



Alfons Figuls – Olivier Weller (Editors)  
*1a Trobada internacional d'arqueologia envers l'explotació de la sal a la prehistòria i protohistòria*  
Cardona, 6, 7 i 8 de desembre del 2003

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## **1a Trobada internacional d'arqueologia envers l'explotació de la sal a la prehistòria i protohistòria**

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1<sup>r</sup> Encuentro internacional de arqueología entorno a la explotación de la sal en la prehistoria i protohistoria

••  
1<sup>r</sup> Meeting archéologique international sur l'exploitation préhistorique et protohistorique du sel

•••  
1<sup>st</sup> International archaeology meeting about prehistoric and protohistoric salt exploitation

••••



**Cardona, 6, 7 i 8 de desembre del 2003**

**ARCHAEOLOGIA CARDONENSIS I**



Alfons Figuls – Olivier Weller (Editors)  
1a Trobada internacional d'arqueologia envers l'explotació de la sal a la prehistòria i protohistòria  
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# Salt and the community loss of civil Liberty

**David D. Bloch**  
*M.R.Bloch Salt Archive*

Common Salt was generally in very short supply during certain critical periods from ancient times until the Industrial Revolution. It was to become the main supporting commodity so basic to any domesticated community that it had to be regulated. Supplies and sources had to be defended, protected and guaranteed. Like petroleum oil in today's economies it was essential, except that it also was needed to sustain human animal life. It was an essence of survival as basic as water, air and protein, though unfortunately it was far less ubiquitous. One such period of short supply seems to have occurred during the early Roman period when sea levels rose steeply. Today more than 200 known archaeological sites in the Mediterranean are still covered by 1 to 3 meters of sea. Inland mines and lake sources of salt took on an historically unexplained importance. The inundation of coastal solar evaporation facilities used by ancient salt makers, forced them to search for salt in forsaken arid deserts such as the Dead Sea, the Tuz Golu, North Africa, Cardona and some very limited known brine sources. Coastal salt making by the many had previously enabled the liberal Greek and early Roman societies to live free of the future coercion and monopolizing of salt supplies by highly authoritarian minorities. These liberal societies are still the envy of many today.

"Common salt" [NaCl] is necessary to enable human life. It is no less needed for life than the air we breathe and the water we drink. If the water concentration in the body is to remain constant, then the regulation of the body salt intake and its excretion by the kidneys is a direct function of this constant. [-<sup>1</sup>] Salt deficiency is equally lethal as a water deficiency.

The 'hunter gatherer' found a plentiful and immediate supply of salt in the blood

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*1 Denton D, The Hunger for Salt. An Anthropological, Physiological and Medical Analysis - Springer-Verlag 1982*

of the freshly killed meat protein he brought to his kin.

Recently researchers Grayson and Delpech examined more than 7,200 bones and teeth from large hoofed mammals that had been recovered from a cave in France. The animals – ungulates such as reindeer, red deer, roe deer, horses and chamois were the most common prey – were the mainstay of human diets in Central Europe, They found a remarkable dietary similarity throughout the 50,000-year record, each bone and tooth assemblage, regardless of the time period or the size of the sample involved, contained eight or nine species of ungulates, indicating that

Neanderthals and Cro-Magnon both hunted a wide variety of game.

As populous agricultural communities developed their livestock was herded and domesticated. Perishable meat and fish had to be preserved with an efficiency that allowed long periods of winter storage and distribution. By far the most effective and most widely used method of preservation was draining the carcass and dehydrating it of all potentially decomposing tissue liquids by an osmotic process. This involved sprinkling salt or soaking the meat in brine. The development of such a technology which could reduce the dangers of bacteria became the preferred method of preservation until the recent invention of refrigeration [ <sup>2</sup>].

This preserving salt was absorbed into the meat and coincidentally replaced the drained blood tissue salts consumed by the “hunter gatherer” in previous ages. Thus it continued to fulfill the original physiological component inherent in freshly killed meat as well as a preservative. Salting became the main form of hygiene integrated into sacrifices performed on the altars of most of the ancient world’s temples and provided a community with its main protein diet. The quantities of salt needed for this single process were considerable.

By the beginning of the Roman period salt had become a very basic everyday commodity used additionally in many other developing technologies, such as

2 Bloch M.R. H.Moller 1930 *Über die modifikationen des jodsilbers* Z. Physikal chem. A 152 245-268 [Crystallization and undercooling]

glassmaking, textiles, armory, tanning, and medicine. Some of these were direct bye-products to the critical meat and fish [Garum] preservation industry. It has been suggested that salt consumption per person for all purposes in the ancient world may not have been very much less than it is today.

The principle technology that enabled increasing the production of salt to cater for these numerous developments was that of solar evaporation on vast coastal flats and marshes suitable for sea brine concentration in open dike pans. Solar heat in the Mediterranean basin and peat or wood burning on coasts further north were the energy sources used to crystallize the salt in the final stage of the process.

In the past three millennia small fluctuations and eustatic oscillations of sea levels have catastrophically [ for coastal salt making] caused flooding and breaks in the necessarily long brine concentration cycles of these facilities which were dependent on a precise rising and falling tide level to fill them.

From tracings of old shorelines, from carbon-14 dating and from sparse historical records a rough chart of these fluctuations can be made and then linked to population and demographic movements. [ <sup>3</sup>].

3 Fairbridge RW, *Dating the Last Movements of the Quaternary Sea Level*, Trans. N.Y. Acad. Sci. 20, 471-482 (1958).

Bloch M.R., *Historical Evidence of Sea-Level Change and its Relation to Polar Albedo*, Symp. Arctic Heat Budget and Atmospheric Circulation, Univ. of Calif. And Rand Corp, 179-196 (1966).

This cycle of minor sea level changes may be associated with the same changing ice conditions that depended on albedo variations caused by dust and volcanic ash on the white surface in the Antarctic. A less than white surface that absorbed rather than reflected the sun's rays in turn caused whole glaciers to melt quickly at their base and surge down into the sea. [-<sup>4</sup>]

Recent investigations claim that a fast fractionating or fusing process is accelerating the melting and breakup of the ice shelf, and the breakup of the Larsen shelf [in 2002] is only an indication of what may be expected.

