THE GLUE FACTORIES OF CASOLLA: ARCHAEOLOGY OF THE STRUCTURES OF A PROTO-INDUSTRIAL BIOCLIMATIC SYSTEM

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1. Introduction

In the borough of Casolla located near Caserta, situated in the pre-Apennine area known as *Terra di Lavoro* (*Liburia* in Latin), there is a large number of proto-industrial buildings which were used for the production of animal glue between the end of the 18th century and beginning of the 20th century. The driers in the glue factories (so-called *collére,* a dialectal word of southern Italy, which derives from the noun *"colla"* meaning glue) characterise the urban skyline, emerging with their vertical volumes from the mass of traditional buildings. In the ground-floor rooms, preparatory activities, such as raw material boiling and application of the glue in sheets, took place. The glue factories are monuments of industrial archaeology, material witnesses of the process of industrialisation of the territory [1], which offer interesting elements due to their unique concentration in the site examined. They are the most important environmental elements of this site [2], defining a specific cultural landscape whose characterisation is correlated with its economic, technological and social aspects [3].

Interest in the glue factories of Casolla (which played a vital role in the development of the economy of this borough, between the late modern age and early contemporary age) has increased, thanks to the possibility of relating the surviving material evidence (Figure 1-2) to production processes, workers' conditions and market situations [4].

In the '*Decennio Francese*' (historical period of 1806 – 1814), despite the abolition of feudal rights and the reorganisation of finances and public administration, production activities in the south of Italy did not increase adequately. This was above all due to the high costs of transporting the raw materials and finished goods, given that the infrastructural network, which deeply limited traffic, was poorly developed and the commercial policy implemented by the state administration was aimed at favouring the French industry [5, 6, 7]. However, the engineering, iron and steel and textile sectors had a certain impulse, which produced some effects even after the Bourbon restoration, especially with the introduction of protectionist measures, that stimulated considerable

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foreign capital investment during the third decade of the century. After the Unification of Italy, production structures in the south could no longer compete on the national market, also due to the fiscal and financial policies implemented by the new regime, which determined a delay in its technological and managerial advancement [8].

Figure 1. Casolla (Ce), views of some of the glue factories: a) Pacifico; b) Vanore; c) and d) Abbatiello.

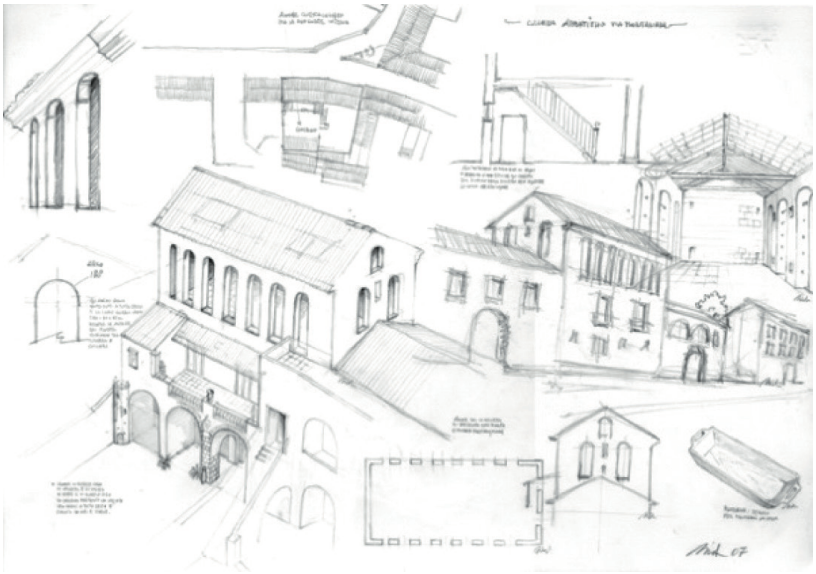

Figure 2. Casolla (Ce), Abbatiello glue factory, preliminary sketches.

In the 19th century, there was not only growth in the cotton, wool and ironworks sectors [9, 10, 11] in the area of *Terra di Lavoro*, but also in the production of strong glue. It became widespread especially in the municipalities of the town of Caserta (Pucciani-ello, Sala and Casolla) and in the nearby municipality of San Prisco.

