Il paesaggio agrario tra età del Rame ed età del Ferro.
Metodi di analisi delle risorse di sussistenza e delle modalità di gestione per una stima demografica.
19 Novembre 2021, Piattaforma Teams UniBO, ora: 14:00- 18:30

FROM BRIQUETAGE TO SALTERNS IN PROTOHISTORIC CENTRAL ITALY, RESEARCH OF A FUNDAMENTAL SUBSISTENCE COMMODITY.

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The importance of an `archaeology of salt'

Salt is vital to mankind and therefore an important object of study as is evident from a range of ethnographic, archaeological and historical studies on the topic (Alessandri et al. 2019; Giovannini 2001; Harding, 2021, 2013; Weller, Brigand 2015). In archaeology, the mining of salt and subsequent trading of this commodity has been stressed as a source of wealth, as for instance evident from the grave goods in the burials of the late Bronze age and Iron age community near Hallstatt, whose members possibly controlled and exploited the mine (Egg 1985). Apart from mines, also salt springs and marine environments were exploited during the Bronze and Iron ages to procure salt. In the call for this conference, it is postulated that demographic growth between the Bronze and Iron Ages would have necessitated increasingly careful planning of forms of arable farming and animal husbandry to upkeep the subsistence base. This would have included continuous access to salt.
In several studies the daily intake of salt by man and animals has been calculated. From these figures, it is clear that considerable attention and energy had to be invested in procuring this fundamental commodity and that production, trade and transport had to be secured (Harding 2013 and references therein). Therefore, it is vital to include salt as a basic commodity in subsistence models. From ethnographic research and ancient literature, we know that salt was, apart from the daily intake by men and animals, also important for the conservation of meat, fish and vegetables, and fundamental to pastoralists for their animals and cheese making (Carusi 2008, 2018; Horden, Purcell 2000; Marzano 2013). Many salt routes exist, the best-known road associated with salt transport being the via Salaria (Alvino 2003). Information on places of production and consumption of salt provides insight into the connection between landscape zones and the possibility to reconstruct transport and trading networks. Insight in population numbers may inform us on the scale on which salt production had to take place and how increasing demands were met. Salt making is often seen as a part-time task, although with increasing population numbers it may turn into a permanent task of specialist saltmakers. To investigate these matters, a crucial first step is to localize the sources where salt could be obtained and establish the way salt was produced. In antiquity as today, in Italy salt was mainly procured from marine environments and we can discern two ways of salt production, the so-called 'briquetage' and salt production in salterns. Briquetage implies preparing and boiling a solution of seawater in special ceramic jars to obtain solid salt, as described in ethnographic sources and archaeologically attested in prehistoric contexts elsewhere in Europe (Harding 2013, 2021; Weller, Brigand 2015). Jars had to be broken to extract salt, hence briquetage sites have huge potsherd dumps. Salterns usually consist of many interconnected water ponds where different salts precipitate, among which is the sodium chloride. While many coastal and peri-lagoonal sites are known where salt production took place or is suspected to have taken place, both briquetage and salterns, actual excavations of contexts where ancient salt production is attested are few and far between. In this paper, we present the outline of a research project started in November 2021 that aims to identify modes of salt production in the coastal environment of Tyrrhenian Italy and to contextualize the evidence in light of the demand for salt by the central

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Italian population. Our central hypothesis is that between the Bronze age and the Roman period the increasing demand for salt by the growing towns led to a scale increase in marine salt production and the change from briquetage to salterns. The growing demand for salt made Central Italy's early city-states want to control coastal environments suitable for salt production.

Salt and Power, Early States, Rome and Resource control, a new project

Control of the salterns in the Tiber delta was important for Rome's rise to power (Liv. I, 15,5; Dion. Hal. II, 55,5-6; Plut., *Rom*. 25,4) as it must have been for the other inland city-states along the Tyrrhenian coast from the protourban turn onwards. But when were salterns first established and how was salt produced before their installation? How did salt production keep pace with the rising population of the early states in central Italy, in particular Rome and how was it secured? Within the framework of the research project `Salt and Power, Early States, Rome and Resource Control', funded by the Netherlands Organisation for Scientific Research (NWO) we have started to investigate these questions with an up-to-date methodology. The aim is to contribute with a historically important case study to the global archaeological and anthropological debate on salt-making and resource control in the context of prehistoric and early state societies. We focus on detecting scale increase in the production of salt that, we assume, occurred in central Italy in the formative phase of the city-states between the Final Bronze to the Early Iron Age around 1000 BCE in a period of population growth (Fig. 1).

