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History and Archaeology of Fires on Major Buildings. Introduction

Today, as in ancient times, major buildings burn. These disasters are an integral part of their history. The aim of this special issue is to assess the actual role played by fire in the history and archaeology of construction, by presenting a series of instructive monographic examples. By going beyond the ambivalence of texts and archaeological evidence, this issue shows the effectiveness of methodical, attentive cross-disciplinary approaches. The seven contributions brought together in this issue highlight several key points.

The first concerns the diversity of types of fire, often accidental or fortuitous, when the cause can be identified (lightning strikes, building site accidents, the propagation of urban fires of domestic or craft origin, etc.). Other fires, on the other hand, seem intentional. Flames are a convenient and rapid way of dismantling, a practice regularly observed in ancient sanctuaries and more rarely in churches, although Cologne cathedral provides an example that is both insightful and original. The permanent risk posed by fire raises questions about the means of protection available in the past once a fire had broken out. Although the resources deployed may often seem derisory, some techniques used to contain fire are nonetheless tried and tested. They often made it possible to prevent fires from spreading. But the best way to fight fire was still to design buildings that would burn little or slowly: stone vaults, partitioning systems and fire-resistant roofing materials were gradually introduced into construction, sometimes in accordance with urban regulations that made their use mandatory. Once fire has struck a building, it leaves very uneven traces on the building and in people's memories. A dual archaeological and historical approach is essential to re-establish the truth, because the physical traces alone are often silent and sometimes difficult to interpret, and the texts are possibly misleading. Associating a known event with archaeological remains interpreted "in negative" remains a complex task, leading to a form of paradox: the most devastating fires leave a deep imprint on our memories, but precisely because they are so destructive, they leave

the fewest traces on the monument. Finally, whatever the scale of the fire, it is undoubtedly a turning point in the history of the building. It often marks the beginning of a vast reconstruction project. By wiping the slate clean, it liberates the new project and replaces the perpetual palimpsest that is the old monument with a new page to be written. In this sense, the catastrophe becomes creative.

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Towards an Optimized Fire Protection of Historic Buildings

As highlighted by recent losses around the globe, fire is a looming threat to historic buildings. However, present regulations ignore the specific heritage value and unique features of each of these ancient constructions. Apart from the safe egress of people, degradation of ancient and frequently irreplaceable fabric, artworks, artefacts, and designs is

not considered acceptable. Unfortunately, standard solutions originally developed for modern dwellings are generally implemented in historic buildings as if these were old versions of new constructions. No specific fire protection features have been developed specifically for historic buildings, and often these protection systems can cause more harm than good if poorly implemented. To avoid losses of invaluable cultural material and long-standing damage, the required performance-based fire safety assessment of each structure involves a broad range of expertise. Historic analysis of past fires can be combined with numerical simulations to provide insights regarding major threats and likely fire scenarios, which should be addressed through adequate equipment and procedures. The 2019 fire of Notre-Dame in Paris is investigated here as a test case to highlight specific features of Gothic architecture, which should be further studied to devise the most appropriate fire protection strategy in line with conservation needs. Beyond the understanding of this tragic event, this analysis can support interventions in similar monuments, once their response to a fire is understood. Taking advantage of the rich documentation and scanning of the building before the fire, and of the very clear timeline of the intervention that shows the fire could grow undisturbed in its early stage, a model is devised to investigate fire growth and demonstrate the role of smoke in preheating the structure. If the fire spread is primarily vertical, as expected, the confinement caused by the lead tiles then preheats the fuel to a point that lateral spread occurs at a rapid pace that condemns the entire roof. This first simple study, with its assumptions and simplifications, needs to be followed by proper sensitivity analyses before technical conclusions are reached. Yet the potential of numerical simulation to assist design choices is clearly illustrated, revealing driving flame spread mechanisms and the associated timeline.

