4.1; Canavas, 2021: 42-43).

The cliffside (lateral) cave dwelling (*kàoyáyáo*) is a type of artificial cave cut into cliffs with a balcony-type flat yard that might link several dwellings dug in the cliff one beside the other (Golany, 1992a: 66, Fig. 4.1b). In several cases a roofed extension is added outside the cliff cave. Furthermore, such balconies can be found in a stare case arrangement one above the other, both in traditional as well as in contemporary constructions.

The focus of the present study regards the sunken courtyard (or pit cave) dwelling (*dikēngyáo*). This construction comprises a roof consisting of existing soil – or made artificially – and a group of cave dwellings dug at the lateral surfaces of the pit (Golany, 1992a: 66, Fig. 4.1a). In several cases the ground morphology could permit variations of a semi-belowground dwelling, with the entrance giving to the balcony yard and one or two walls in the soil (Golany, 1992a: 66, Fig. 4.1d).

Hooped (independent) dwellings (*gūyáo*) constitute a category of *yáodòng* dwellings built away of cliffs or pits. They are mostly based on a more or less sunken fundament. The reason for which these alone-standing buildings are considered as *yáodòng* is related to the construction material and to the forming of the inner space. Their walls are built with bricks of rammed loess earth. Their characteristic outlook (Golany, 1992a: 66, Fig. 4.1c) is related to their hooped roof made of loess soil or rammed earth, generally structured by wooden beams. Their specific architecture includes arcs constructed with bricks or/and stones.

Generally, there is no cliff in their neighbourhood; however, the way of forming the inner space is considered to simulate a cave – therefore several authors call them “constructed caves”.

Finally, several combined constructions are encountered, in which architectural types mentioned above are combined, or other extensions are added – eventually in a later phase – to an initial *yáodòng* dwelling (figs. 1, 2).

The dwelling types described above are mostly found agglomerated in villages. Typical formations include cliffside villages built (actually dug) into the slopes of terraced cliffs, as well as pit villages consisting of several sunken courtyards (Golany, 1992b: 151-162).

## Evolutionary approaches and ideological discourses

The discussion on the history of *yáodòng* as underground dwellings has been occasionally dominated (especially in the Chinese discourse in the 1950s and 1960s) by ideological premises that considered the historical emerging from the ground towards less deep pits, up to the semi-subterranean and, eventually, the aboveground constructions, as linear civilisation process (understood as civilisation *progress*). Such claims were proposed – among others – by the Chinese architect and historian of Chinese architecture Liu Dunzhen (1897-1968), who embedded them in “fundamental” valorisations regarding the alleged unity of Chinese architecture (see e.g. Liu 1957/1980, 42-43). Alternative approaches suggesting parallel evolutionary models, or indicating inverse evolutionary directions have also been proposed as interpretations of more recent archaeological evidence (see e.g. Loubes 1988, 30).

Critical approaches regarding the linear evolutionary model imply an explicit or implicit re-evaluation of the role of the soil. Moreover, closer observation of the process of construction itself imply that experiences with certain types of *yáodòng* should have been incorporated into the concepts of constructing more elaborate ones, e.g. the sunken courtyard. A discussion on such issues has been summarised elsewhere (Canavas, 2021).

## Social organisation of construction

Whatever generic models for the development of the dwellings known as *yáodòng* might be claimed as valid, the processes of construction and maintenance of these underground dwellings presuppose specific forms of societal participation and labour organisation. This condition is met by the collective character of construction.

In his monumental treatise *Science and Civilisation in China*. Vol. 4, Part III, 28: *Civil Engineering* Joseph Needham has reproduced a historical drawing from a later copy of the *Erh Ya*, Chapter 2, p. 6b (*Literary Expositor*), a dictionary with a long history of





Fig. 1 – Combination of cliff cave and sunken courtyard *yáodòng* in northern Shaanxi (photo by the author, 24.09.2019).

transmission, probably stabilised in the 3<sup>rd</sup> century BCE, enlarged and commented in ca. 300 CE. In this drawing a group of men are represented schematically during a process of constructing a wall using rammed (tamped) earth (*pisé*) (Needham 1971, 39, Fig. 719). Two men are preparing the material, the other two are depicted ramming the material as it is filled in the wooden moulds. Comparing this illustration with a recent photograph by J.-P. Loubes (Loubes, 1988: 45, Fig. 8) depicting a similar procedure in a village in the region of Xi'an, Shaanxi Province, one can't but notice the increased number of persons involved in the contemporary representation (seven instead of four, in a similar frame). This phenomenon of large social presence during works associated with loess-related structures (repairing walls, brick fabrication) was also observed by the author of this study during a recent field study in northern Shaanxi (Shaanbei) in September 2019. J.-P. Loubes has made the point that the process of constructing rammed-earth walls from loess can be regarded as a specific social act – a kind of mutual communitarian help (Loubes, 1988: 44). In a later work, he refers the design of *yáodòng* to “old Chinese cosmology” adopting a generalising regard on urban and rural, royal, noble and villagers' architecture (Loubes 2003: 18ff., 76ff.). In our reading of the visual evidence, the work with the loess or-