The Ross Ice Shelf is the main outlet for several major glaciers from the West Antarctic Ice Sheet. This ice sheet contains enough above-sea-level ice to raise global sea level by 5 meters. The glaciers which are supported by this ice shelf should they too melt, then the sea level could rise by more than 50 meters

### COASTAL SOLAR EVAPORATION or INLAND MINING ?

Following the last ice age and the mighty 75 to 100 meter ocean rise [Daly<sup>-5</sup>], Neolithic man moved everywhere back and forth between coastal and inland

4 Wilson A.T., *Origin of Ice Ages, Nature*, 201, 147-149 (1964).

Hoinkes H.C., *Research in Geophysics, 2: Solid Earth and Interface Phenomena*, pp. 391-424 M.I.T., Massachusetts (1964).

Bloch M.R., *A Hypothesis for the Change of Ocean Levels depending on the Albedo of the Polar Ice Caps, Palaeogeography, Palaeoclimatology, Palaeoecology*, Elsevier, Amsterdam, 1, 127-142, (1965).

5 Daly, R.A. *A recent Worldwide Sinking of the Ocean Level, Geol. Mag.* 57, 246-261 (1920).

habitats, accommodating his life to this sea oscillation. The early period of these movements is not well documented until we come to the time of the Judean Kings 1000 BC [sea level -G] then the ocean was certainly above present day sea levels. Between the 7<sup>th</sup> [sea level - F] and 6<sup>th</sup> [sea level graph E] centuries BC the ocean receded.

One fact seems reasonably certain: at the height of the ancient Greek and Phoenician civilizations, around 500 BC, the ocean level was from one to two meters lower than it is today. More than 200 known archaeology sites from this period are submerged below today's sea level.

From then on for 1000 years, from 600 BC to 400 AD, a relatively steep rise caused many of the Mediterranean sea ports to be inundated, including for example the Portus of Ostia and the neighboring Roman salt pans which had to be moved inland [Meiggs R.<sup>-6</sup>]. The Portus was successively rebuilt by the Emperor Claudius, near the present Fumicino airport, and finally by Trajan still further up the Tiber as a six-sided basin, two meters above present day sea levels. By 400 A.D., they too were flooded. The areas at Ravenna and Aquilea [Gotz<sup>-7</sup>] and Classis, previously deep inland, turned into ports and were almost the only ones near salt-works to survive in Italy. Today, their remains can be seen, high and dry, about 10 km inland from the coast [Bloch<sup>-8</sup>].

6 Meiggs R., *Roman Ostia*, p. 269, Clarendon Press, Oxford (1960).

7 Gotz, W. *Ravenna*, E.A. Seemann, Leipzig (1913).

8 Dendemonde M., *The Dutch and their*

This temporary loss of salt producing Italian sources caused a salt famine in the Western Roman Empire. As Procopius notes: "During his [Justinian] rule over the Romans, many disasters of various kinds occurred: . . . . The Scirtus River flooded Edessa, creating countless sufferings among the inhabitants, . . . The Nile, rising as usual, but not subsiding in the customary season, brought terrible calamities to the people there, as I have also previously recounted. The Cydnus inundated Tarsus, covering almost the whole city"

Early in this development the African and Asian rock salt mines, as well as some desert lakes, had alternatively become salt havens for the European civilization. This perhaps explains the otherwise senseless determination of the Roman emperors Vespasian and Titus to conquer desert strongholds like Masada on the Dead Sea [Yadin-<sup>9</sup>].

By the 6th century AD the Levant ports and other towns in Palestine had become important trade centers [Bury-<sup>10</sup>]. Positioned on the trade routes [via *salaria*] to and from these inland salt lakes and mines of Asia Minor, the Tatta salt lake in central Turkey, and the Dead Sea hinterland. These centers also reflected the increased movement of spices [salt] from the so-called "silk routes" sourced from even more distant mines such as the great Salt Desert in Persia. At the other end of the Mediterranean the North African

mines and Cardona in Spain, also supplied monopolised and well protected lines. They shipped salt and "salted" perishable goods to the Empire in forced though benevolent exchange for so-called "security", and military aid, or in return for gold. However this soon stopped when Rome depleted of gold and inevitably weakened locally by authoritarian regimes had nothing left to offer except slaves.

The effects of a further rise [sea level -D] in sea levels probably ending in the 4th century AD must have been catastrophic in Western Europe. Between 450 AD and 500 AD the population density fell to a fraction of what it had been, despite an influx of Germanic tribes from the north [<sup>11</sup>]. During the Dark Ages the salt traffic almost disappeared and the coasts of Britain and France became deserted. The western parts of the continent were an under-developed area and people began to migrate to the more arid zones where natural salt outcrops not yet dissolved by a wet climate were known to exist.

By the 10th century AD [sea level -B] the ocean had again receded and along the European coasts, people in the most part freely reactivated their salt making. According to the Domesday Book in 1086 AD hundreds of saltpans were operating again in the English estuaries. Yarmouth [-<sup>12</sup>] was founded on a newly emerged island, because of the drop in sea level [-

Dykes, p.47, *De Bezige Bij*, Amsterdam, (1956).

9 Yadin Y. *The Excavation of Masada*, *Israel Exploration Journal*, 1-2, 37 (1965).

10 Bury J.B. *History of the later Roman Empire pp 161,213*. Dover pub. N.Y 1958

11 Bloch D. *Salt and the Evolution of Money Vol 6 1999 CIHS Journal of Salt History*

12 Ives, *Remarks upon the Garianium of the Romans, the Site and Remains Fixed and described*, I.D. Downes for Messrs. G.&J. Robinson, London (1815).

<sup>13</sup>], to become the main focus of the English fish salting industry. It bridged an interval of 400 years since Garonium, the Roman town by now in ruins and which had ceased production and export of “garum” fish sauce. Along the west coast of France, in Normandy, at the mouth of the Rhone, in Sicily and the Crimea, salt production was again in full swing. The revival of European coastal salt making brought invaders. In about 700 AD Europe’s population vacuum began to fill violently. Norsemen took over the British and French salt centers; from the east the Arabs invaded first North Africa and then Spain, finally clashing with the Norman conquerors in Provence. Many ports like Ravenna, Classis and Aquilea appeared to have “silted up” and Venice, like Yarmouth, emerged from the flood and began to thrive.

