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Salt and Capitalism in Western Europe (XVIIIth–XIXth Centuries)

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ABSTRACT

The salt industry underwent a rapid capitalist transformation in certain European countries during the eighteenth and nineteenth centuries, such as France, Germany and above all England. Other countries, such as Spain and Italy, were scarcely affected by modernization. This process took the form of using new sources of energy: coal replaced firewood; mining led to the discovery of rock salt deposits; and deep drilling allowed rich brine to be pumped up to the surface. Sometimes this capitalist transformation was preceded or accompanied by profound social change such as the elimination of feudal-type saltworks which had fallen heavily into debt. The government also contributed towards this change by its fiscal policy and encouraged the establishment of joint stock companies in place of the preceding feudal structure. The modernization of transport networks — canals in the eighteenth and railways in the nineteenth century — did away with the obstacles that had hindered inland saltworks and had kept them confined to a local market.

The transformation took place first in England; it occurred fastest in West Prussia; but it had the most profound consequences in France. In the Middle Ages and early modern period, Northern Europe had been supplied with salt from the salt ponds on the French Atlantic coast, but from the end of the eighteenth century onwards English salt was used instead. The Atlantic salt ponds were abandoned and northern France was supplied with rock salt from Lorraine after ca. 1860. The Mediterranean coastal saltponds of France and Italy were equally affected by the capitalist transformation and underwent a concentration of ownership and production.

The process of salt boiling underwent fastest change: the thermovacuum process was invented at the end of the nineteenth century. The status of workers has also been changed by capitalist modernization. Two social groups (small tenants and unspecialized seasonal workers) disappeared progressively from the larger saltworks in southern France. The architecture of the saltworks was significantly changed by the revolution in techniques. High buildings opening out onto canals and railways replaced low buildings opening out onto interior courtyards.

INTRODUCTION

With the following account, for which it does not seem desirable to keep a geographical order (Great Britain, Germany, France) which, however, could show the evolution and rhythm of modernization, a typology of the new techniques and the capitalist growth of salt industry, selected through a few examples which seem significant will, be taken into account. This study will sometimes be biased by some disparities in research. May it induce British searchers to a further examination of a subject which is at the heart of their country's industrial stages, such as coal, development of ports or railways. In Germany there are a great many excellent studies on salt history but no synthesis has come out of them as yet. In France historians have the opportunity of using rich administrative surveys involved by State centralization, but apart from Lorraine and Franche Comté, monographs are unfortunately missing. It is hoped that those few previous considerations might attract attention to a subject of the highest interest.

THE CRISIS OF OLD TIME SALTWORKS

For more than a thousand years, the European populations had exploited the poorest salty resources to get salt: in Northern Europe they used peat and salty sands from the coasts or salt springs from the continents (Hocquet, 1986), while in Southern Europe they built saltponds along the Atlantic coast and the Mediterranean to produce a solar low-cost salt. In the North, boiling salt was produced by the combustion of peat or wood. The production cost was high, much labour was needed to extract the raw material (brine), to deliver a refined product (salt), to fell trees and supply fire wood, and to make and maintain the implements (boring tools, pans and

furnaces). Most of the saltplants which had the advantage of working for a regional market did not have to pay for high carriage costs. The Atlantic salt was produced by free natural sources of energy, the tides, the sun and the wind. It was a low-priced salt produced by just a few small tenants, and it was able to bear high carriage costs to reach northern markets (Hocquet, 1992).

Lunebourg: the crisis of a feudal-type of saltworks

In Lunebourg (Lower Saxony, Germany), the boiling techniques from the Middle-Ages had been left unchanged: 216 leaden pans, one square metre each, distributed in 54 saltworks, were used to boil the brine on a wood-fire furnace. The big saltplant had known prosperous years from 1554 to 1614 with an average output of 20,000 tons exported through Lübeck towards the Baltic ports. The Thirty Years' War brought about serious damage and seriously disrupted their exports. When the war came to an end with the treaties of Westphalia, the Lunebourg salt underwent the shock of double competition, first from cheap Scottish salt, then from the Atlantic salt reintroduced in the Baltic sea by the King of Denmark (Table 1). The Lunebourg salt was more and more restricted to the nearest surroundings, i.e. the Kingdom of Hanover (Witthöft, 1976, 1978). The crisis, which grew worse and worse, also had structural causes. The balance sheet of a saltworks in 1777 (Table 2) showed a heavy deficit (Bleeck, 1985). There was no investment. It was time to change the old medieval techniques.