The borough of Casolla stretches along two main routes (corresponding to *Via Montanara* and *Via Croce* – *via* is the Italian for street). It is located along the Piedmont axis

crossing the boroughs built on the slopes of the Tifatini hills and links the urban centre of the plain with the mountain nucleus of Casa Hirta. This is a particularly windy site, a peculiarity that has favoured the development of manufacturing activities related to the production of glue and particularly the last phase of the production cycle, that consists in drying the product (Figure 3).

Figure 3. Casolla (Ce), late 19th century cadastre. The glue factories still existing today are highlighted in blue.

2. "Strong glue"

Animal glue (obtained from fish, skins or bones) was the main adhesive product used in cabinet-making until the first half of the 20th century, when it was replaced by synthetic glues. As a result, there was a consequent, sudden interruption in the production of the former, that was non-competitive in comparison with industrial products. "Strong glue", also called "connective tissue scraps", was obtained from boiling (in large containers placed on special "tiny furnaces") animal parts rich in collagen (connective tissue, skin, tendons and bones), which had been previously purified with a wash in lime water. This particular type of glue is defined as glue of "Holland or England" in the *Encyclopédie* by Diderot and d'Alambert and minutely illustrates the production process, consisting of the phases of boiling, pressing, filtering, cutting and drying [12].

The dense broth substance produced by boiling was collected in wicker baskets that served as a filter by retaining any impurities and solid residues, separating them from the liquid rich in collagen, which was poured into special *matrelle* (i.e. wooden boxes) where it solidified. Afterwards, the glue was cut into thin sheets, then placed on *telarelle* (wooden racks) in the driers, where it remained for a few days and acquired the right consistency to be sold on the market.

3. Glue factories

Despite being vigorously developed, especially in the 19th century, the presence of activities linked with the processing of slaughter waste (leather) in Casolla has been attested since the late Middle Ages. The relevant historical records became more numerous in the 18th century, when there was a heated controversy between the inhabitants of S. Prisco and those of Casolla. The former complained about the possible damage that would result as a consequence of the miasmas from the glue factory of Casolla, which were managed by a certain Sir N. Cutillo [13], to the Royal Site of Caserta (evidently instrumentally involved, since the applicants were mainly interested in protecting their own private interests) in 1763. Indeed, the processing of the meat scraps and leather waste, called fleshings, produced a pestilential stench which spread to the surrounding area. This led the royal administration to establish, in 1752, that the three factories involved in the glue production in S. Prisco had to limit their activity to the winter months to mitigate the residents' discomfort. It was also established that any new plant would be located outside the farmhouse, in the direction of Capua, rather than towards Caserta.

In 1763, following the above-mentioned statement, the expert A. Tartaglione was commissioned to investigate whether Cutillo's factory had caused "any inconvenience or infection", reporting that the plant in question, which had been active for decades, had limited its production in winter to avoid any damage. Essentially, the controversy reports how the San Prisco inhabitants attempted to maintain the monopoly on the production of strong glue, which had been endangered by the development of its production in Casolla, in order "to sell the glue at a high price and also defraud the Royal Treasury which expected to be paid a duty of 2 *carlini* for each *cantajo* imported in Naples" (a *cantajo* corresponds to about 89 kg). Cutillo's initiative had a great consequence, which was the introduction, over time, of the driers: a typical innovation derived from the leather industry, as demonstrated, among others, by the tanneries of Solofra, in Irpinia [14]. L. Giustiniani, in 1797, recalled that the inhabitants of Casolla derived "excellent glue" from both connective tissue and skin waste called "*libelluccio*" [15], bearing further witness to the spread of the glue industry in the local environment. Twelve glue producers were mentioned in the economic statistics of 1862-64 for Casolla, including A. Lombardi who specialised in gelatine and ceased his activity in 1872. One fellow countryman, N. Fusco, was able to make his production appreciated at the Universal Exhibition of Wien in 1873, where he participated with seven types of strong glue [16].