Concurrently for example, trading towns in the Judean hills such as Jerusalem, Nablus, Hebron, Arad, Mamshit and Abdat, decayed. They had been rich and well populated for some 800 years while the caravans brought salt from the Dead Sea to the agricultural and fishing people in the coastal plains. But now they lost their salt trade to the new maritime conquerors. They became depopulated again repeating the earlier history of 600 BC under similar circumstances. In Egypt, Maenas [<sup>-14</sup>] and the other trade centers in North Africa probably suffered in the same way. Another group of inland sources like Volterra and Cosenza in Italy

<sup>13</sup> H. Goswin, *Coastal Peat Beds of the British Isles and North Sea*, *J. Ecology*, 31, 217 & Fig. 12 (1943).

<sup>14</sup> E.M. Forster, *Alexandria, A History and a Guide*, p. 217, Doubleday, New York, (1961).

which had attracted the Germanic tribes during the general migration period, lost their importance again by about 700 A.D. when the coastal flats re-emerged.

Of these newly established maritime flats and marshes, the one with the greatest potential was possibly Nourmoutien, by then occupied by the Vikings (834 AD). It became part of the famous “Bay” salt and wine emporium at Bourgneuf, which was to supply Scandinavia, England and the Baltic by the sea routes during the Middle Ages [<sup>-15</sup>]. A similar revitalization took place in the Rhone and Dnieper deltas where the Vikings restored the salt-works in the Carmargue fishing and salting towns as well as those on the Crimean Peninsula. This sea level remained relatively low for the following three centuries, during which time millions of tons of peat provided fuel for salt makers. Great cavities were left behind to become known as the Dutch “meers”, the French “clairs” and the English “broads” - lake-like reminders of their former service [<sup>-16</sup>]. A new rise [sea level A] caused flooding in the Dutch, French and English tidal peat areas and closed them down. This rise is now quite clearly seen in the ice-core evidence of the poles.

The reduction of coastal activity was fortunately now compensated by a renaissance of inland salt mining technology and brining methods in

<sup>15</sup> A. Agate, *loc. cit.*, Reference 49, p.9.

<sup>16</sup> M. Dendermonde, *loc. cit.*, Reference 69, pp. 47, 48.

H.E. Hallam, *Salt Making in the Lincolnshire Fenland during the Middle Ages*, *Lincolnshire Architectural Archaeology. Soc. Rp. Papers. New Ser. 3*, 35-112 (1959/60).

England, Burgundy, Germany, Poland and Austria [-<sup>17</sup>]. However not without considerable social consequence and loss of freedom in the sense that these operations were dependent on fuel, either wood or coal [-<sup>18</sup>]. An important and unforeseen effect of this shift was the need to create, develop and maintain forestry for fuelling the new furnaces. The monopolies governing the supply and transport of these essential components in the production of salt from these few sources themselves became the exclusive responsibility of eager authoritarian regimes. They created tax controls, check points, borders and artificial 'limites' later to become the national borders of the sovereign states and countries we know today.

Most transport was by river or by pumping brine through long wooden pipelines, both of which could be effectively and exclusively controlled strategically by relatively small armed forces. Caravans of 1000 camels protected by carnets de passages tax payments to local "warlords" were common.

A radical change, both technologically and politically, began to occur in the late

16th century when the old Chinese brining method was revived in Cheshire and north Germany. It consisted of deep hole drilling, allowing the brine to "well" up and boiling it by means of burning coal [-<sup>1920</sup>]. It is the technique of using these modern fuels to extract salt from sea water and dissolved rock salt which finally made salt available in unlimited quantity. It also became inexpensive, widely distributed and a forgotten innocuous commodity. The hierarchy of the autocratic regimes developed over thousands of years to protect the very limited known salt sources had become redundant and signaled a renaissance of Athenian democracy

### Monopoly and taxation

Milton Friedman has noted that "Monopoly frequently... arises from government support or from collusive agreements among individuals". The administrative hierarchy of a Monopoly requires that the chain of command be above any suspicion of collusion. A community may democratically vote to operate a perfectly innocent monopoly service as the best and most efficient solution. However over a period of time no monopoly can be free of collusion and corruption. Somewhere at some point in time down the chain of command

17 W. Carle, *Zur Frage der vor-und fruhgeschichtlichen Salinen in Baden-Wurttemberg, Oberrhein. Geol. Abh. 141-166, Karlsruhe, (1965). Geschichte der Salinen in Baden-Wurttemberg, no. 1-14.*

W. Carle, *Beitrage zur Geschichte der Wurttembergischen Salinen, Lohlhammer Verlag, Stuttgart (1968).*

J.U. Nef, *The rise of the Coal Industry, Vol. 1, p. 158, Routledge, London (1932).*

18 Needham J, *Private Communications from T'ien Kung K'ai wu, 1937.*

Nef, J.U. *The Rise of the British Coal Industry, pp. 206-208 Routledge, London (1932).*

19 Rudolf Palme: *Early capitalistic tendencies in Austrian saltworks in the late Middle Ages*

20 Allen, Gary. *None Dare Call It Conspiracy.* Seal Beach, Calif.: Concord Press, 1971.

Ralph Nader, *The Monopoly Makers: Ralph Nader's Study Group Report on Regulations and Competition.* (Grossman Publishers, 1973

collusion will occur. Even a seemingly benevolent system of monitoring will become depressive at the slightest suspicion of collusion requiring all the ingredients of an authoritarian hierarchy

The essence of anti-trust must be to prevent the conditions that allow this inevitable corruption to take seed. The price paid for the establishment of a parallel but separate alternative to the monopoly controlled service may be at a nominal cost. Again the principal of a democratic choice must be made. This should be seen as the equivalent to a form of tax, since there remains the tendency to force it upon its public "for the public good." The right of choice is democratic but the existence of an alternative is due to anti-trust law.

It may be arguable that anything and everything can be taxed by an authority. However in a liberal or "free" society this relies on the democratic agreement of a community and by definition this would allow only a small [if any] central authority funded by voluntary tax. It seems the Athens of the 5<sup>th</sup> century BC was just such a society and the population along the Mediterranean coast where low sea levels exposed coastal "salt winning" flats and marshes was basically independent. The meaning of "Free and Autonomous" included avoiding any direct taxation of citizens. The many temples of the gods' provided the daily 'sacrifice' of domesticated animals with a tithe system that was not yet a centralized service. There were indirect taxes on the income from slaves [Greek *hal-ootinei: exchanged for salt*] and the use of community owned salt pans, harbors and

fisheries.