ganises a social space in a way in which the actors fulfil symbolical functions beyond necessary operations in the construction procedure. In this approach the process of constructing rammed-earth walls from loess can be read as *mise-en-matière* of the collective memory of the given community. Thus, the process of construction can be seen as a procedure in which the depositing of material (loess) enacts the participation of a large number of community members in a project of strengthening the collective memory of rural earth dwelling. Such aspects of current public perception and re-valorisation of *yáodòng* become visible and audible in the documentary video by E. Brosseau and C. Bodolec on repairing works regarding existing *yáodòng* in Shaanbei/North Shaanxi (Brosseau and Bodolec, 2012).

### Contemporary considerations and the heritage issue

The above claim that the process of *yáodòng* construction or maintenance engenders forms of collective memory or collective experience does not necessarily correspond to the current public perception of *yáodòng* dwelling culture by an external observer. Abandoned caves and buildings, or *yáodòng* constructions not





Fig. 2 – Sunken courtyard complex (Wikimedia Commons).

used for dwellings any more form an essential part of the *yáodòng* landscape in Shanxi and Shaanxi. From the perspective of interested visitors the guide words “abandonment” or “ephemeral buildings” have become popular classifications. In fact, numerous internet sites are named under these classifiers (e.g. <http://ignition.eg2.fr/2016/04/30/ephemeral-buildings-perpetual-architecture-shanxi-yaodong/>). This perception is supported also by the fact that in many cases the old *yaodong* dwellings are not officially registered as “houses”; they are considered just as “caves” with no certificates of use, and that may also be one reason why they are not maintained and preserved by some village authorities. In 1992 Golany reported that “construction of new pit cave dwellings was officially forbidden and currently only aboveground structures are being approved as new dwellings (Golany, 1992a, 51). Recently, new cave dwellings have been built in *yáodòng* style as annexes to the traditional ones that have been partially abandoned or adapted to the needs of modern dwelling (Genovese, 2019). This

re-discovery or re-activation of rather some *yáodòng* patterns than the tradition itself has several reasons. Beyond the re-valorisation of the character of vernacular dwellings, issues of environmental adaptation, thermal properties, and re-evaluation of earth-sheltered architecture have become focus of many recent studies and on-going local, national, and international projects – including projects of touristic development (see e.g. Cao 2013, Genovese, 2019). Following national and local law and regulations, a large number of projects intending to protect the value of built vernacular earthen heritage are initiated. In order to permit to the people to continue living in the site, however, the changing of social needs becomes increasingly an important issue taken explicitly into consideration. Thus, the architectural character or singular aspects of the *yáodòng* construction (fig. 3) are eventually modified during recent rehabilitation works (Frenda, 2016). Combining current social needs with traditional issues as they are incorporated into the official herit-