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Building Archaeology and Fire. The Materiality and Immateriality of a Disaster

The archaeological approach to buildings is regularly confronted with the issue of fire, particularly through the discovery of characteristic clues: abraded masonry or floors, burnt wood, etc. However, a variety of expert reports have shown that archaeological analysis of fire often becomes a delicate exercise when placed in a wider context, with the help of written documentation or a diachronic view of the building. In this way, the usual view of the disaster and its consequences can be nuanced, allowing us to take a more accurate measure of it and go beyond preconceived ideas. Conversely, the absence of its materiality on sites and in contexts where the facts are perfectly attested, for example in texts, raises questions about the scope and chronology of reconstruction programs. And not only in the act of (re)building, but also in terms of the intention to erase a trauma and the opportunities to impose new forms or functions. The memory of a fire can be more powerful for what it made possible than for what it destroyed.

Through a series of examples, this contribution illustrates the main challenges and difficulties posed by the archaeological reading of fire traces in the analysis of ancient buildings, while questioning the disaster

in its relationship to materiality. The archaeological analysis of fire traces is easier to understand in a sedimentary context, because they are "fossilised" by stratigraphy, unlike the clues found on elevations, which are extremely difficult to understand. Furthermore, it is clear that a mention of fire does not automatically mean the complete disappearance of a building or its wooden structures. On the other hand, there are situations where the materiality of the disaster is not at all obvious and must be interpreted "in negative", as a counterpoint to often ambitious architectural programs. As drivers of construction and architectural innovation, fires also appear to be strong stimuli for the preventive means and techniques employed by builders.

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Stone Vaults as Fire Protection? The Case of Saint-Benoît-sur-Loire and the Fires of 1002 and 1026

The biographies of Abbots Abbon (988-1004) and Gauzlin (1004–1030) tell us much about the buildings of Saint-Benoît-sur-Loire both in the monastery and the nearby settlement (burgh) in the early years of the Romanesque period. Some of these buildings are related to the devastating fires of 1002 and 1026, fires which the texts refer to with some considerable feeling. After the first fire, Abbon took the decision to build a vaulted treasury, which has largely survived. In the text the building is called the *gazofilatium* (it is today known as the Chapelle Saint-Mommole), but it is much more than a merely utilitarian building. In addition, the text makes it clear that it was vaulted as a protection against fire. The list of works carried out after the 1026 fire stresses as a guiding principle the wish to embellish. For the sanctuary of the abbey church, Gauzlin had already presented a marble pavement in *opus sectile* from the region of Ravenna *(Romania*) but he also replaced the wooden roof which had been destroyed in the fire with a stone vault measuring more than 7 m across. It is worth noting that the term used for this vault is *fornix*, a word rarely used at the time but which can be applied by classical writers to a triumphal arch. What is more, Gauzlin intended to decorate this vault with a mosaic and to this end he sent to *Romania* for an artist capable of executing it. As to the church of Saint-Denis in the settlement near the abbey, it gives further grist to our reflection. We have an eyewitness, the builder himself, the monk Helgaud: he tells us that the church was first covered with a wooden roof and then vaulted after the 1026 fire. Archaeology of the building and archaeometry have confirmed two construction campaigns separated by a short time gap and shown that the upper walls of the choir were cut back to accommodate a barrel vault. However, no traces of the fire have been detected either on the walls or in the subsoil. Thus all that can be said is that the restructuring of the church of Saint-Denis seems to have been

a representative example of that taste for vaulting and, in general, for fine stone buildings, which from the earliest years of the 11th century onwards proliferated in certain regions of *Francia occidentalis.* Old age and inconvenience were, of course, factors in determining the rebuilding of churches, but protection from fire and a hoped-for longevity in the case of vaulted buildings also offered an argument for rebuilding, often in the face of the heavy costs of these construction campaigns.

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Saint Lambert's Cathedral, Liège, Fire in 1185. A Total Disaster?