These taxes may even have been paid by the coastal inhabitants in the form of salt. However around 400 BC due to flooding coastal salt supplies began to dwindle [sea level E – D], and authorities were forced to take steps to guarantee themselves other sources. Caesar and then Augustus turned to the mines and lakes of Asia Minor. Modeled on public life and customs of the Greeks, ninety four known "city states" were established in the colonies and were awarded the status of 'free and autonomous'. The young men's and the Elder's associations began to thrive and acquired a corporate character. Many 'city states' began minting their own coins. Perhaps it was Alexander the Great who was summoned to search for the great Tatta salt lake in Anatolia, the great salt desert of Persia and even the salt mountains of the Indus valley. Many of these 'city states' were directly on the trading routes between the Tatta salt Lake, the Dead Sea and beyond, and the increasingly salt hungry destinations at home.

Resistance to comply with increased taxes in turn meant that the temple authorities who were clearly the main users of common Salt had to be in a position to force their implementation. The associated by products such as bone, leather and furs were needed to produce the now necessary leather accessories of armory and ordinance, and the chain of authority became directly and indirectly increasingly powerful.

Imperial Rome grew from Augustus to Trajan and quickly acquired exclusive

control of the inland salt deposits of northern Africa, most of Great Britain and Gaul, much of Germany and Eastern Europe around the Black Sea, as well as Mesopotamia and the northern part of the Arabian Peninsula. We recognize these outstanding accomplishments but historians have hardly provided convincing and practical reasons necessitating such a glorious expansion. In the same vein it seems Rome could not have 'fallen' just because of the coincidental greed and corruption of a few ruling misfits. The unfortunate circumstance of the flooding salt pans led to, and created the conditions of monopoly and exclusive control of the few known alternative deposits. Only the corruption of such a monopoly could have resulted in such social catastrophe. It forced anyone and everyone to accept its terms. Neither was it the extra expense of the now extended conquering armies that drained Rome of its last vestiges of what had been a model of democracy, freedom and equal rights. The riches that were returned to Rome were surely enough to cover this expense.

For the past three millennia mankind has battled for the few known sources of this innocuous but critical commodity. Survival of the fittest is no idle paraphrase, even as animals' battle over a salt lick..

Possibly mans' greatest achievement in terms of the advancement of modern civilization was learning to manufacture unlimited quantities of Salt from seawater employing the new fuels and evaporation technology. It signaled the dawn of the Industrial revolution and resulted in the

inevitable population explosion.

However the effects of surviving such monopoly conditions have today left many nations suspicious of any alternative form that may be of a 'less' than authoritarian regime. Many desert tribes inhabited those sections of what is today known as the Silk Road [though possibly a more precise description would be the 'salt' road] from the Levant coasts to the oriental Far East, providing a militant protection service. They still understand little else other than the simple hierarchy of an authoritarian sectarian or "warlord" autonomy. Similar behavior is pertinent to those sectarian communities lining the Danube, the artery which supplied the salt from the central European salt sources. The British controlled their empire in India with no pretensions or even excuses when confronted by Gandhi. So deeply embedded is this way of life that in spite of the many examples of cruel dictatorship and feudal government these populations still seem to cower with admiration at the individual power of a ruthless leader.

To some it may not be immediately clear why a public service monopoly well implemented by a democratic regime, ought to be disallowed. Nor is it perhaps clear that it ought to be considered as a potential danger to the success of that regime or even its supporting society. Laissez faire may be the cry of government, but the predatory practices of the legendary "robber barons" are still looked upon as examples of a free economy.

Like any liberal organization that may be misused and abused with a given trust or

responsibility, the added bureaucracy of regulating its monopoly can only lead to either authoritarian or manipulative solutions. Only the existence of an alternative perhaps competitive organization for public comparison, would limit the abuse to be ineffective and at the least irrelevant.

### Conclusion

The historical scars of the salt monopolies are still in evidence and the now quaint legislation on many country statutes was still operative at the beginning of the 20<sup>th</sup> century vividly demonstrated by Gandhi in India. Even today China's salt police, 25,000 officers strong with red epaulettes and gold badges in the shape of salt crystals still enforce one of the oldest economic policies in the world: the Chinese government's exclusive right to produce and sell salt for the past 2600 years. Although now it is iodized salt needed for the health of the population. [21 Fackler ]

The monopolies ran concurrently with periods of salt famine. Episodes such as the controversial and violent latter part of the Roman period and the move to the Levant, or the despicable inequality of the Gabelle regime were necessarily accompanied hand-in-hand with fiercely authoritarian regimes to protect and oversee their implementation. Possibly the most recent period of slavery from West Africa bears witness to the worst form of salt famine. Towards the end of the Greek and early Roman period the resulting social upheaval forced the focus of communities away from the slowly

flooding coastal salt sources that had been synonymous with more liberal civilizations and undisturbed coastal salt making. They were drawn toward the few known highly protected inland salt quarries, brine springs and salt lakes catered by military with supply lines and 'via salarium'. The salt famines provided periodical significance to those places that have regularly suffered the cycle of prosperity and then decay in unison with the fluctuating sea.

Peaceful maritime Trade and liberal regimes grew with the ability of those blessed with salt sources, to supply themselves and barter their salted goods. War, on the other hand, cursed those same communities when the lines of supply became unreliable and defense and protection became synonymous with monopoly and coercion. It is perhaps no coincidence that the word for 'war' in ancient Hebrew [*mel'chama*] means literally "a fight for [salt and bread]" "Similarly we may also find the words for salt in the etymology of "peace" : *salaam, shalom, saluti, salvete!* And even a rejoicing, [Greek; salt=hal] '*hallelujah!*'

The salt monopolies and their enforcement were the cruelest but perhaps the most practical of instruments for consolidating and wielding power until the start of the Industrial Revolution. The inventive use of modern burning fuels suddenly allowed the efficient mass production of salt for everyone with unlimited supply.

The remnants of these authoritarian regimes are still with us, because anti-trust law is not yet fully recognized or perhaps even understood. The representative

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21 Martin Fackler, *Salt Soldiers Associated Press*, 11/17/2002 11:04 [BOSTON.COM]

Heads of our Communities still mistakenly consider many basic public services to be their exclusive domain. They sincerely believe that community control over essential exclusive services is for the good of the community. They mouth their intentions of 'privatization'.