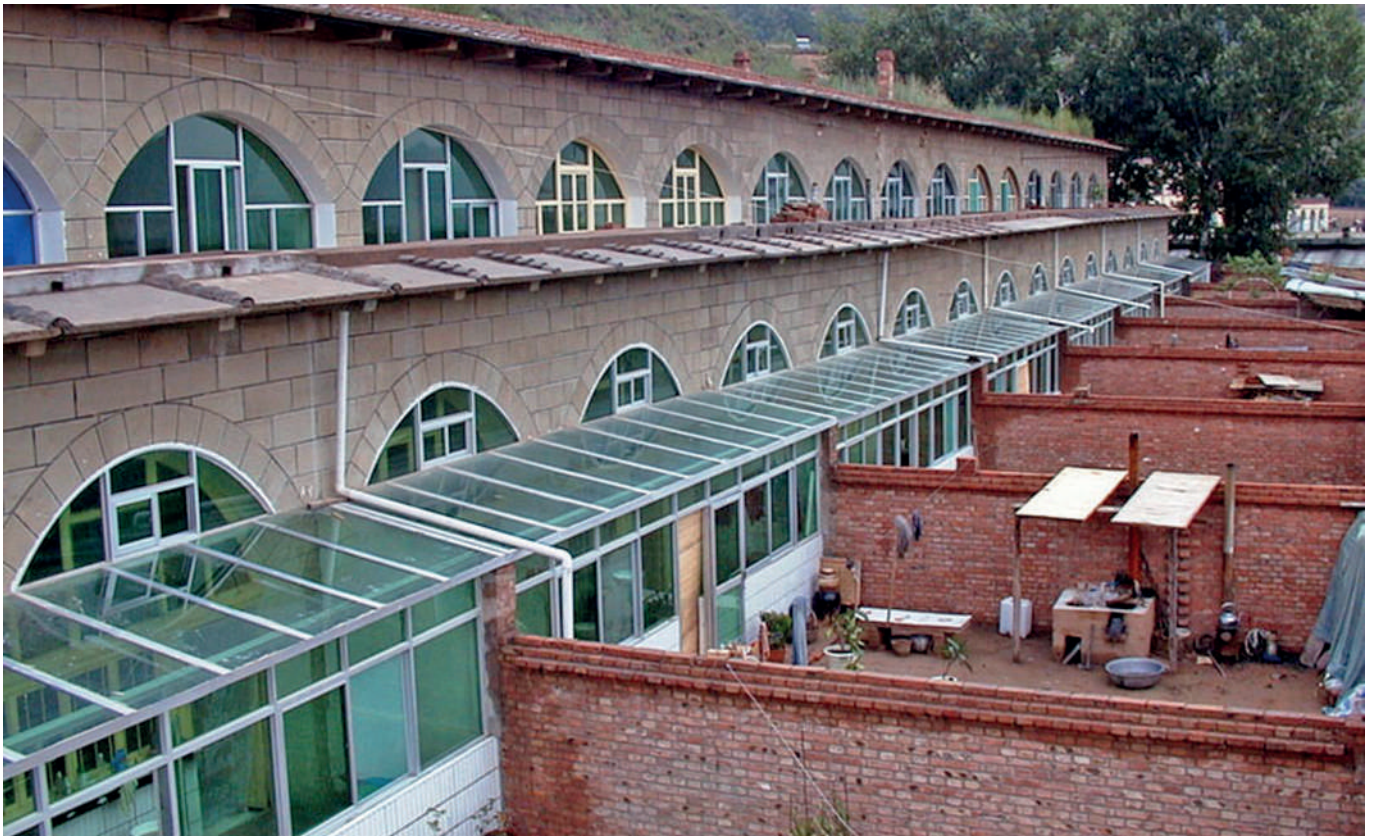


Fig. 3 – The new generation of Yaodong cave dwellings, Loess plateau (Wikimedia Commons).

age discourse concerning the Chinese *yáodòng* has several faces. Some *yáodòng* constructions, especially some belonging to the independent hooped-roof type (“constructed caves”), are already part of ensembles listed by the UNESCO as tangible world heritage such as small fortified towns, e.g. Pingyao, listed since 1997 (Bodolec, 2005: 269). On the other hand, the collective memory mentioned above can be a very ambiguous issue in a specific historical context. The mainstream national Chinese narrative on *yáodòng* is connoted with the historical focus directed upon sites around Yan’an in Shaanxi, where the communist leaders under Mao Zedong had installed their headquarters and living spaces during the period 1935–1948 in local *yáodòng* (Golany 1992a: 52–53). This scenery constitutes currently a major touristic attraction in a region which is marked by still on-going coal mining.

An increasingly important aspect that influences the current debates on *yáodòng* is the land use for agriculture and its relation to the specific form of sunken courtyard (or pit cave) dwelling. Whereas in the past, images of “dwellings below and fields upstairs” were used for arguing in favour of this particular *yáodòng* type, the rapid mechanisation of agriculture and the tremendously increasing demand for (new) cultivation areas in the Yellow River valley constitute arguments against these underground constructions and explain the reluctant or rejecting attitude of local and central authorities towards this particular type of

*yáodòng*. Indeed, current planning priorities of local and provincial authorities, as well as new societal orientations are unfavourable towards the construction of new sunken courtyards. Moreover, in some cases they eventually undermine the preservation of existing ones.

Even if cliff caves have entered into the focus of restoration and preservation projects, sunken courtyards are more exigent in technical support and more vulnerable when left out of use. A crucial prerequisite for constructing and inhabiting sunken yards was the social solidarity among the constructors and dwellers which is necessary for organising the collective work of construction and maintenance, as well the everyday-life in a strongly shared space. In times when large families with their strong relation networks were typical for rural North-Central China, this condition was easily fulfilled. The politically organised rural society after 1949 could still support necessary collective works for maintenance. However, the structure of the individual small families inhabiting nowadays the cave dwellings around the sunken yard is not comparable to that of the past. Social mobility, especially mobility of labour accompanying the rash urbanisation trends in 21<sup>st</sup> century China, affect crucially the social conditions of living and working in a sunken yard *yáodòng* in ways that render its maintenance as well as its adaption to the needs of the evolving society a great challenge – if not an overambitious vision.