In the night of 28-29 April 1185, the cathedral of St. Lambert in Liège was struck by a violent fire that reportedly led to the total destruction of the church; this event was related in detail by a local cleric in the famous *Breviloquium de incendio ecclesiae sancti Lamberti Leodiensis* (ed. W. Arndt, MGH SS 20, 1868, p. 620). The accurate description of its propagation in this contemporary testimony has widely contributed to its credibility. The year 1185 has established itself, in historiography as in any attempt to date the archaeological remains of the edifice, as both a landmark and an emblematic date: the pivotal moment of the forced transition from "the Romanesque city to the Gothic city" (J. Lejeune, 1967).

The colloquium devoted to the Gothic Saint Lambert's Cathedral in Liege in April 2002 brought to light the apparent contradiction

between written sources and archaeological remains on the question of the *terminus a quo* of the construction of the 13th-century Gothic cathedral.

In a recent article (*Bulletin de l'Institut Archéologique Liégeois*, 2019), the archaeologists Denis Henrard and Jean-Marc Léotard made the scientific community aware of the importance of isolating the ground data from the written testimonies. They called for these data to be studied for themselves with archaeology's own resources. They systematically describe the archaeological occupation phases of the site of St. Lambert's Cathedral prior to the Gothic cathedral, freed from the traditional landmarks such as the year 1185. This work has highlighted the need to relativise the degree of compatibility between the written and material sources, inasmuch as some of the descriptions of places found in the texts do not correspond to the archaeological remains found on site. Comparing the *Breviloquium* with the results of the excavations, the question arises of the real extent of the damage caused by the fire that night.

Might the fiery alarmist pen of the cleric from Liège, taken out of its initial context, have, over the course of the centuries, first misled medieval historiographers, then generations of researchers who came up against it?

This contribution takes stock of what is known about the event in the light of recent work. It calls for the contemporary testimony of the *Breviloquium* to be put into perspective.

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Palaces Burn, Too. On Some of the Traces Left by the Fires that Occurred in the Palais des Papes in Avignon in the 14th Century

This article looks at the history of fires through the misfortunes of a building that has long been presented as a Gothic anti-cathedral: the Palais des Papes in Avignon. The predominance of masonry in this construction should not overshadow the extensive use of wood to cover many spaces. With this woodwork, fire is not far away and introduces an element of imponderability into a history that may be thought to be made up of a succession of projects (demolition, reconstruction, alterations or additions). The Palais des Papes has had to suffer the ravages of fire on several occasions. An analysis is proposed of two major events—the fire of the Tower of Trouillas, in 1354, and that of the Great Chapel, in 1369—two instances rich enough to provide some elements of reflection on the origin of the disasters, the means implemented to fight the fire and the memory of the fire.

A fire may have multiple origins, about which the documentation provides little information. In a few cases, responsibility is clearly stated, but the accounts usually stress the accidental nature of the disaster. If there is no mention of any surveillance, it is more than likely that the times and places of least traffic were more conducive to danger. Prevention then involves keeping combustibles as far away as possible and taking particular care in the construction of chimneys and lighting systems.

The accounts say little about prevention, but are more explicit on the question of active firefighting. The number of people mobilised at the time is significant, even if the means made available to them may seem derisory.

To limit the fire and slow down its progression, and also try to extinguish it, the accounts mention the use of isolation partitions.

The range of responses that can be seen in the accounts testifies to a certain responsiveness in the face of the fire, which they tried to tackle as quickly as possible, to contain and isolate, even if it meant only doing what they could.

As for the memory of the fire, we note that as long as the Palais in Avignon was the residence of the pontiffs, the stigma of the

disaster seems to have been erased as quickly as possible. The aftermath of the fire thus consisted of two phases: cleaning the area and restoration-reconstruction.

More than the fire suffered, it is the fire "as experienced" that we are given to see. A fire that leaves a mark on the buildings that we still have to learn to decipher to a large extent.