Fig. 1 - Briquetage sites, ancient salterns and Early States along the central Italia Tyrrhenian coast.

In this period the transition from the briquetage mode of salt production (Fig. 2) to the salterns mode of production, which is a more efficient production mode using a series of ponds for salt precipitation (Fig. 3), must have taken place. We also want to investigate the possible state control of salt production during early state formation. To investigate these issues, we develop a novel interdisciplinary field methodology to detect the transition between briquetage and saltern mode of production, combining palaeogeography, geophysical techniques, soil chemistry, excavations, and functional and chemical artefact analysis. Below we illustrate our approach with case-studies from work we have carried out in advance of this project and work that is currently underway. Recently, we discovered the origins and chaîne opératoire of two early salt production sites along the Tyrrhenian coast (Fig. 1). In the Pontine Plain, south of Rome, the team investigated a Bronze Age settlement in the Caprolace lagoon (Alessandri et al. 2019) revealing its involvement in salt production. Evidence consisted of remains of the briquetage technique. The Caprolace ceramic evidence suggests salt production was linked to food conservation (probably fish) and that salt and salted commodities were traded and consumed inland. In the Final Bronze Age/Iron Age Puntone site, in Tuscany, the team recovered similar evidence and reconstructed the *chaîne opératoire* (Sevink et al. 2020, 2021) (Fig. 2). As stated in the introduction, understanding salt production techniques gives insight into labour organization, time investment and thus the scale of production, which can be linked to contemporary settlement organization. Our reconstruction was achieved by combining geophysical techniques, archaeological excavations, functional artefact study and chemical analyses of soils and artefacts.

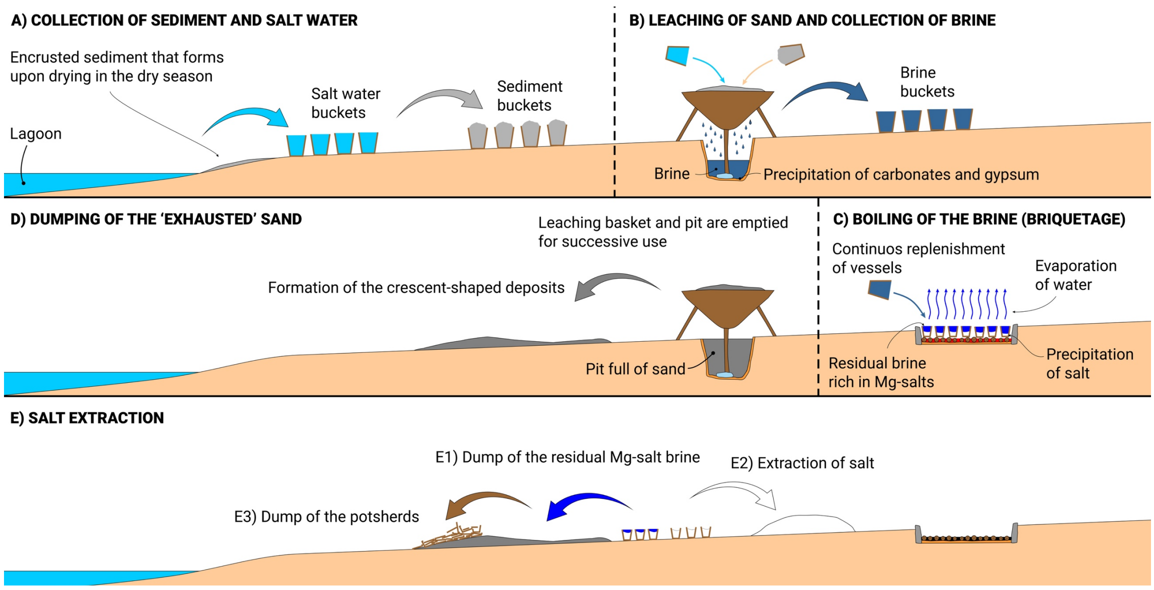

Fig. 2 - The reconstructed chaîne opératoire for the salt production processes in the Puntone site (from Sevink et al. 2020)