Of the modern corridors of power only democracy has visibly embraced anti-trust legislation. To this writer [with an admitted mono-mania for salt], the recent failures of communism for example were primarily due to the non existence of anti-trust law and the resulting graft. Socialism still seems to concern itself with intervention and the prevention of competition where government owns and regulates commodities and services for the declared public good. China however with its long rich experience of salt monopoly now seems to be successfully combining modern capitalism with a single ruling administration. Provided that this new capitalism will service the Chinese with competitive and fair enterprise of equal opportunity embedded with effective antitrust legislation, it would seem to matter little what kind of administration presides over this paramount principle.

The Achilles heel of any organization is corruption but when it becomes the reason for a failing or inefficient monopoly organization then either collapse or

ruthless dictatorship are the only interim alternatives for that community and for the governing regime.

Ironically it is the monopoly of corruption that can only be countered by an alternative and competitive regime. Thus eliminating any potential for corruption must also have its alternative in the form of a default regime or organization that can act as an antidote and if necessary as a replacement.

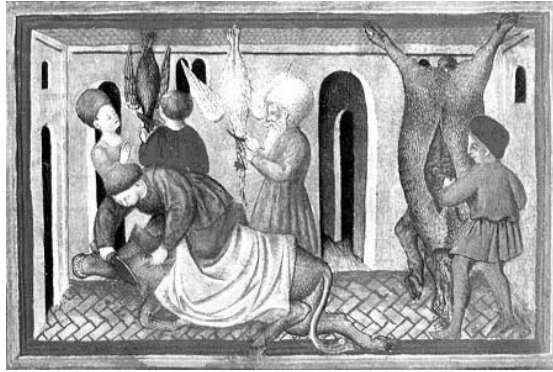
Winston Churchill once said that in his opinion "democracy is the worst system devised by the wit of man, except for all the others". What ever the type of regime: whether it is a form of contemporary communism or non violent anarchy, democracy or even a neocapitalism that leads to Globalism, all must be considered "bad governance " doomed to failure unless an integral concept of antitrust legislation and enforcement is operative. No regime can rely on the goodness of any man for long.

The trends that today seem to threaten our western world are not globalisation by any specific governing regime or even a religion. Rather - It is a basic fear by those still authoritarian communities and lacking the basic alternatives provided by anti-trust law who have yet to learn to make intelligent choices about their lifestyle.

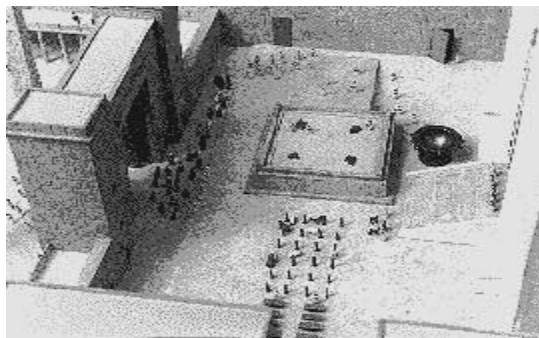


fula /preservative/saltedmeat

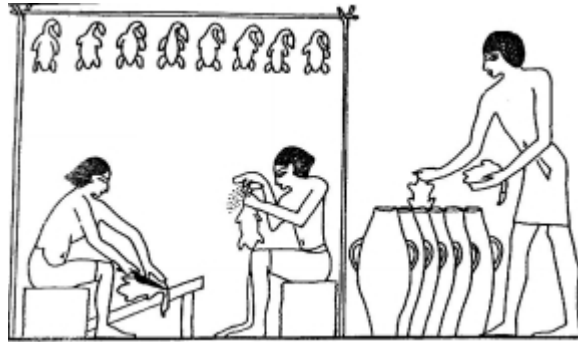
*Illustration 1: Fula chiao yen mixtures of two thirds salt and admixed spices into most familiar Chinese food preparations provide the preservative for salted meat .*



*Illustration 2: Segovia - Jewish Abattoir*



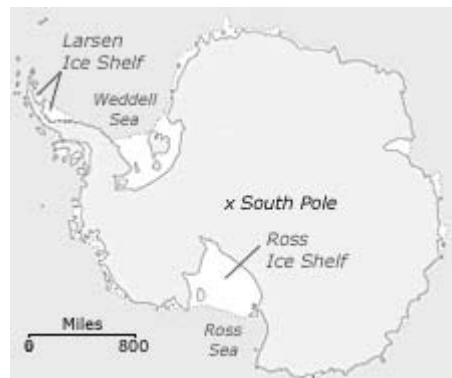
*Illustration 3 The temple in Jerusalem – scale model showing the position of the altar, and production lines with posts for hanging and stripping carcasses almost identical to a modern abattoir processing plant.*



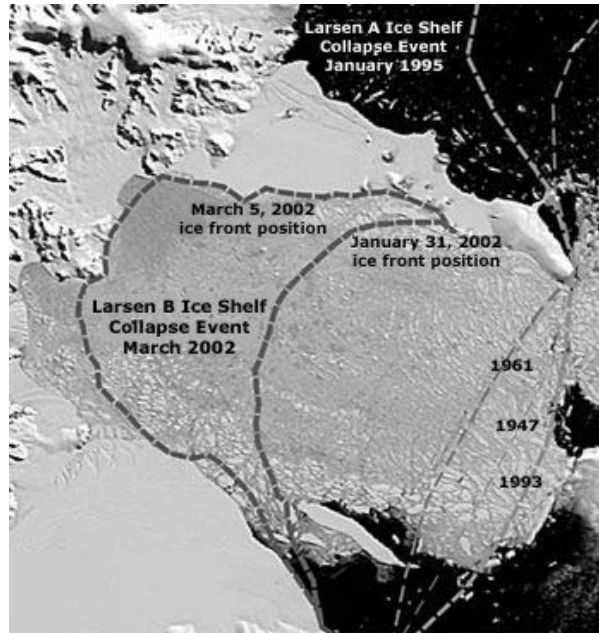
*Illustration 4 Egyptian salting and packing poultry into amphorae [ddb]*



*Illustration 4 Moroccan coastal salt evaporation pans [ddb]*



*Illustration 5: Image courtesy of the CIA World Fact Book, adapted by the National Snow and Ice Data Center, University of Colorado, Boulder.*



*Illustration 6: Extent of Larsen Ice Shelf retreat. MODIS image courtesy of Ted Scambos, National Snow and Ice Data Center, University of Colorado,*