In 1889, a report on the industries of the province of Caserta registered only three glue factories in Casolla [17], greatly underestimating the actual presence of this activity attested by the archaeological evidence consisting of production plants with driers dating back to the 19th century. More realistically, 24 glue factories were documented in Casolla [18] in 1931. The introduction of German synthetic products in the last decades of the 20th century finally determined a crisis in production. However, the crisis was not effectively handled and only some feeble attempts were made to introduce new equipment, such as a cavity boiler and a cutting machine. This eventually led to a halt in the radical revision of the production procedures and management systems of the family-run factories which, in the end, were gradually closed [19].

Nowadays, 18 glue factories are found in the historic centre of Casolla, largely characterised by the coexistence, due to the family management mentioned above,

of a residential area and several production areas. The latter consisted of ground-floor rooms, sometimes opening onto the courtyard where both the first phases of processing were carried out and the masonry tanks were allocated (some of which are now missing and only marked by negative stratigraphic units on the floors and along the walls) and which were used for cleaning up the meat scraps, leather waste and tools. Next to them, were the rooms with the furnace equipped with one or more boilers supported by masonry structures and from which the liquid resulting from the boiling was transferred to underground tanks. An external masonry staircase allowed the transport of the frames with the sheets of glue to the drier, located on the third level of the building, above the residential floor. The drier always had a very long rectangular layout (at intervals divided by a transversal wall, particularly developed in its height and characterised by high, narrow vertical openings (with a curved, or at times, a trabeated end). The closely sequenced openings extend for almost the entire height and are, for the most part, positioned on the long sides, a fact which was determined by the width of the internal wooden frames used for drying the sheets of glue. The architectural style of the alternating solids and voids, the considerable height and the steeply inclined pitched roofs (functional to the development of convective motions within such environments) define the typological and environmental characteristics of the driers (emerging volumes which characterise the inhabited area considerably) with very interesting architectonical solutions. As mentioned, they closely resemble those of the tanneries, as underlined by the similarity in their structures and equipment documented by the drawings in the technical manuals dealing with leather tanning.

In the glue factories, fleshings were stowed in the courtyards, from which they were transferred to the ground-floor rooms and cleaned in the largest of the three tanks that each plant had (the other two were used for washing *matrelle* and *telarelle*). They were then transferred to a second room which had a masonry vault (in order to avoid the risk of fire, linked with the presence of wooden horizontal sections) and put into a copper boiler. The boiler was nearly 1 m high with a diameter of nearly 1.20 m and was embedded in the wall structure of the tiny furnace that was fuelled by wood.

In most cases (Figure 4), the structure of the driers is made of masonry in rows of tufa blocks (stratified yellow or grey) with nineteenth-century and proto-twentieth-century mensiochronological characteristics [20, 21], confirming what was suggested by the sources about the meaningful development of this production sector during the early contemporary age.

Some glue factories are located around an open courtyard, as in the case of the plant owned by Fusco, located in Via G. Fusco (Figure 4 – No. 2). This factory is characterised by a ground floor portico, with barrel vaults and dominated by a residential level (disengaged from a loggia with masonry columns) and by the drier which is oriented east-west and characterised by very high openings and strong external buttresses. The *Pacifico glue factory* in Via B. Croce (Figure 4 – No. 3 and Figure 5) is similar and the driers tower over two angular buildings. A. Fusco's glue factory (Figure 4 – No. 4) is disengaged from an open courtyard, in which there is an arched portico with pillars. The back rooms were used for processing (with three masonry tanks of various sizes) and were served by a back courtyard (where there was a furnace protected by a roof) on the ground floor, while the drying rooms, ventilated by narrow arched openings, were on the second floor (Figure 6).

Figure 4. Casolla (Ce), identification of the most interesting existing glue factories.

In other cases, the plants have an inner courtyard, as can be seen in the *Graziadei* glue factory in Via A. Fusco (Figure 4 – No. 5), which underwent important renovation in 1870, when it took on its current appearance. Production activities were concentrated in the eastern factory building, surmounted by the drying rooms, which had an east-west orientation.