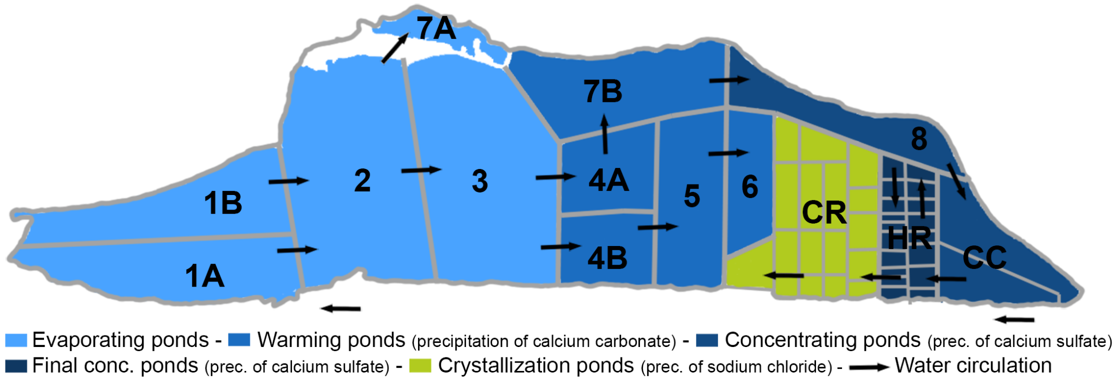

Fig. 3 - The water circulation in the Cabo de Gata saltern (Spain).
The precipitation of salts differs among successive ponds
(data from Castro-Nogueira et al., 1997; López et al., 2010)

Currently available evidence and research hypotheses

Along the Tyrrhenian coast of *Latium Vetus* and Etruria multiple sites with dumps of reddish jars are archaeologically attested (Fig. 1). These can be tentatively linked to the briquetage technique (Alessandri et al. 2019, 2021; Belardelli 2013; Pacciarelli 2010). In Etruria, their appearance is contemporary with the birth of the early states of Tarquinia, Cerveteri and Veio (10th century BCE). In *Latium Vetus*, their chronology spans from the Middle Bronze Age (17th c. BCE) to the Archaic period (6th c. BCE). Evidence about the introduction of the saltern production mode comes from the Maccarese lagoon, north of Tiber's mouth. Here hydraulic structures of a saltern, (first half of the 1st century CE) were attested (Grossi et al., 2015). However, palynological data point at increased salinity already around 2600 calBP (end of 7th century BCE), caused by artificial opening the lagoon to let in seawater (Di Rita et al. 2010). The southern saltern, controlled by Rome according to the ancient sources, has not been identified yet, but a similar increase in salinity was detected in pollen records from the Ostia lagoon (700-600 BCE) due to its opening (BELLOTTI et al. 2011). The current evidence for briquetage and salterns led us to formulate the following hypotheses on the relationship between scale increase in salt production and early state formation in Central Italy;

(1) The “reddish jar sites” were early salt production (briquetage) and/or food preservation sites;

(2) Briquetage sites in time became part of the political network of the inland emerging Early States;

(3) The Early States required a scale increase in production because of their rising populations. This led to a proliferation of briquetage sites towards the end of the Bronze age/start of the Early Iron Age;

(4) Not able to keep salt production in pace with the increasing salt demand of the expanding population, Early States created salterns to upscale production. This required geopolitical control as mentioned in historical sources.