*Illustration 7: The Roman quay at Aquilea*

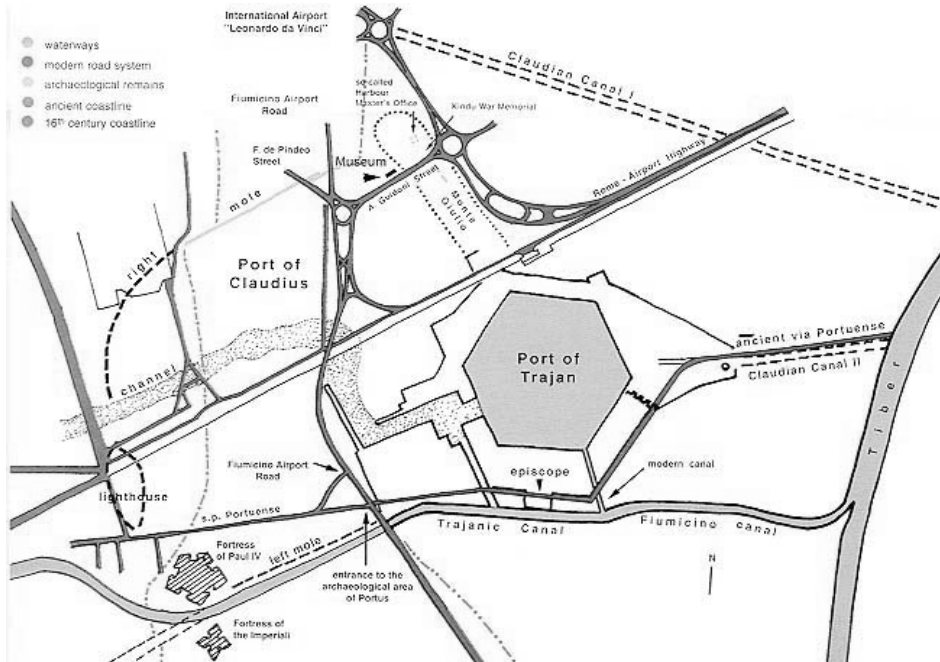
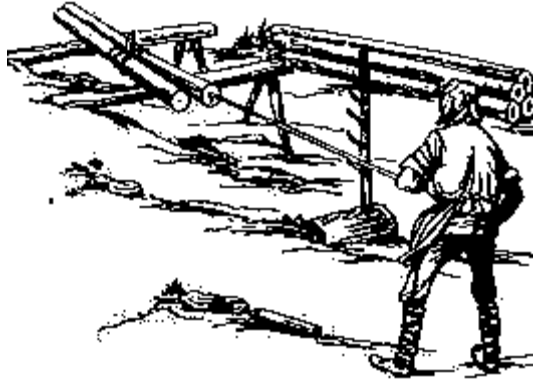


Illustration 8: Ostia - Trajan port - now used to irrigate nearby fields



Illustration 9: Jebel Usdum - Solid salt of the mountain at Sdom, the Dead Sea [very similar in its historical use to Cardona]



*Illustration 10 Honing tree trunks for piping  
brine 1*



*Illustration 11: Salt money bar -Abyssinia [Pitts  
Museum Oxford]*



Illustration 6: The "Tatta" salt lake [TuzGolu]

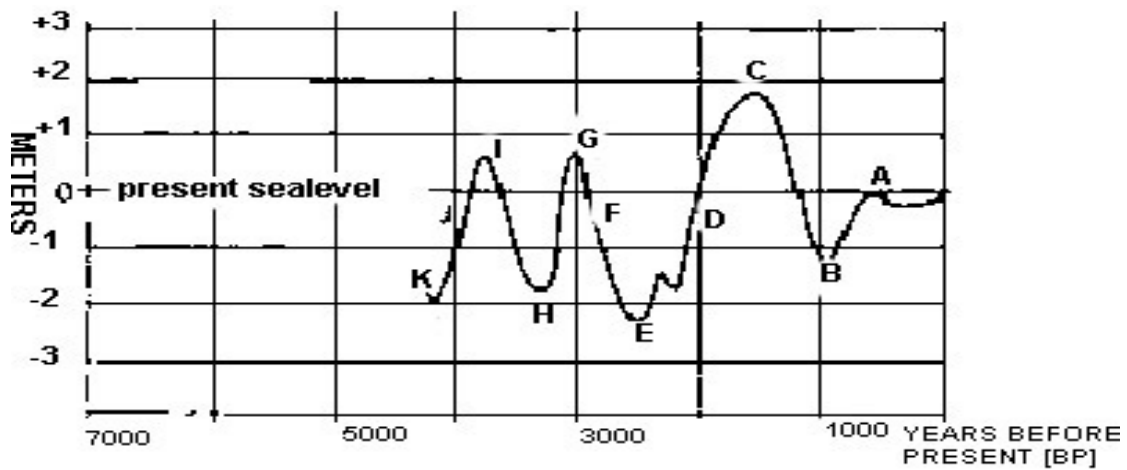


Illustration 7: The timeline curve is based on A hypothesis for the change of ocean levels depending on the albedo of the polar ice caps -  
M.R.Bloch - Palaeogeography, Palaeoclimatology, Palaeoecology, 1965 127-142-Elsevier Publishing Company, Amsterdam-Printed in The Netherlands

TIME LINE [sea level curve]

Antarctic Ice cores

**Volcanic ash layers were found at 172.1 m, 219.4 m and 222.8 m in the "Little America", ice core by: Crary, Robinson, Bennett and Boyd [1962] indicating discoloring of the ice cap and effecting the Albedo, These following dates: ash layers, corresponding to period between 1700 and 600 B.C. correspond to 3700 years, and 2600 years - BP**

These may be translated into the following key periods of high and low, sea levels: according to the curve:-

**Estimated ocean level changes in pre-historic and historic times**

.. Fluctuation of Sealevels at all the points designated : =levels [A] - to- [K]

**level [A] - 16th century**

present day sealevel

**level [A] - 15th century AD**

general rise in price of salt, causes social political unrest [Kolner] broads, meres, clairs and kogs flooded - peat salt production ceases. Holland weakening sea defences

**level [A] - 14th century AD**

Rising sealevel - Prussia Livonia salt famine [ Tanner] salt prod. forbidden in Holland [Dendermonde/Debbits] Chersonesus settlements decay [Mongait]

