

## 3D DIGITAL MODELS FOR A WIDESPREAD MUSEUM: THE RENON'S "BAUERNHÖFE".

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### Commission II

**KEY WORDS:** Architectural Heritage, Digital Models, Museum, Virtual Reality, Augmented Reality

### ABSTRACT:

The aim of the paper is to study the characteristics of different 3D digital models (point clouds, mesh, CSG, BIM) for the realization of a museum of historical buildings widespread in the territory of South Tyrol through the 3D modeling of several farmhouses between the towns of Collalbo, Longomoso and Siffiano, in the Renon area. Therefore, moving from a defined case study, the paper proposes a workflow for model choice, use, and sharing considering also users profile. The objective is to create a system that allows, the sharing, both on site and remotely, of farmhouses digital models, information, images and documents found during the research. The purpose is to enhance the territory with the promotion of its knowledge taking into account also the importance of the participative aspects. In fact, in this system, are crucial and are a fundamental part of the safeguarding process, effectively increasing the information content and filling any information gaps, allowing the system to grow and become increasingly considerable and effective for the knowledge, documentation and enhancement of the territory

## 1. INTRODUCTION

According to the well-known concept of "Interpretation" as conceived by "The ICOMOS Charter (2008) for the Interpretation and Presentation of Cultural Heritage", the activities of raising public awareness and improving the understanding of cultural heritage play a central role for the safeguard, communication and enhancement of the heritage itself. For this reason, the proposal of a digital system for the use of the cultural heritage identifiable in the whole of the *bauernhöfe* in Renon is an irreplaceable engine for the protection awareness of the construction and functional Alpine and, more specifically, Trentino-Alto Adige tradition.

In this context, the phenomena related to the growth and diffusion of ICT and to the potential offered by digital modeling, virtual reality, and augmented reality technologies, favor the creation - on-line or in site-specific installation - of a digital heritage museum.

The study focuses on the important architectural heritage of the territory of South Tyrol through the proposal of a virtual museum and 3D modeling of several farmhouses between the towns of Collalbo, Longomoso and Siffiano, in the Renon area (Figure 1). The farms (in German *Bauernhöfe*) are the rural farms of South Tyrol which, thanks to a series of constructive peculiarities, different from each other in the various valleys, offer constructive and design typologies that characterize the territory of the country. Starting from 3D models, the technologies of virtual reality and augmented reality will be used to propose a hypothesis of a diffused digital museum whose key points are some of the traditional architectural and landscape elements of South Tyrol (Brusaporci, 2018a). Our proposal intends to act as a model of approach to a heritage that is not easy to use directly (all the farms identified maintain traditional agricultural functions) and that in digital technologies find an optimal infrastructure for their awareness and protection.

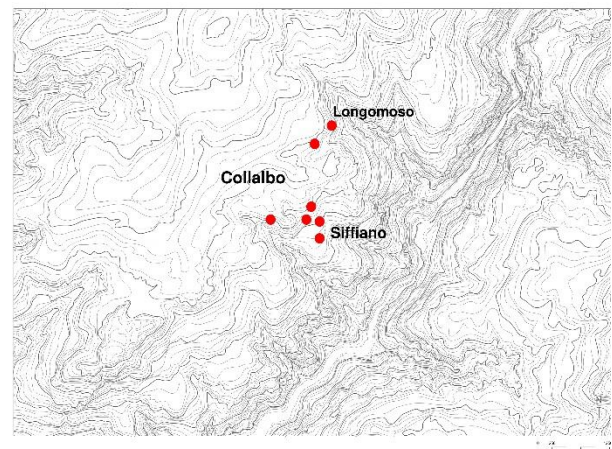


Figure 1: Orography of the Renon area with the identification of the seven farmhouses between the towns of Collalbo, Siffiano and Longomoso.

## 2. THE ROLE OF DIGITAL TECHNOLOGIES

The diffusion of low cost and easy to use digital tools and technologies for the creation, processing and re-processing and sharing of content, and at the same time the development of ICT, has made these tools an integral part of people's daily lives and has favored their use for the protection and enhancement of cultural heritage and for its awareness.

The very concept of a museum, in particular thanks to digital technologies, has changed, in ever more complex and inclusive terms. No longer just a meeting place - and potentially study -, exhibition and presentation of artefacts, but a social and cultural ecosystem of interconnection between institutions and people.