## Conclusions

It is a fact that traditional *yáodòng* ensembles still continue to serve as living, working, or depositing space for over millions of people in the PR of China, and – because of certain advantageous ecological features (e.g. thermal isolation) – they become increasingly a source of inspiration for modern constructions and large-scale projects. However, the social changes and the economic-political priorities mentioned above constitute reasons for which the sunken courtyards as examples of tangible cultural heritage are severely threatened. Without *enacting* the processes of construction, maintenance and use, the materialisation of collective memory in the sunken *yáodòng* practically loses its major witnesses.

In this context comparisons with similar geomorphological situations in other regions and countries become increasingly interesting. Regarding the debates on sunken courtyard (or pit cave) dwellings a comparison with the considerations on the vertico-lateral cave dwellings in Haddej, Guermessa and Matmata in Southeast Tunisia could sharpen the analytical views on social organisation induced by such dwellings, and could yield new insights into possibilities and potentials of heritage preservation and geotourism (Boukhchim, Ben Fraj and Reynard, 2018; Boukhchim, 2020).

## Bibliography

- Boukhchim, N., Ben Fraj, T. and Reynard, E., 2018, *Lateral and “Vertico-Lateral” Cave Dwellings in Haddej and Guermessa: Characteristic Geocultural Heritage of Southeast Tunisia*, in The European Association for Conservation of the Geological Heritage, *Geoheritage* 10: pp. 575-590. Springer.
- Boukhchim, N., 2020, *Matmata (Sud-Est tunisien): peuplement et habitat troglodytique*, Al-Sabîl: Revue d'Histoire, d'Archéologie et d'Architecture Maghrébines N°9: pp. 1-28.
- Bodolec, C., 2005, *L'architecture en voûte chinoise – un patrimoine méconnu*. Paris, Maisonneuve et Larose.
- Brosseau, E. and Bodolec, C., 2012, *Yaodong, petit traité de construction*. (Video) Paris: EHESS.
- Canavas, C., 2021, *Cutting in the Chinese Loess*, in Sciuto, C. et al., *Carved in Stone*, BAR Publishing, Oxford.
- Cao, Y., 2013, *The Renovation of Traditional Cave Housing in China - New Ecological Design for Old Yaodong*. Milano: Politecnico di Milano, Facoltà di Architettura.
- Evlogiev, Y., 2007, *Evidence for the Aeolian Origin of Loess in the Danubian Plain*, *Geologica Balcanica*, 36. 3-4: pp. 31-39. Sofia.
- Frenda, A., 2016, *Earthen architecture in the agri-cultural heritage system: sustainable development, restoration and continuity of tradition*, *J. Mater. Environ. Sci.* 7 (10): pp. 3614-3622.
- Genovese, L., Varriale, R., Luvidi, L. and Fratini, F., 2019, *Italy and China Sharing Best Practices on the Sustainable Development of Small Underground Settlements*. *Heritage*, 2, 53: pp. 1-13.
- Golany, G., 1992a, *Chinese earth-sheltered dwellings: indigenous lessons for modern urban design*, Honolulu: University of Hawaii Press.
- Golany, G., 1992b, *Yachuan Village, Gansu, and Shimado Village, Shaanxi: Subteranean Villages*, in Knapp, R. K. (ed.) *Chinese Landscapes: The Village as Place*: pp. 151-162. Honolulu: University of Hawaii Press.
- Handbook (no author), 1994/2001, *Handbook of Xi'an*. Xian.
- Knapp, R. G., (1990), *The Chinese House: Craft, Symbol, and the Folk Tradition*. Hong Kong: Oxford University Press.
- Liu, D., 1957/transl. into French 1980, *Zhōngguó zhùzhái gāishuō/La maison chinoise*. Paris: Berger-Levrault.
- Loubes, J.-P., 1988, *Maisons creusées du Fleuve Jaune. L'architecture troglodytique en Chine*. Paris: Créaphis.
- Loubes, J.-P., 2003, *Voyage dans la Chine des cavernes*. Paris: Arthaud.
- Pye, K., 1995, *The nature, origin and accumulation of loess*, *Quaternary Science Reviews*, vol. 14: pp. 653–667.
- Needham, J., 1971, *Science and Civilisation in China*. Vol. 4, Part III, 28: *Civil Engineering; Hydraulic Engineering*. Cambridge: Cambridge University Press.