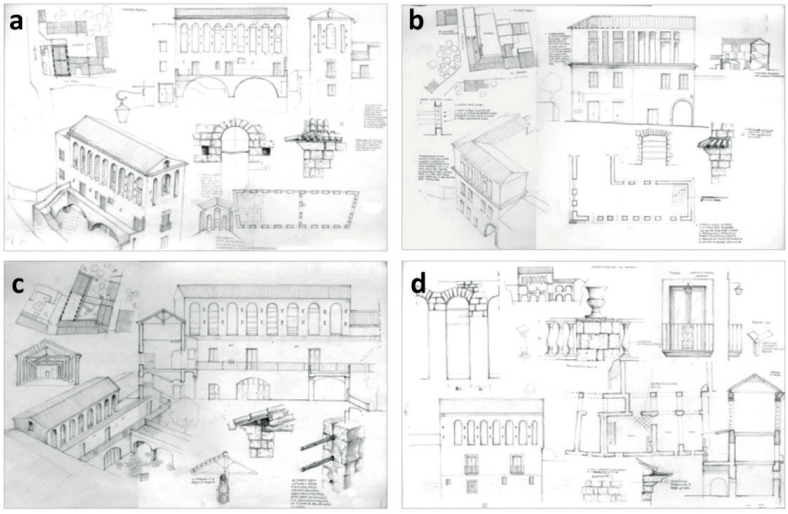

Figure 5. Casolla (Ce), glue factories, sketches; a) Pacifico; b) Sparano; c) Vanore; d) Abbatiello

Figure 6. Casolla (Ce), the Pacifico glue factory, drier.

The *Brancaccio* glue factory in Via Cupa Brancaccio (Figure 4, No. 10) stands in the suburbs of the borough in an elevated position; it includes nineteenth century production buildings with twentieth century extensions around the inner courtyard, including the drier, situated at the highest level of the building (Figure 7). The tanks and furnaces have been removed, while the machine used to cut the glue into sheets, the press and the smoke extraction pipes of the boiler flue used for the fleshing still exist (Figure 8). The glue factory owned by Fusco in Via Giaquinto (Figure 4 – No. 11), located outside the town along the road that connects it to the other boroughs, has an inner courtyard and is surmounted on the east side by the high volume of a well-preserved drier with an east-west orientation. The *Vanore* glue factory in Via Montanara (Figure 4 – No. 8), is equipped with a nineteenth century drying room oriented north-south, which has two rooms on the ground floor, with barrel vaults, preceded by a portico and is equipped with a masonry oven and a tank; there is a deposit for finished goods on the first floor; in the courtyard there is still a shed for drying the skins. Four more underground tanks are situated in another sector of the courtyard.

The tools used for processing were kept indoors. There were storage spaces for the fleshings, cleaning tanks, a furnace and adjacent press, and a glue solidification and cutting room on the ground floor; the drier was situated on the top floor. A drier with a north-south orientation was also found on the Fusco property (Figure 4 – No. 6) which faces the parish church of S. Lorenzo Martire, located along one of the main roads of the borough.

Likewise, the *Marino* glue factory (Figure 4 – No. 7), in Via Vanore has an open courtyard plan, as the result of an important stratification of structures; the drying rooms, with a rectangular plan and north-south orientation, constitute the top floor of the north side and have very high arched windows. In some cases, the openings of the driers are trabeated, as can be seen in the *Sparano* glue factory in Via B. Croce (Figure 4 – No. 1) which is characterised by stratified structures built around the courtyard; there is a portico with arches and pillars and the boiling rooms are on the ground floor, while the drying rooms are on the first floor.

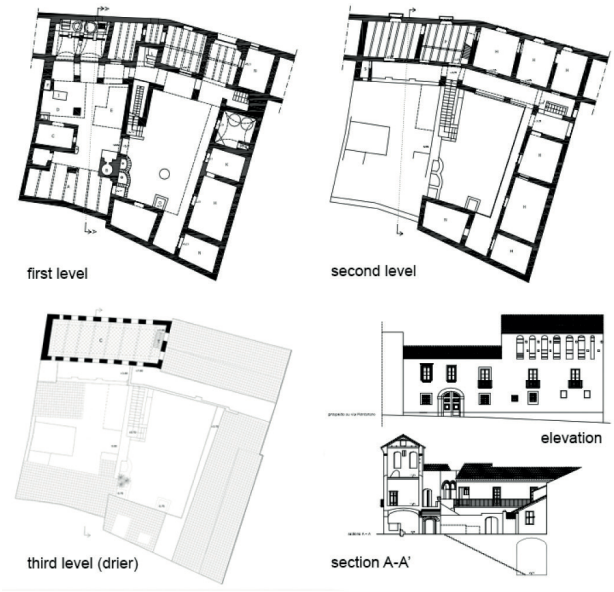

Figure 7. Casolla (Ce), the Abbatiello glue factory, plans and elevations.