An essential role is played by new technologies that expand its “dimensions” and “dematerialise” its structures.

In the field of several disciplines, the theoretical-methodological reflection on “Digital Heritage” and its implications is increasingly widespread, profound and important. As underlined by Pescarin (Pescarin, 2016) “Digital Heritage is used today by the scientific community in a wider sense, referring to ICT applications and technological approaches to our cultural and natural heritage, or, better, to the use of digital media in the service of heritage” (Cameron and Kenderine, 2007).

Therefore, Digital Heritage refers to an interdisciplinary approach and strategy, to involve and overlap multiple sectors and different fields: scientific, economic and social.

In particular, in a social context in which life long learning is increasingly multi-modal and multi-nodal, the role of tangible and intangible heritage is taking on a position of great importance. Heritage education and education to artistic and creative expressions in general, develops starting from the use of digital participatory environments, promoting the growth of a sense of belonging, civic engagement and development of “participatory cultures” (Jenkins, 2009).

As for over a decade it has been acquired, heritage education is defined “as a formative, formal and informal activity, which, while educating in knowledge and respect for goods, by adopting responsible behavior, makes heritage the concrete object of research and interpretation, adopting the perspective of recurrent and permanent training for active and responsible citizenship of all people” (Bortolotti, Calidoni, Mascheroni, Mattozzi 2008).

This, obviously, radically changes the way of thinking and designing a museum. Digitization, more than any other factor, affects the ability to construct the museum experience, cognitive but also formative, telling stories, always new.

In fact “one of the fundamental tasks of museum culture and conservation of cultural heritage is to question objects whenever technologies allow us to ask new questions” (Luigini, Pancioli, 2018, p. 23): from material analysis to the digitalization of heritage and from documentation to the digital representation of intangible heritage, technology allows us to deepen our knowledge of our cultural roots, and digital technologies in particular, have the merit of a pervasiveness with which they can affect society as never before happened previously (Figure 2).



Figure 2: Perspective view of the farmhouse’s 3D model.

At the center of the digitalized museum system, therefore, there is no longer the cultural asset or the art object, but the experience of knowledge and training of the individual, supported by a multimodal and multimedia approach (Rossi, 2010). The more the system is adaptable, navigable, accessible and immersive, the more the training potentials intertwine with the museum's ability to adopt a different, expanded, semantic value, to reconfigure itself according to the user's cultural background, to adapt to the times and purposes of each individual visitor. Thus digital technologies can no longer be understood only as instruments for the production of content or for

visualization, but refer to a different methodological approach to research, knowledge, interpretation, presentation, conservation and education.

In particular, the various forms of digital heritage foster an iconic communicative flow (Brusaporci, 2015) which supports a re-mediation of cultural heritage (Bolter and Grusin, 1999). In this sense the relationship between observer and object is renewed from different points of view: the observer is no longer “alone” but part of a community, the object is no longer “passive” but active participants, indeed observers and contents can participate in the cultural definition of the asset itself. At the same time the new forms of “observation”: Virtual Reality, Augmented Reality, and Mixed Reality, combine the materiality of the asset with an information system that evolves over time (Sutherland, 1965; Milgram and Kishino, 1994; Brusaporci et al., 2018c). The non-linear narratives resulting therefrom foster the attention, the reflection, the knowledge, the valorization and the conservation of the same assets (Brusaporci, 2017). Meanwhile ICT make VR, AR and MR ubiquitous by our smart devices (Figure 3).

In this context, the present research aims to study the characteristics of the different types of digital models for architectural assets with regard to the different methods of use, in order to support a complex user-driven digital museum system, for conservation and enhancement of the architectural assets object of study.