METHODOLOGY AND HYPOTHESIS TESTING

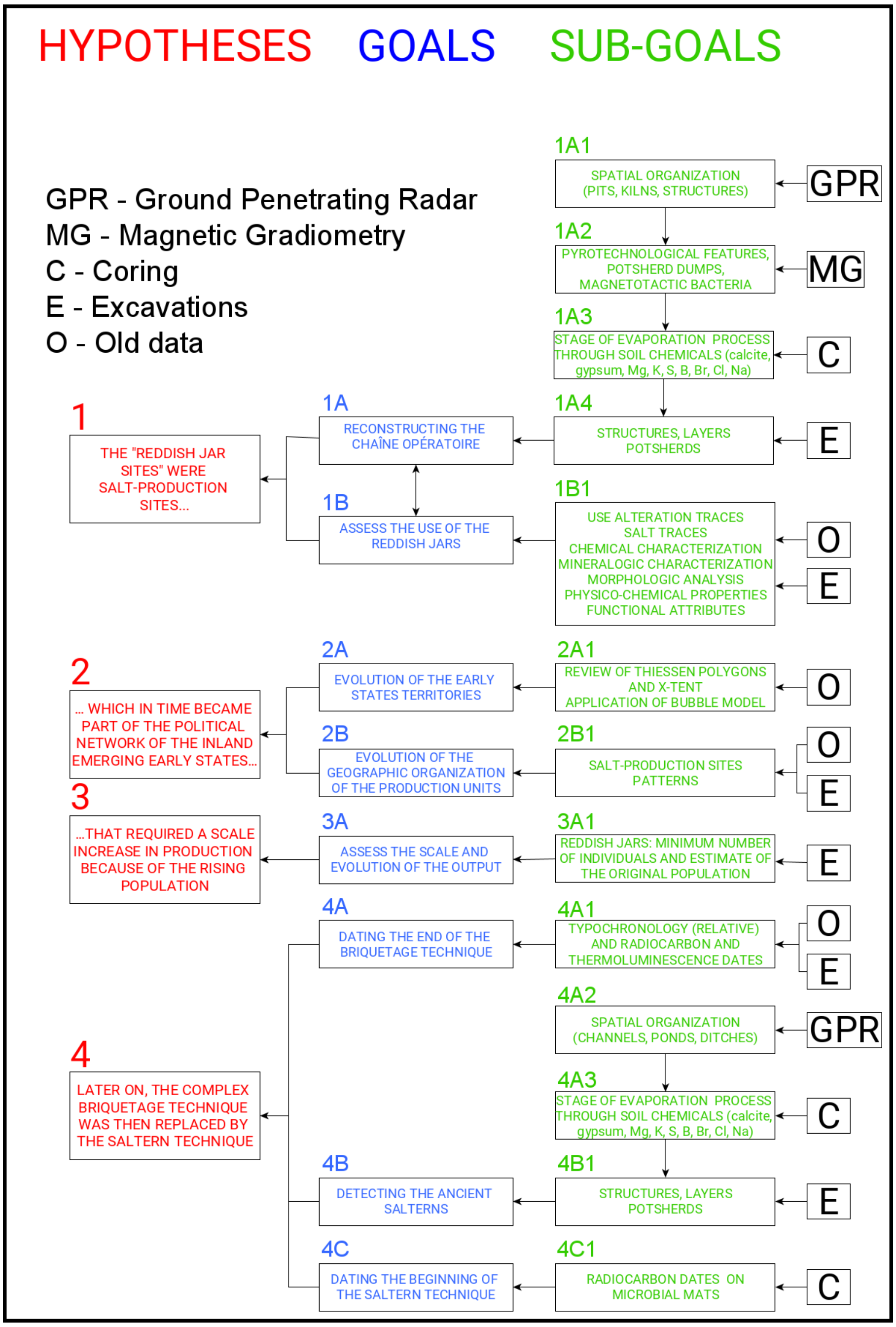

Fig. 4 - The research strategy: hypotheses, goals, sub-goals and methods

To test our hypotheses, we will employ geophysical, chemical and archaeological methods to study both the briquetage and saltern production modes in their environmental and geographical context (Fig. 4). Any attempt to derive salt (NaCl, halite) from seawater by evaporation (briquetage or salterns) goes through the same steps (WELLER, BRIGAND 2015): A) concentration, an initial enrichment to produce brine, B) crystallization, artificial (fire) or natural (sun) evaporation process and, if needed, C) conditioning (moulding) and D) packaging. During the evaporation process, salts precipitate in this order: calcium carbonate (calcite), calcium sulphate (gypsum), sodium chloride (halite) and finally magnesium sulphate and other salts, referred to in the literature as 'bitterns'. They give a strong bitter taste to the mixture and to obtain a good tasting salt one needs to get rid of the bitterns. Archaeological features linked to each of these steps can be identified through a combination of data captured by Magnetic Gradiometry (MG) and Ground Penetrating Radar (GPR), which allow the identification of spatial structures, of which the nature and function can be checked by Coring Surveys (C) and Archaeological Excavations (E).