Figure 8. Casolla (Ce), the Vanore glue factory; view of the ground-floor rooms with the masonry boilers for the fleshings.

Crossing the streets of Pozzo and Olvitelli, on the southern border of the town, the *Fusco* glue factory (Figure 4 – No. 12) has a closed courtyard with two drying rooms, the result of a super-elevation, with ventilation openings divided into two sections by flat bands of stone.

All the glue factories are located along the roads, with the exception of that owned by *Cocozza di Montanara* (Figure 4 – No. 9), which, being a pertinence of the homonymous palace, is set back from urehe road, presenting itself as an isolated building with a rectangular plan and east-west orientation.

4. Driers: a bioclimatic system

The driers of the glue factories of Casolla are a distinctive feature of the borough's urban landscape. The driers are characterised by a planimetric slat configuration and are oriented along the north-south longitudinal axis (with the exception of some driers oriented east-west, due to the specific conditions of the urban lots), which almost systematically follows the orientation of the built tissue, dictated in turn by its disposition along the main roads. Nonetheless, natural ventilation is maximised in both orientations, because in Casolla, as well as in the whole area of Caserta, the average wind direction is north-north-east in winter and west-south-west in summer. The driers' location, higher than the surrounding residences, guarantees complete exposure to the prevailing winds. Furthermore, the sequence of high openings on the perimeter walls further contributes to the effectiveness of passive ventilation all year round [22].

The favourable ventilation conditions are also amplified by the shape and size of the openings that are present in varying numbers, ranging from 5 to 10, on each external wall. Each opening, measuring 1.5 m (nearly 1.20 m wide and from 5.00-5.60 m high), is repeated along the envelope walls (from 7.00-9.00 m high). Their shape and number generate the so-called Venturi effect, i.e. a significant increase in air speed in correspondence to the opening edges, which further favours drying [23]. These circumstances, together with the above-mentioned orientation conditions, make the bioclimatic behaviour of the driers even more effective in comparison with either a completely open environment or a semi-confined shed.

It was also possible to adjust the speed of the air flows in the driers by using light wooden screens, suitably positioned in front of the openings in order to attenuate the ventilation or change its direction as desired.

Within these structures, the position and size of the wooden frames on which the sheets of strong glue were laid were consistent with the size and disposition of the external openings. In the unaltered driers, wooden rods with a circular section can be noted, placed at a distance of nearly 60 cm along the entire height of the external openings. Such openings corresponded indoors to the crossbars, which constituted the leading frames of the drying sheets, divided into two aisles by paths placed at different altitudes, in correspondence with the centre line of the driers, reached by the workers with ladders.

5. Conclusions

In the last post-war period, the culture of restoration abandoned the nineteenth-century aesthetics used to define monuments. Nowadays, cultural heritage is qualified exclusively for its documentary value, in accordance with the lesson from M. Bloch, accepted in the field of the history of architecture and architectural restoration [24].

In other words, monuments can be identified with all the material records of human history [25, 26] and can be recognized as documenting historical facts and processes. Architectural heritage can therefore be seen as being made up of all structures built in the past, as a result of historical stratifications.

The glue factories of Casolla, as monuments of industrial archaeology, are material witnesses of the process of industrialization that took place in Caserta, evidence of artisanal knowledge which is now outdated and no longer reproducible. Moreover, a resumption of the activities of the factories would not be feasible anyway, because of their environmental impact and health risk. Instead, it is possible to propose a demonstration of the production process only for educational and tourist purposes. The actual conservation of these factories may only be implemented through a refunctionalisation that respects their typological characteristics and material consistency.

This strategy would be particularly effective due to the specific characteristics of the driers, as it would enable the preservation of a characteristic element of the cultural landscape of the area of Caserta.

Notes

The present contribution is the result of a shared commitment from three authors; each of them has individually conducted the following paragraphs: “Strong glue” (Luigi Guerriero); “Glue factories” (Roberto Bosco); “Driers: a bioclimatic system” (Antonio Bosco).