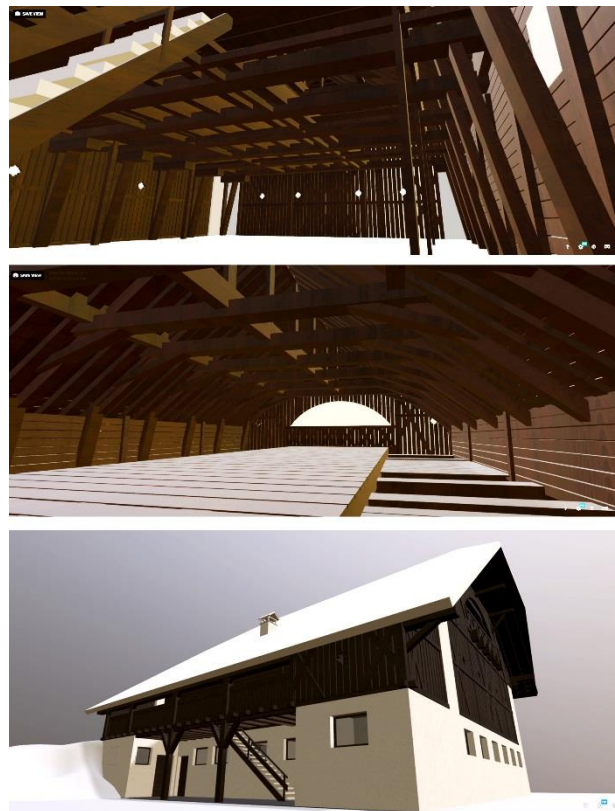


Figure 3: VR internal and external images of the *Aschnerhof* farm.

The project of the Renon’s farmhouse virtual museum goes in this direction, proposing itself as a physical / digital ecosystem capable of increasing the potential for social return of documentation and digitization of heritage: the simple establishment of a digital fruition system would risk remaining limited to special interest, while integrating different modalities,



with different media, with different communication strategies and content construction, the possibilities to adhere to the single methods of approach to heritage. Also fun (Figure 4).



Figure 4: Fruition of the internal spaces of the 3D model's farmhouse through the use of the AR viewer.

### 3. TYPOLOGY AND CONFIGURATION OF THE FARMHOUSES IN RENON AREA: BETWEEN DIGITAL DRAWING AND ICONOGRAPHY

The farmhouses, as key elements for understanding the South Tyrolean architectural heritage, include building techniques and design values of rural architecture consolidated over time. The seven farmhouses located in the areas between the towns of Collalbo, Longomoso and Siffiano, in the Renon valley, contain a series of typological and formal features that can be ascribed to the architectural and landscape tradition of South Tyrol, such as the adaptation of the architectural structure to the morphological complexity of the site (Figure 3). Without involving deep territorial transformations and in relation to the landscape, climatic and geomorphological characteristics of the territory, the farmhouses system is differentiated into two types: the single farmhouse system (Einhof) and the one with more buildings (Paarhof). The aggregative, formal and constructive configurations of these farmhouses are greatly influenced by agricultural needs, by the environmental conditions and by the social structure that underlie the construction of the buildings. The majority of these buildings dates back to the sixteenth century, with usually later interventions, as in the case of the so-called Erkerkammer, large spaces illuminated by bow-windows, often adjacent to the Stube, the living room, and dating back to the seventeenth century (Stampfer, 1990). Three of the case studies consist of two volumes, generally distinguished by agricultural or housing functions, characterized by three floors.

The buildings are differentiated by the use of the material, generally in masonry at the first two levels and in wood with the bunk-systems framework (Blockbau), planks and columns (Ständerbau) and crossed frame (Bundwerk), at the last level or at the roof's gable (Figure 5).

In relation to the typical morphological complexity of the site, the external stairs also intervene on the volumetric perception of the building as recurrent elements to solve the site altimetric differences also providing autonomous accesses, especially in the case of farmhouses with more aggregated buildings. The entire agricultural area is identified by the fences or dry-stone walls, that are not always the boundaries of ownership.

The internal spatial arrangement of some of the analyzed farmhouses is characterized by a central corridor which has the function of separating the residential and agricultural parts, as well as the distribution of the rooms.

Very often the corridor of the first floor is covered by cross vaults, whose modularity corresponds to the sequence of entrances to the rooms, characterized by pointed-arched openings. The internal functions layout (residential, production and storage) is guaranteed by ramps, piers and ladders corresponding to the traditional construction techniques of the vertical connection. The topological and typological grammar of these rural settlement systems is characterized not only by the construction techniques adopted in relation to the climatic and geological characteristics of the site or by the internal spatial configuration, but also by the connections between the site altimetric differences and the accesses. Another aspect of the farmhouse project concerns the modularity of the geometries that define the decorative apparatuses, mainly external, the distribution spaces and the constructive solutions.