TABLE 1

The crisis of the production of the Lunebourg salt

Years	Production (tons)
1554–1614	20,000
1680–1700	10,000
1770–1790	5,000

TABLE 2

Balance-sheet of a saltworks (1777)

Sales of a saltwork	3,250 Mark	
Expenditure	3,565 Mark	
– Taxes and rental charges		49%
– Purchase of firewood		25.5%
– Carriage expenses		23%
– Maintenance, interests		2.5%

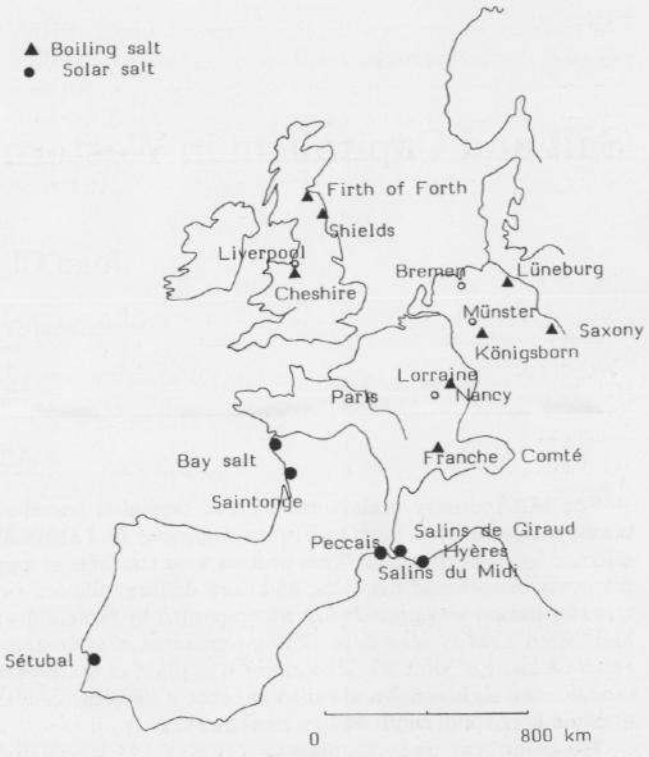

Fig. 1. Location of the western European saltplants quoted in this article.

The crisis of sea salt in France

The French salt market went through an important mutation at the beginning of the 18th century. The French production of the Atlantic coast which, besides supplying nearly three-quarters of the "national" territory, was exported to all the Northern markets, and lost its outlets one after the other from the end of the 14th century until the 18th century. Considering the irregular sunshine and production along the French Atlantic coast the fleets coming from the North had felt very early on (15th century) inclined to sail as far as Portugal and even to cross the Straits of Gibraltar in order to ship salt (Hocquet, 1985). The Continental Blockade established by Napoleon had actually resulted in a naval blockade of the French coasts by the English Navy which finally led to the breaking of the old commercial links between French Salt merchants and their Prussian, Scandinavian or Russian clients on the Baltic Sea. The lost outlets were won by a new product, the English boiling salt. That is why radical changes proved necessary for a salt market deeply upset by the loss of foreign outlets in a period of rapid industrial development.

According to the Favreau report in 1852 the French production of salt in the middle of the 19th century was bearing the marks of the Ancien Régime

TABLE 3

Production of salt in France (1850)

Sea salt from the Atlantic coast	225,000 tons
Sea salt from the Mediterranean sea	267,000 tons
Boiling-salt from Lorraine-Franche Comté	60,000 tons

TABLE 4

Cost and selling price of a quintal of Mediterranean salt

Wage expenses	0.85 F
Depreciation charges, dividends	0.77 F
Overproduction	20%
Total cost price	1.94 F
Selling price	1 F
Loss	0.94 F

(Table 3). Therefore the Atlantic salt was still representing 40% of the French production. The saltponds along the coast covered from 15 to 16,000 hectares, there were 20,000 owners who employed workers on a share-crop system. Only 158,000 tons were sold and the third of the production was, in fact, over-production.

On the Mediterranean, the saltpans belonged to joint-stock companies. The saltpans were often as large as several hundred hectares; in Hyères or Berre the assets invested in the works were as high as 2,300,000 F. in each. The crops were made by hand without machinery; the numerous workers were divided into three categories: the salt workers and their supervisors paid by the year, the maintenance workers coming for a third of the year from the end of Winter to Spring and then a few hundreds of seasonal workers hired for the crops only one month in Summer. In spite of their favourable weather conditions and high outputs the south coast saltworks were not without problems. In fact they had to allow for 0.85 F a quintal in wage expenses and 0.77 F for depreciation charges plus dividends. But each of the saltworks also faced a rate of 20% over-production. This had to be included in the cost price which finally came to a total estimation of 1.94 F a quintal. As the average selling price for the year 1850–51 only reached 1 F, the amount of the loss was just equal (Table 4).