To assess the use of the reddish jars (hypothesis 1) we will use a combination of data from use-alteration traces, vessel content (salt?) and functional and physical characteristics. Diagnostic potsherds from excavations and existing collections will be analysed. A first screening will be done using a pXRF (portable X-Ray Fluorescence) (DONAIS, GEORGE 2018; FRAHM, DOONAN 2013) chosen for its rapidity, non-destructive analysis and in situ application. The range of elements that a pXRF can detect being limited, more powerful analytic techniques will be used on a selection of potsherds. We will then establish a classification based on stylistic attributes and chemical fingerprints and select sub-samples based on types. The chosen potsherds will be further processed to study:

1. Use alteration traces. These concerns surface use alteration traces like internal and exterior carbonization and sooting patterns, which can provide direct evidence for contact with open fire. Ceramic attritions (SKIBO 2015) will be recorded with optical microscopy. Among the non-abrasive attritional processes, the presence of spalls might be of particular interest since they can form during fermentation processes (SKIBO, BLINMAN 2008);

2. Salt traces? A SEM-EDS (Scanning Electron Microscopy/Energy Dispersive Spectroscopy) will be used to characterise qualitative and semi-quantitative chemical properties of the potsherds. In recent research, the focus has been on the penetration of Na and Cl into the walls of potsherds as a proxy for the presence of ancient salt traces. But since Na and Cl are highly mobile elements easily leached by infiltrating water, this method is not reliable (Raad et al., 2014). Moreover, in coastal areas, salt spray constitutes a potential cause of relatively high Cl and Na. We suggest using Boron (B) and eventually Bromine (Br) as proxies for seawater used in the production processes (SEVINK et al. 2020). Boron is far more common in seawater than in a terrestrial environment and is less sensitive to leaching and salt spray (Sevink et al., 2020); Bromine is also mostly present in seawater and is characteristic of saline environments at times reaching very high concentrations (DOLPHIN et al. 2013; MORENO et al. 2017) ;

3. Chemical characterization. We propose to complement the SEM-EDS with ICP-MS analysis (Inductively Coupled Plasma – Mass Spectrometry) to improve the chemical characterization of the samples (POLLARD, HERON2017). SEM-EDS is capable of performing analyses of selected point locations but does not give absolute quantities and has poor sensitivity to trace elements lighter than Na. ICP-MS is a bulk analysis method, unable to trace trendlines across the potsherd walls, but has a much greater sensitivity to trace elements and gives absolute quantities. We will pay particular attention to the presence of sulphate which is less mobile than NaCl and is a proxy for the evaporation process due to the gypsum (sulphate mineral) precipitation from the seawater;

4. Mineralogical characterization. The petrographic and mineralogic characteristics of the selected samples will be described using a PLM (Polarizing Light Microscope) (HUNT, BISHOP 2016; STOLTMAN 2015) according to the recording system already proposed by Orton and Hughes (ORTON, HUGHES 2013).

5. Physicochemical properties. The combination of the results from points 3 and 4 will reveal the physicochemical properties of the reddish jars.

6. Functional attributes. To study the steps of C) CONDITIONING (moulding) and D) PACKAGING the capacity, stability, accessibility and transportability will be evaluated through technical considerations and parallels with already published ethnographic data (ORTON, HUGHES 2013).

Interpretations of the inferred use (RICE 1996) of the jars will be made on the basis of these results and the interpretation of production structures both published and found in our planned new excavations. Results will be used to enhance our understanding of the chaîne opératoire.