The survey and the cataloging of the autochthonous elements of the South Tyrolean architectural tradition allow to integrate the current knowledge on the social and architectural evolution of the site bringing to light all the heritage of the everyday life belonging to the past that, following the development of

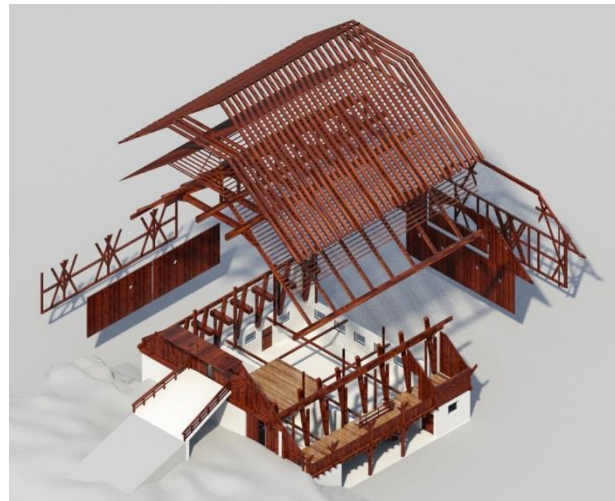


Figure 5: Exploded axonometric view of the construction system of the *Aschnerhof*.

agricultural techniques, has resulted in a gradually greater loss of some of the traditional elements of the farmhouses, with their consequent replacement: the mills, the fountains, the Harpfen (timber-framed structures for drying cereals), the barns, the ovens and the 19th century cableways used for hay transport (Lösch, 2001).

The digitalization of the orographic system and the insertion of archive images within the digital model define the control and understanding terms of the South Tyrolean architectural heritage, providing an integrated tool for the management of data and identifying a further modality of conservation of the cultural good through its fruition and visualization in the dimension of the digital drawing.

### 4. DEVELOPED METHODOLOGY

Following a territorial mapping of the farmhouses of this research, the paper describes a deepening on the iconographic

corpus related to the architectural typology and construction techniques that characterize these artefacts, through the digitization of the documents cataloged in the preliminary investigation phase. The objective is to create a system allowing the sharing, both on site and remotely, of farmhouses digital models, information, images and documents found during the research enhancing the territory with the promotion of its knowledge (Ippoliti and Albisinni, 2016).

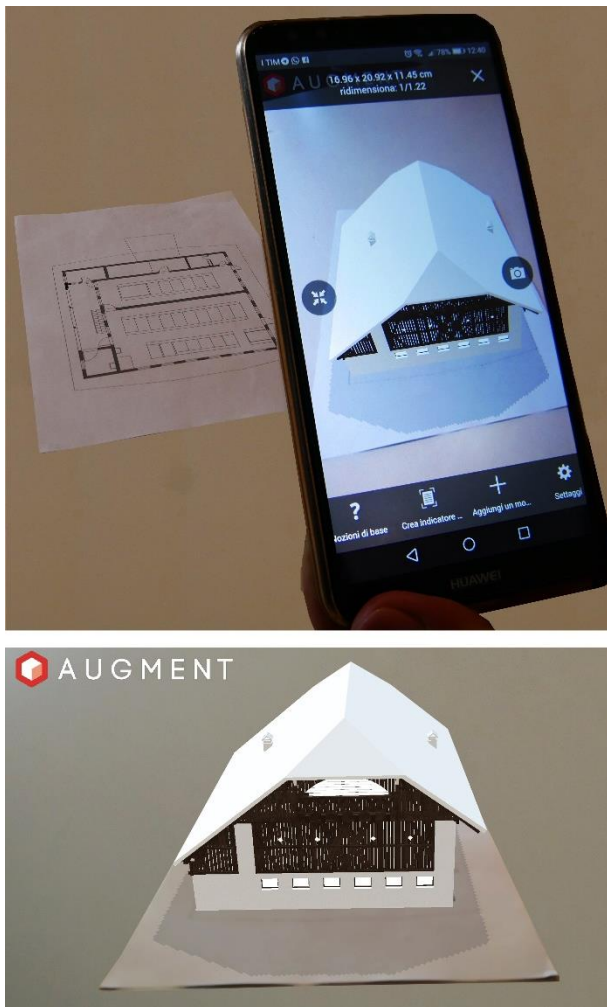


Figure 6: AR images of the *Aschnerhof* farm.