In 1851, they had reached a breaking point. How could they have let such a crisis grow in their business for such a long time? Every saltplant taking advantage of a production stop in Peccais caused by a flood of the Rhône had tried to increase their own production and to gain hold of their competitors' markets. A few prosperous years had yielded handsome profits which had been reinvested in extensions of the saltplants or the creation of new ones (Hocquet, 1990).

TECHNICAL TRANSFORMATIONS

The use of coal and the invention of new techniques

At the turn of the 17th century the old English industry of boiling salt was deeply transformed by the use of coal instead of firewood or peat in the furnaces. From then on the salt makers could start using larger pans directly served by a system of sea pumping. Thence forward a salt-shed with four pans was able to produce 20 bushels (7.27 hl) of salt in 24 hours instead of 2 gallons (9.1 l) in a four-hour boiling. The daily output was multiplied by 13. The use of low-quality coal involved the migration of salt industry from peat-bog to coal-mines and coal-ports on the Tyneside, the Wear estuary and along the Firth of Forth. The Scottish saltworks used to burn 3 cwt (152.4 kg) of coal to produce a bushel of salt in the Forth where 98 pans were at work. In 1730, Shields, not far from the Newcastle coalfields, had 230 pans for the boiling of seawater. In this new system the purchase of coal and its transport over short distances represented the main part in the salt production costs.

However in Shields the seawater was also enriched with rocksalt from the Cheshire mines. Cheshire, the old traditional region for the production of brine from wells and of salt coming from salt boroughs, introduced several innovations in the salt industry: besides coal, they started using steel instead of lead pans, and steam pumps as well. As the Cheshire salt industry was using almost saturated brine thus lowering the production costs, its expansion ruined the Northumberland saltworks. In 1785 Shields only had 20 pans left in use (Ward, 1875–1876; Calvert, 1915; Hughes, 1934; Barker, 1951).

In Western Prussia, vom Stein, the High Councillor to the Mines, trying to set up new saltworks at the request of the Rhineland populations, decided the making of the first German steam engine in order to extract the brines to be boiled in the Königsborn new saltplants. As early as 1782, Frederic II was recommending its use considering the cheap price of coal. On August 30th 1794, they started using the new engine. From then on the brine was set in motion by pressure of steam and gravity: it was first drawn out at a depth of 50 m, then it was raised 15 metres high at the top of a graduation house (Gradierwerk) by a system of pumps. Thanks to this engine which had cost 30,000 Reichstaler (Rtlr), Königsborn became one of the chief Prussian

TABLE 5
Cost of a ton of salt plus carriage to Paris

Under the Monarchy of July	80 F
Under the Second Empire	
– with the railway	15 F
– with canals	10 F

saltworks. In 1850 it produced 166,000 quintals of salt (Kaiser, 1938; Timm, 1978; Burgholz, 1988).

This inventive policy had been induced by technical progress which broke the previous double-bind created by the existence side by side of brine and fuel. The decisive steps were the devising of graduation buildings, the setting up of powerful pumps and the use of coal.

Modernization of transport

Another advantage for the salt industry was the modernization of transport which allowed a link between coal and salt on the new canals: the River Weaver Act in 1721 brought about the deepening of the canal and the construction of 11 sluices, then the Sankey Navigation Act in 1755 allowed the canalisation of the River Sankey, tributary of the Mersey. The coal from St. Helens then came into Cheshire, from where the salt could be shipped down to Liverpool which was promoted as a great salt port (Barker, 1951). As salt is a ponderous and widely consumed product, it is of course essential to be able to command good means of transport, rivers, canals and seaports.

In Germany the Ruhr and the Lippe had been canalised as early as 1770 to allow exportation of salt to Holland and to carry coal from the Ruhr to Unna-Königsborn saltworks.

In Lorraine too, the salt industry was able to grow by using the transport revolution. From the year 1845, in Varangéville, a company with national funds which had carried on a profitable boring, was granted a concession by the name of Rosières-aux-Salines, which started producing in 1853. This new saltworks was set up along the river Meurthe near the canal and the future railway line which would soon carry the coal and wood and export the refined salt. The construction of railways was highly profitable to Lorraine (Table 5). From 1870 to 1914, eighteen concessions were granted and new borings were scattered throughout the region from Nancy to Luneville following the railway line and reached the Moselle valley and the canal of the East (Hottenger, 1928; Coudert, 1981).