**level [B] - 11th century AD**

Lower sealevel - Doomesday Book 1200 salinae [Bridury] Walcheren island flourishing [Bronsted]

**level [B] - 10th century AD**

Haithabu near Schleswig, flourishing [Koster] also Yarmouth [Clark][Ives] Lubec

**level [B] - 9th century AD**

Vikings occupy Noirmoutier, Bourgneuf developed [Agate]

**level [B] - 8th century AD**

Camargue in production. Crimea [Bronsted]- Ravenna, and Aquilea had become landlocked due to receding level but Venice flourishing [Pirenne] - Peat areas of Wadden with their tidal flats trading intensively [Pirenne] salterns of Pyrenean coast [Ellis] Pope owned salt pans in Ostia [Fea] previously flooded after Trajan

**level [C] - 5-7th century AD**

Almost no coastal salt production. Only upper peat bogs in Ireland, salty sands in Isle of Man and oil shales [for boiling]in Dorset, Salamis still flooded [Newman] Tyre separated from mainland, [St Jerome] - Maritime Greece population dwindling [Nilsson]

**level [C] - 2nd century AD**

inland Norfolk broads still in use [Clarke] Classis near Ravenna harbouring ships up to reign of Gothic kings [Goetz]

**level [D] - 1st century / 100 AD**

Tiber ports progressively built inland, by Claudius and Trajan. The Dead Sea becomes a prime source for salt again. Trajan succeeds in rejuvenating the "Suez canal" built originally by RamsesII [Muir]

**Ash layers**

**level [F] \* 700-100 BC**

very low sealevel- The catastrophic rise in ocean sealevel between 100 BC to the 2 century AD [-1.5m to +1.8m] (much more pronounced than in the 13th cn) Flooding at the Dead Sea caused a sudden increase of the Dead Sea level of - 72 m (seventy two meters) [Cippora Klein-HUJ] The ocean sea level left Greek, Phoenician, Roman ports inundated. Some of these ports were probably built partially into the sea anyway **with no consideration of possible sealevel rise [viz.recent finds at Caesaria]**

**level [G] \* 1000 BC**

-Judean kings, the sea level was well above today's levels although not well documented, the Dead Sea was again a prime source for salt, because of flooding of the sea shore salt pans

**Ash layers**

**level [H] \* 1700-1250 BC**

Maritime Mycenaean civilisation flourishes.and Jericho civilisation declining.[Albright]

**level [I] \* 1700/ BC**

Jordan valley civilisation flourishes, [Albright] - Aegean Minoan culture at a low.

**Ash layers**

**level [K] \* 2200 / 1800 BC**

Aegean Minoan coastal populations prospered. Desolation in the Jordan valley. Egyptian "old kingdom" 2575 – 2150 BC followed by 1000 "dark"years

## **Bibliography.**

Agate, A., *Ioc. cit.*, Reference 49, p.9.

Allen, Gary. *None Dare Call It Conspiracy*. Seal Beach, Calif.: Concord Press, 1971.

Bloch D. Salt and the Evolution of Money Vol 6 1999 CIHS Journal of Salt History

Bloch M.R. H.Moller 1930 *Über die modifikationen des jodsilbers* Z. Physikal chem. A 152 245-268 [Crystallization and undercooling]

Bloch M.R., *A Hypothesis for the Change of Ocean Levels depending on the Albedo of the Polar Ice Caps*, *Palaeogeography, Palaeoclimatology, Palaeoecology*, Elsevier, Amsterdam, 1, 127-142, (1965).

Bloch M.R., *Historical Evidence of Sea-Level Change and its Relation to Polar Albedo*, *Symp. Arctic Heat Budget and Atmospheric Circulation*, Univ. of Calif. And Rand Corp, 179-196 (1966).

Bury J.B. *History of the later Roman Empire* pp 161,213. Dover pub. N.Y 1958

Carle, W. *Beitrage zur Geschichte der Wurttembergischen Salinen*, Lohlhammer Verlag, Stuttgart (1968).

Carle, W. *Zur Frage der vor-und fruhgeschichtlichen Salinen in Baden-Wurttemberg, Oberrhein*. Geol. Abh. 141-166, Karlsruhe, (1965). *Geschichte der Salinen in Baden-Wurttemberg*, no. 1-14.

Daly, R.A. *A recent Worldwide Sinking of the Ocean Level*, *Geol. Mag.* 57, 246-261 (1920).

Dendemonde M. , *The Dutch and their Dykes*, p.47, *De Bezige Bij*, Amsterdam , (1956).

Dendermonde, M., *Ioc. cit.*, Reference 69, pp. 47, 48.

Denton D, *The Hunger for Salt. An Anthropological, Physiological and Medical Analysis* - Springer-Verlag 1982

Fackler, Martin *Salt Soldiers* Associated Press, 11/17/2002 11:04 [BOSTON.COM]

Fairbridge RW, *Dating the Last Movements of the Quaternary Sea Level*, *Trans. N.Y. Acad. Sci.* 20, 471-482 (1958).

- Forster, E.M., Alexandria, A History and a Guide, p. 217, Doubleday, New York, (1961).
- Goswin, H., Coastal Peat Beds of the British Isles and North Sea, J. Ecology, 31, 217 & Fig. 12 (1943).
- Gotz, W. Ravenna, E.A. Seemann, Leipzig (1913).
- Hallam H.E., Salt Making in the Lincolnshire Fenland during the Middle Ages,
- Hoinkes H.C., Research in Geophysics, 2: Solid Earth and Interface Phenomena, pp. 391-424 M.I.T., Massachussets (1964).
- Ives, Remarks upon the Garianium of the Romans, the Site and Remains Fixed and described, I.D. Downes for Messrs. G.&J. Robinson, London (1815).
- Lincolnshire Architectural Archaeology. Soc. Rp. Papers. New Ser. 3, 35-112 (1959/60).
- Meiggs R., Roman Ostia, p. 269, Clarendon Press, Oxford (1960).
- Nader, Ralph The Monopoly Makers: Ralph Nader's Study Group Report on Regulations and Competition. (Grossman Publishers, 1973
- Needham J, Private Communications from T'ien Kung K'ai wu, 1937.
- Nef, J.U. The rise of the Coal Industry, Vol. 1, p. 158, Routledge, London (1932).
- Nef, J.U. The Rise of the British Coal Industry, pp. 206-208 Routledge, London (1932).
- Palme, Rudolf: Early capitalistic tendencies in Austrian saltworks in the late Middle Ages
- Wilson A.T., Origin of Ice Ages, Nature, 201, 147-149 (1964).
- Yadin Y. The Excavation of Masada, Israel Exploration Journal, 1-2, 37 (1965).