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Biographical notes

Antonio Bosco graduated in Architecture; since 2000 he has been a researcher in Architectural Technology at the Department of Architecture and Industrial Design of “Luigi Vanvitelli” University of Campania. Since 2000 he has been an Associate Professor of Architectural Technology in the same Department. He is interested in architecture and landscape, with particular reference to the building-environment relationship. He studies bioclimatic behaviour and landscape relevance of buildings and urban micro-areas. He is also interested in the sustainable design of buildings and the conscious restoration of the urban landscape. He has collaborated in ministerial research and university projects carried out in collaboration with important public and private bodies.

Roberto Bosco graduated in Architecture summa cum laude and right of publication at “Luigi Vanvitelli” University of Campania, with a thesis on “Restoration of the Cathedral of Caserta vecchia” in 2018. He is currently leading a research activity on the Architectural Restoration course held by Prof. Luigi Guerriero at the same University.

Luigi Guerriero graduated in Architecture with a Ph.D. in Conservation of Architectural Heritage; since 2000 he has been Associate Professor of Restoration at the Faculty of Architecture of the University of Naples. He has organised and directed research groups and coordinated national scientific initiatives. He has been a member of the scientific council of National meetings and exhibitions. His research concerns the main topics of the twentieth century, the mensiochronological characterisation of construction elements, with related protocol of deterioration and structural modelling and methods and techniques of urban restoration.

Summary

In the borough of Casolla, near Caserta, a large number of proto-industrial buildings still exist that were used for the production of animal glue between the end of the 18th century and the beginning of the 20th century. The driers, an integral part of these structures, characterise the urban landscape, emerging with their long, high volumes from the mass of traditional buildings.

The position and orientation of the driers of the glue factories (known as *collére*), as they can still be seen today, were chosen solely for the purpose of achieving a very specific natural regime for the internal microclimate, aimed at maximising air flow and speed in order to accelerate the glue drying process. These formal aspects have been preserved until today, despite the changes made by the owners in order to transform the old driers into modern houses.

The glue factories of Casolla, with their driers, constitute a "*unicum*" from an architectural point of view. A partial and updated re-proposal of the ancient production processes would be unimaginable for conservative purposes, because of their harmfulness to human health and their negative impact on the surrounding environment. That is why their conservation may only take place through refunctionalisation, respecting the typological characteristics and material consistency of the old factories. This type of strategy would be particularly effective due to the specific characteristics of the driers, as it would allow these special characteristics of the cultural landscape of the Caserta area to be preserved.

Riassunto

Nel borgo casertano di Casolla sussiste un cospicuo numero di edifici proto-industriali utilizzati, tra la fine del XVIII secolo e l'inizio del XX, per la produzione di colla animale, i cui essiccatoi connotano precipuamente il panorama urbano, emergendo con i loro lunghi e alti volumi dalla massa degli edifici tradizionali.

La posizione e l'orientamento degli essiccatoi delle "collére", come ancora oggi possiamo constatare, sono del tutto funzionali al raggiungimento di un ben preciso regime naturale del microclima interno, orientato alla massimizzazione del flusso e della velocità dell'aria al fine di accelerare il processo di essiccazione della colla. Questi caratteri formali si sono conservati fino ai nostri giorni, nonostante le alterazioni apportate dai proprietari per trasformare gli antichi essiccatoi in moderne abitazioni.

Le "collére" di Casolla, con i loro essiccatoi, costituiscono un "unicum" dal punto di vista architettonico, per le quali non si può immaginare, ai fini conservativi, una riproposizione seppur parziale e aggiornata delle antiche funzioni produttive, a causa della loro nocività per la salute dell'uomo e dell'impatto negativo sull'am-

biente circostante. Per tale ragione la loro conservazione non potrà che attuarsi attraverso una rifunzionalizzazione rispettosa dei caratteri tipologici e della consistenza materica delle antiche fabbriche. Questa strategia risulterebbe particolarmente efficace in ragione degli specifici caratteri degli essiccatoi, costituendo una condizione essenziale per la salvaguardia di un elemento caratterizzante del paesaggio culturale dell'area casertana.