Modernization and transfers of technology

In Lunebourg, at the end of the 18th century the signal for structural modernization was given by the transfer from (1) the saltplants feudal-type organization to joint stock companies; (2) the production of only one product (salt) to the system of factories with a diversified range of production; and (3) monopolized local outlets to a regional cartel with sales negotiated by a syndicate of producers. An industrialized setting of saltplants was also considered (Aagard, 1989).

In 1780 Friedrich Ernst von Bülow was commissioned to start a radical reform by the King of Hanover (also King of England). Von Bülow was in close dealing with von Hardenberg, the director of saltplants in Saxe. There, three saltplants were among the most modern ones in Germany at the end of 18th century: Dürrenberg, Kösen and Artern (South Germany). In Dürrenberg the boiling was made in big pans of 20–23 m^2 distributed in 9 large saltworks which had extensions for drying and storage. After a journey around Saxony in 1797, von Bülow could submit a modernization plan in nine items which specified the giving up of old buildings, the construction of two saltworks each able to produce 1,500 last per year, with drying and storage annexes, the setting up of eight new pans of 37 m^2, a heating by peat which could be found in the surroundings, the fittings of furnaces giving out a radiating heat, the building of a big storage basin down which the purified brine would pour by the force of gravity into the pans and the setting up of a new forge for manufacturing steel spare parts.

In Westphalia, too, they had to resort to the competence of great salt engineers (Hocquet, 1985) such as the most famous, Joachim Friedrich von Beust, whose qualifications were used to modernize the salt industry in the Bishopric of Münster. In 1741 the Oktroyierten Münsterischen Salinensozietät was founded: 30 saltplants share worth 1,000 Rtlr each, were given out to 18 noble landowners.

In the South of France the process of integration was immediately chosen and the first attempts at merging the companies took place in 1853 and 1854. The Compagnie des Salins du Midi was established in 1857. It was a limited partnership with a company's capital of 10 million francs, one half of which was secured by a bank, the Crédit Mobilier. In 1866 this company was the owner of 12 saltplants and leased five more. In an attempt to surmount commercial problems due to an abundant and scattered production, they incorporated several joint-stock companies, among them Renouard and Cie which was running the Peccais saltplants, and they closed nine saltplants (Hocquet, 1990).

ECONOMIC TRANSFORMATIONS

Role of the State and growth of investments

According to its vocation the State often initiated modernization. Salt was considered as the King's property, belonging to the public domain. From the period of mercantilism it had tried to create new saltplants as a guarantee of its independence from the foreign countries.

In order to carry out this reform in Lunebourg, the King of Hanover became a shareholder of the saltplants and obtained a financial contribution from all the private or religious owners. In the year 1797, the financial plan for modernization works is well known (Table 6). The works of the new salt plants were started in 1797 and completed by 1801. Lunebourg then had the most modern technology of that period. How successful was this achievement? They had hoped to lower the costs to 10 Rtlr but at the beginning they had to be satisfied with 20 Rtlr. However technology was not responsible for this extra cost which was due to the refunding of the old debt amounting to 900,000 Rtlr at the beginning of 1802 (Aagard, 1989). The past was weighing on them heavily but from 1801 the saltworks were producing nearly 12,000 last of salt (1 last of salt = 4,800 pounds, i.e 2,326 kg).

In France, too, the State played a primordial role following its long tradition of intervention in a department long-considered as a commercial and fiscal monopoly which still brought in large profits to the Treasury in the 19th century.

In Lorraine in 1819 rocksalt was discovered at a depth of 65 metres. The State hurriedly got hold of this new deposit. In 1825 it founded the Compagnie des Salines et Mines de Sel de l'Est which was awarded by contract the whole salt deposits: private firms were closed. In 1825 a law granted the State a share of the profits made by the Company which was operating the new mine and saltworks as a concession. The Treasury would get a fixed rent and a share of the products (75%). To promote the sales of salt from Lorraine the State allowed the Company to fix decreasing selling prices according to the carriage cost. Thus, on the borders of its selling area, the salt from the east could compete victoriously with salts from the west or the south. However, in 1840 a law cancelled the Company contract and the State concession was auctioned to private owners in 1842 and 1843. In 1840 the supporters of this new law had divided the plants into two areas, the first one in Lorraine with the Dieuze mine and the second one in Franche Comté with Salins, Arc and Montmorot. The sales only reached 8.5 million francs. The transaction proved still worse when the two buyers were identified as representatives of the Queen Mother of Spain who was seeking safe investments abroad. From 1844 the two buyers merged into a partnership with a capital of 12,600,000 F which in 1863 was given the name of Société Anonyme des Anciennes Salines Domaniales de l'Est (Hocquet, 1991).