Alfons Figuls – Olivier Weller (Editors)  
1a Trobada internacional d'arqueologia envers l'exploració de la sal a la prehistòria i protohistòria  
Cardona, 6, 7 i 8 de desembre del 2003

## ABSTRACT

*La sal comú generalment es subministrava en poques quantitats durant certs períodes crítics des de l'antiguitat fins la Revolució Industrial.*

*Anava a convertir-se en la mercaderia principal, tant bàsica per qualsevol comunitat domesticada que havia de ser regulada.*

*Els llocs de subministrament i les fonts havien de ser defensades, protegides i garantides.*

*Tal i com succeeix amb el petroli en les economies actuals, era essencial, exceptuant que a més era necessària per a mantenir la vida humana i animal.*

*En l'essència de la supervivència, era tant bàsica com l'aigua, l'aire i les proteïnes, no obstant malauradament no era omnipresent.*

*Un d'aquests períodes de poc subministrament sembla haver succeït a principis de l'època Romana, quan els nivells del mar van pujar moltíssim. En l'actualitat més de 200 jaciments arqueològics coneguts en el Mediterrani encara estan coberts d'un a tres metres de mar. Les mines situades terra endins i els recursos salins lacustres van prendre una importància històrica inexplicada.*

*La inundació dels equipaments costaners d'evaporació solar utilitzats pels antics productors de sal, els va obligar a buscar sal en desemparats deserts àrids com el Mar Mort, Tuz Golu, el Nord d'Àfrica, Cardona i algunes fonts de salmorra poc conegudes. La producció costanera de sal per la majoria, anteriorment havia permès a les societats liberal Grega i de la primera època Romana viure lliures de la futura coerció i monopolització dels subministraments de sal per les poderoses minories autoritàries. Aquestes societats liberals avui en dia encara són l'enveja de molts.*

*Los emplazamientos de suministro y las fuentes tenían que ser defendidas, protegidas y garantizadas.*

*Tal como sucede con el petróleo en las economías actuales, era esencial, exceptuando que además era necesaria para el sustento de la vida humana y animal.*

*En la esencia de la supervivencia, era tan básica como el agua, el aire i las proteínas, no obstante desgraciadamente no era omnipresente.*

*Uno de estos períodos de poco suministro parece haber tenido lugar a principios de la época Romana, cuando los niveles del mar subieron muchísimo. En la actualidad más de 200 yacimientos arqueológicos conocidos en el Mediterráneo todavía están cubiertos de 1 a 3 metros de mar. Las minas situadas tierra adentro y los recursos salinos lacustres tomaron una importancia histórica inexplicada.*

*La inundación de los equipamientos costeros de evaporación solar utilizados por los antiguos productores de sal, los obligó a buscar sal en desamparados desiertos áridos como el Mar Muerto, Tuz Golu, el Norte de África, Cardona y algunas fuentes de salmuera poco conocidas. La producción costera de sal por la mayoría, anteriormente había permitido a las sociedades liberal Griega i de la primera época Romana vivir libres de la futura coerción y monopolización de los suministros de sal por parte de las poderosas minorías autoritarias.*

*Estas sociedades liberales en la actualidad todavía son la envidia de muchos.*

*Le sel de table généralement était fourni en des petites quantités pendant certaines périodes critiques de l'histoire depuis l'Antiquité et jusqu'à la Révolution Industrielle.*

*Elle était en train de devenir la marchandise principale, si basique pour les communautés apprivoisées qu'elle devait être réglée.*

*Les emplacements de fourniture et les sources devaient être défendus, protégés et garantis.*

*Aussi comme il se passe avec le pétrole dans les économies actuelles, il était essentiel, à exception de qu'il aussi était nécessaire pour la nourriture de la vie humaine et celle des animaux.*

*Dans l'essence de la survie elle était si basique comme l'eau, l'air et les protéines, néanmoins malheureusement il n'était pas omniprésent.*

*L'une de ces périodes de peu de fourniture, semble avoir lieu au début de l'époque romaine quand les niveaux de la mer ont monté beaucoup. Maintenant plus de 200 sites archéologiques connus parmi la Méditerranée sont encore couverts d'un à trois mètres de mer. Les mines situées à l'intérieur et les ressources salines lacustres ont pris une importance historique inexplicable.*

*L'inondation des équipements côtiers d'évaporation solaire utilisés par les anciens producteurs de sel, les obligeait à chercher du sel en délaissés déserts arides comme le mer Mort, Tuz Golu, le Nord d'Afrique, Cardona et quelques sources de saumure peu connues.*

*La production côtière de sel pour la majorité, antérieurement aurait permis aux sociétés libéral Grec que et de la première époque romaine, vivre libres de la future coercition et monopolisation des fournitures de sel par les puissantes minorités autoritaires.*

*Dans l'actualité il y a beaucoup de gens qui sont jaloux de ces sociétés libérales.*

*Common Salt was generally in very short supply during certain critical periods from ancient times until the Industrial Revolution.*

*It was to become the main supporting commodity so basic to any domesticated community that it had to be regulated.*

*Supplies and sources had to be defended, protected and guaranteed.*

*Like petroleum oil in today's economies it was essential, except that it also was needed to sustain human animal life. It was an essence of survival as basic as water, air and protein, though unfortunately it was far less ubiquitous.*

*One such period of short supply seems to have occurred during the early Roman period when sea levels rose steeply. Today more than 200 known archaeological sites in the Mediterranean are still covered by 1 to 3 meters of sea. Inland mines and lake sources of salt took on an historically unexplained importance.*

*The Inundation of coastal solar evaporation facilities used by ancient salt makers, forced them to search for salt in forsaken arid deserts such as the Dead Sea, the Tuz Golu, North Africa, Cardona and some very limited known brine sources. Coastal salt making by the many had previously enabled the liberal Greek and early Roman societies to live free of the future coercion and monopolizing of salt supplies by highly authoritarian minorities.*

*These liberal societies are still the envy of many today.*



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