The goal is to develop a procedure that allows the user, through the navigation of BIM models, mathematical models and numerical models, to access information and places otherwise not accessible (Mures, 2016). For the sharing of these data, modelling can take place through the use and the creation of different types of models: mathematical and continues models of surfaces or solids, the elements are represented through a mathematical descriptions of the surfaces, of their boundaries and, in the case of solids, of the topological relationships between them; numerical models in which elements are discontinuous and constituted by coordinates.

In order to maximize the benefits derived from the three types of models:

- BIM models are used to make structural, historical, maintenance and construction information available to users through the use of the cloud A360 platform and the VR Revit Live viewer to virtually visit inside the farmhouse and to be able to visualize also some

information constituting the BIM model (Brumana et al., 2018, Brusaporci et al., 2018b).

- Mathematical models, instead, they are used to allow users a realistic, indoor and outdoor, experience of visiting the farmhouses through the use of remote VR viewers such as *Unity* or *Unreal* and AR on site through the use of the *Augment* app that allows framing the general plan or a pre-determined image of the building, to virtually visualize the model even from a mobile device (Guttental, 2010, Emler, 2015).
- Lastly, the use of these models is integrated through the option to navigate, via smartphones, point clouds and mesh models, using sites such as *Potree WebGL* and *Sketchfab* (Mancera-Taboada et al., 2011).

The choice of the use of different types of models and visualization is made to meet all the different needs that may derive from the use of this system for knowledge and promotion of heritage; moreover, the forecast of all these possibilities with regard to the models, uses and available information, derives from the intention to best satisfy the different profiles of users in relation to the individual needs and expectations in the approach to the system (Figure 6).

Through the geo-location of the models and their connection through a personalized map with the farmhouses in the area, it is possible to share places of interest, models and information with users. The sharing of the map takes place through its insertion into ad hoc web pages and social networks.

The purpose is to involve the user through the creation of an interactive sharing system in which he can access to information and to models and in which he can generate new information and add contents.

This allows an interactive flow of information in which users can suggest new farms not on the map, share photographs, missing information and point clouds made through photos taken from smartphones. In this way the user is active and is a fundamental part of the safeguarding process, effectively increasing the information content and filling any information gaps, allowing the system to grow and become increasingly considerable and effective for the knowledge, documentation and enhancement of the territory.

## 5. DISCUSSION

The Faro Convention (Council of Europe, 2005) puts at the center the “community”: It says that Cultural heritage is “a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time”; and define ‘Heritage Community’ as “people who value specific aspects of cultural heritage which they wish, within the framework of public action, to sustain and transmit to future generations” (p. 2). Therefore, the focus shift from heritage definition to the process of heritage making. Silberman and Purser (2012) say: “This whole hearted acceptance of re-creation and adoption as essential part of heritage significance places a new emphasis on process rather than product”. It is a new idea of people centered heritage, “distinct from older, static conceptions of heritage as unambiguous, expert-defined and needing protection from the forces of change” (p. 13). This approach gives to people an active and ineludible role in making sense of heritage and of sites. They are the main actors of interpretation. Heritage making becomes a social activity of interpretation, and according to a postmodern line, the discourse on interpretation defines the content.



The line of Cultural Heritage naturally inserts in the most recent reflections on participative heritage. The World Heritage Cultural Landscape says "The intangible cultural heritage is traditional and living at the same time. It is constantly recreated and mainly transmitted orally.