To reconstruct the political network in which the briquetage sites functioned (hypothesis 2), we will review the existing literature about the reconstruction of the territories of the Early States. Several scholars studied this issue with different spatial but synchronic models, borrowed from geography, such as Thiessen polygons (BARBARO 2010; FULMINANTE 2014) and XTent (REDHOUSE, STODDART 2011). We opt for a diachronic model (ALESSANDRI 2016), linking chronological phases in complex time-space models (Bubble Model) to trace the evolution of the settled landscape before and after the birth of the Early States embedding the salt production sites in their territories. To study the labour organization of salt production, we focus on the distribution and density of briquetage sites over the landscape. An even distribution of production units would point to a production geared at local demand while aggregated specialists, with few production units randomly distributed in the landscape, can be interpreted as evidence for regional or interregional exchange (COSTIN 2005). Based on previous research, we envisage this transition to have occurred at the end of the Bronze age in the period of the formation of the Early States (ALESSANDRI et al. 2019). We use a model that describes the transition from seasonal household production to workshops in times of increased economic demand (NIJBOER 1998).

To assess the scale and evolution of the output (hypothesis 3) we will use collected potsherds from the excavations to infer change(s) in the output scale (BANNING 2020; ORTON, HUGHES 2013) and link the evidence for change in the output scale to the concentration of specialised sites established during Early State formation (Late Bronze Age /start of the Early Iron Age). We compare the composition of assemblages using MNI (Minimum Number of Individuals) to reconstruct the amount of salt produced, calculating the volume of the jars (RODRIGUEZ, HASTORF 2013) and the original pottery population based on the brokenness and completeness of the samples (FELGATE et al. 2013).

To check if the Early States created salterns to upscale production we will assess the timing of the transition between the briquetage mode of production and the former (hypothesis 4) which, in turn, also requires to identify and date the ancient salterns. The only radiocarbon dates available from briquetage sites come from Pelliccione in the Pontine Plain and fall into the Late Bronze Age (ATTEMA 2004). However, reddish jars typologically dated to the VII century BCE have been found at Nettuno, south of Rome (ALESSANDRI 2013). To assess the relative chronology of the last evidence of the briquetage technique both north and south of the Tiber we will use the data from literature and the newly collected ceramics from the excavations. Absolute dates will be obtained by radiocarbon (organic) and thermoluminescence (pottery) (AITKEN 1985; FEATHERS 2009). As mentioned, salt production through evaporation of brine always follows the same steps and the methods used to reconstruct the chaîne opératoire of the briquetage sites can also be used to detect the presence of ancient salterns. We employ both GPR and MG to detect terrain adaptations, dug-out ponds and water channels transporting seawater or brine. Coring campaigns (C) will be conducted to chemically characterise detected ponds, analyse the concentration of Boron (B) and Bromine (Br) expecting their gradual increase in successive ponds and detect the presence of the bitterns in the final stage of the process. Test pits will be dug to double-check our interpretations. Importantly, we want to date the earliest evidence of salterns. In the literature, the beginnings of the Ostia and Veio salterns are dated around the 7th and 6th centuries BCE. While corroborated by the artificial increase in salinity of the lagoons, the salterns themselves have not yet been physically attested and dated. Study of the Puntone site revealed that brine pits and associated sediments contain organic matter of largely microbial origin (SEVINK et al. 2020), which is suited for absolute dating of phases in the salt production process. The same holds for salterns in which microbial mats form, the remains of which can be used for dating purpose. Combining C14 with thermoluminescence dating of collected ceramics will give a reliable chronological framework for the salterns.

FEASIBILITY OF THE PROJECT AND EXPECTED RESULTS

Studying salt and salt-related issues in pre and protohistory has always been extremely difficult due to the lack of a reliable research strategy to detect its presence in the archaeological record. This has led to an underestimation of salt's paramount role in the food economy of the ancient world. In our project, we merge the traditional archaeological methods (chrono-typology, use alteration traces, functional and morphological analyses) with advanced physicochemical analytical techniques to investigate the very origins of its industrial procurement reconstructing modes and scales over time. Novel is the use of a combination of non-invasive geophysical techniques (GPR, MG), targeted coring survey and soil chemistry to enhance our understanding of buried structures and to detect debris layers linked to salt procurement activities. Applying this novel methodology to study the relationship between resources that are essential to mankind and the demand for them we hope to increase knowledge on the socio-economic realities of the evolving Early States in Central Italy and the control they exerted on resources. Such knowledge will increase our understanding of economic relationships between landscape zones (coast, foothills, uplands and highlands) and the relationship between scale increase and specialization.

Particularly interesting is the demand for salt by communities involved in forms of mobile pastoralism.

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