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The Use of Fire to Demolish a Building and the Burning of the Old Cologne Cathedral in 1248

The *Chronica regia Coloniensis* informs us of a bizarre event: in order to dismantle the old choir of the Carolingian cathedral more efficiently, those in charge of the construction site decided, in April 1248, to excavate the space under the walls, support the masses with wooden beams and, finally, set fire to them so that the construction would collapse. Unfortunately, they lost control and the fire destroyed the entire cathedral. This spectacular accident preceded the beginning of the construction of the new Gothic choir, the first stone of which was laid shortly afterwards, on the day of the Assumption of the Virgin (15 August). The article first presents the text of the Cologne Chronicle and provides a French translation of the relevant passages. The source is contrasted with the archaeological findings in order to locate the approximate origin of the fire. The article looks for historical examples and sources of this unusually radical and dangerous method, which does not seem to have been used on

other cathedral construction sites of the 13th century. Explanations are provided above all by military manuals such as the *Epitomea rei militaris* ("Compendium of military matters") by Publius Flavius Vegetius Renatus, a work of the 4th or 5th century, as well as *De regimine principum* ("On the rule of princes") by Aegidius Romanus, written between 1277 and 1279, not long after the fire in Cologne. Nicola Pisano was also apparently familiar with the method, for he chose it to remove a tower in St John's Square in Florence in this way. Finally, two examples from modern times bear witness to the knowledge of this military technique. Between 1797 and 1800, Louis-François Petit-Radel (1739-1818) destroyed the church of St-Jean-en-Grève in Paris in this way, and Viollet-le-Duc describes a similar procedure in his *Dictionnaire*. What seems to be unique in Cologne is that the local builders tried to apply this procedure in an almost "surgical" manner in order to speed up the partial destruction of the old building. However, the destructive power of the chosen method was underestimated, as was the general danger of a large fire inside a building.

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Fires and Sanctuary Building Sites During Antiquity. Three Case Studies: Autun, Vieil-Évreux and Genainville

This paper addresses the relationship between fires and construction sites in the context of Roman sanctuaries. It is based on data from a meeting organised on 7-8 September 2021, in Évreux ("Les chantiers

de construction de sanctuaires dans le monde romain", collaboration between the MADE – Conseil général de l'Eure and the AOROC laboratory – UMR 8546, CNRS-Université PSL, ENS-EPHE). Three cases of recently excavated sanctuaries are presented and enable us to interpret the presence of hearths or ash layers.

First, in the so-called "Janus" temple in Autun, the earliest remains of the sanctuary, consisting of two buildings made of earth and wood at the turn of the 3rd-2nd centuries BC, appear to have been deliberately burnt down, after a meticulous cleaning of the structures. This destruction was intended to prepare the reconstruction of a second state of the sanctuary towards the end of the 1st century BC and the first third of the 1st century AD.

Second, on the site at Vieil-Évreux, two types of structures are distinguished: hearths associated with occupation levels, and charcoal fills. They reflect the abandonment of the sanctuary around the middle of the 3rd century, the construction of the building being dated to the end of the 2nd or beginning of the 3rd century. They predate the reoccupation of the building by a fortification, before the final demolition and recovery of all the architectural blocks.

Third, at the temple of Genainville (Val d'Oise), thick ash layers dated to the third quarter of the 3rd century AD were found next to the double-*cella* temple. They were formed when the temple was partially disused. The parallel with Vieil-Évreux is close and the grouping of the furniture associated with these layers of combustion demonstrates a deliberate fire, perhaps linked to a closing ritual following the abandonment of worship.

The data collected from these three case studies opens up a discussion that deserves to be applied systematically to other archaeological sites. With a different chronology, Iron Age in the first case and late Antiquity in the other two, they show the role of fire in the dynamics of sanctuary sites. Intentional fires were set following the abandonment of a previous state, in order to facilitate the dismantling of structures and favour the establishment of a new form of occupation. It is therefore a material and logistical choice, but it may also have a symbolic dimension, in the context of a cult building that has lost its function. Fires, which are programmed during

a change of use, are therefore an integral part of the demolition and reconstruction process.

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