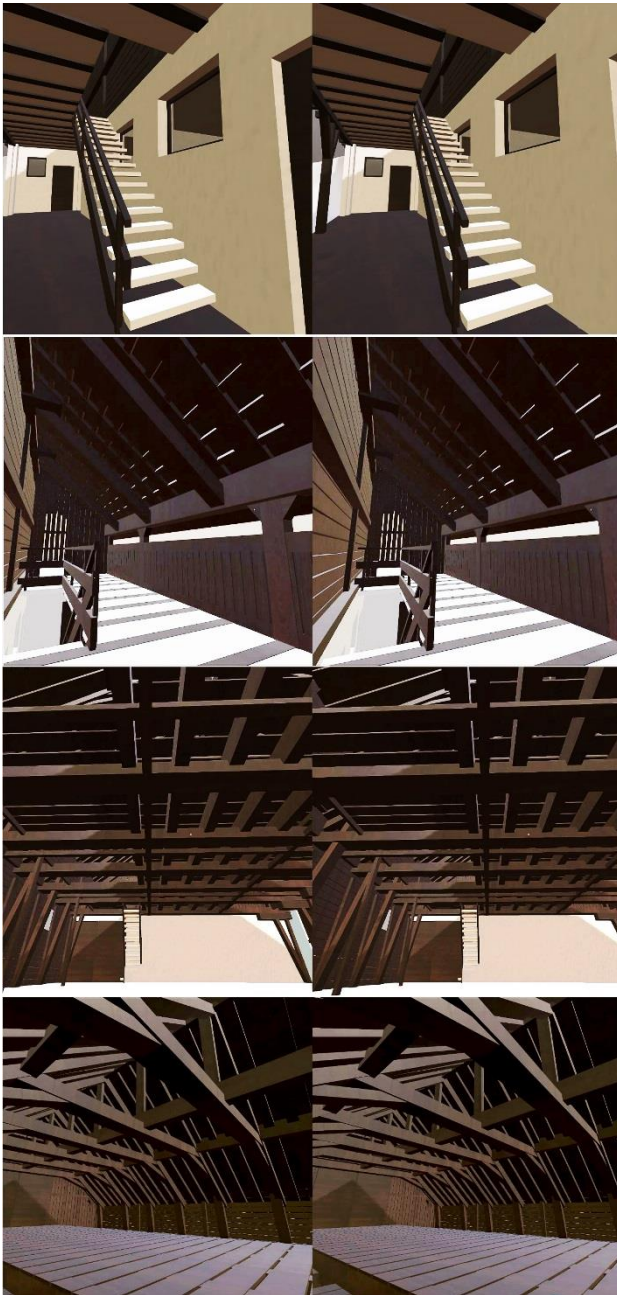


Figure 7: Internal views of the farmhouse in VR.

It is difficult to use the term authenticity in relation to intangible cultural heritage; some experts advise against its use in relation to living heritage" (UNESCO 2009). This in line with the Convention for the Safeguarding of Intangible Cultural Heritage (UNESCO, 2003) that underlines that intangible heritage is "recreated by people".

In relation to this cultural contest, the studies presented in this paper aspire to have a direct implication into the "Conservation" through a process of documentation / communication / education, a concept that refers to a general approach of protection (Figure 7). A rationale that is based on a constant attention to the

artefacts, other than "Preservation" and "Restoration" interventions that are considered as exceptional interventions. The same principle of Conservation has evolved over time in the sense of an inclusive logic that embraces both the tangible and intangible aspects, both about the changing and interrelated dimensions of natural, anthropic, cultural, and landscape assets. On the one hand there has been an enlargement of the idea of heritage from the monument size, to its context, to the landscape, in addition to including both the tangible and the intangible aspects; on the other, the concept of environment has expanded to include the entire ecosystem.

The principles attested by the UNESCO "Nara Document on Authenticity" (1994) remain firmly, which is based upon the conservation of the principle of the critical understanding of the "Cultural Diversity" and of the "Heritage Diversity".

Continues the recommendations by the UNESCO "Managing Cultural World Heritage" (2013), for which conservation actions include some trend topics of the scientific discussion, such as participation, sharing, sustainability, the use of digital technologies.

In conclusion, this research aims at two inseparable objectives: first, it wants to conduct a study on the characteristics of 3D architectural models in relation to their use for the creation of a widespread museum; on the other hand, on the basis of this study, we want to promote a theoretical-methodological reflection, in the form of a pilot project, on how such 3D models can act as preferential tools for awareness and for heritage education useful for conservation and enhancement of that historic-historical-cultural unicum consisting of buildings, their mountain environment, their inhabitants and their traditions.

\* Although the chapter was conceived unitedly, Brusaporci and Luigini are the authors of paragraphs 1. Luigini is the author of the paragraph 2; Vattano is the author of paragraph 3; Tata is the author of paragraph 4; Brusaporci is the author of the paragraph 5.

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