TABLE 6

Structure of the capital for the new saline in Luneburg

Capital	88,663 Rtlr
Funds of the old saltworks	17%
Public taxes (salt tax)	21%
Private partners	51%
Owners of pans and brine	11%

After the defeat of 1871 and the annexation of the department of Moselle and the district of Château-Salins to the German Empire, the German authorities did not try to change to their advantage the private statute of the saltplants. The French kept their own property and were free to manage it themselves. The Société des Anciennes Salines Domaniales de l'Est remained until 1914 a strictly French company with their headquarters in Paris and a quotation of their shares in the Paris Stock Exchange (Roth 1981).

A new outlet: chemical industry

Apart from technical innovations and the transport revolution, the salt industry also found another line favourable to its expansion: the development of chemical industries. The South of France was the first to find more outlets for salt in the new chemical industries. In Camargue the Pechiney Company founded what was to become one of the widest European saltplants supplying the Soda Factory in Salindres which sent its products to the glass factories in the region of Alès. Henri Merle, who founded the Soda Factory, entered into partnership with the chemist Jérôme-Antoine Balard who had discovered in the mother liquors of the Hérault saltplants first bromine and then all the other salts, among which was potassium chloride. The two men took over the property of two companies in clearance sales and in 1855 they founded the Compagnie des Produits Chimiques d'Alais et de Camargue, for a capital of 4 million francs. Until now the Giraud saltplant has maintained its original aim, i.e. to provide the south-east chemical industry with a million tons of first-rate salt and all the range of products formerly thrown back into the sea with the bitterns (Gignoux, 1955).

The chemical industry also offered Lorraine an alternative in case of over-production of salt and the word "saltplant", which was still used for a long time

about the Dieuze production, was improperly appropriated in many respects. From 1805 Carny, a chemist, had set up a workshop near the saltplant to transform the salt into chemical products and make sodium carbonate by using the Leblanc process. Later, his son introduced the production of sulphuric acid, hydrochloric acid then nitric acid. In 1835 the importance of chemical production had by far exceeded that of salt which had become subsidiary.

From 1855 the Société des Mines et Salines de Rosières et Varangéville, which was conducting a boring by injection of fresh water, came to an agreement with the Compagnie de Saint-Gobain for a yearly supply of 60 to 90 thousand quintals of rocksalt to the plant. They had to bore a well, open a mine and to start a loan in order to raise the Company's capital to 1,000,000 francs, including 300,000 F brought by Saint-Gobain. Thanks to the Leblanc process the growth of rocksalt extraction went on: from 70,000 t in 1878 to 147,000 t in 1908. However the Belgian plant, MM. Solvay et Compagnie settled in Dombasle after the war to make chemical products from the brine and not from rocksalt, according to a process worked out by their company founders. They decided to pump up the brine themselves and obtained concessions. They delivered refined salt at reduced prices but only to the traders who bought their soda. Soda was the only production able to bring in high profits. Thus the Solvay firm with the definite advance bestowed by their new process, saw their production growing from 5,000 to 316,000 t in 1913. In 1884 the Dombasle plant set up in 1873 was employing 784 workers (Roth, 1976).

Growth of production and trade

The British Isles had started exporting salt very early. Scottish salt was arriving in Breme (Germany) as early as 1587. From 1634 to 1675 (the years 1662 and 1672 are missing) 9,825 last of salt were imported, i.e. a yearly average of 491 last. The expansion of the salt industry in Cheshire was going to upset the market. In Breme the importation of Cheshire salt is supposed to have started in the Autumn of 1754. The Breme imports would have then risen to 16,000 last from 1770 to 1800 (Schwebel, 1988). Liverpool (Table 7) exported more and more salt (Iredale, 1967).

In 1868 the production of salt in Lorraine was only reaching 64,000 t, then in 1874, in Lorraine deprived of the Valley of Seille deposit, 100,000 t and in 1913, 180,000 t. From 1870 to 1914 the production of refined salt trebled but there were four times as many companies so that the markets available for the most recent companies were more and more restricted whereas the oldest ones had their domination called into question again. The Lorrains contacted other

TABLE 7

Salt export from Liverpool

1732	15,000 t
1800	150,000 t
1840	400,000 t

producers, the Comptoir des Sels de l'Est set up the Société Anonyme des Salines de Bayonne. But the most momentous event occurred unquestionably in 1912 when the Société de Tonnoy gave up its production and surrendered its plant to a southern company, La Compagnie des Salines et Pêcheries d'Hyères (Bonnefont, 1981). Thus a salt plant from the South was setting to work in Lorraine even before the First World War.

In the annexed Lorraine, Dieuze, Vic and Moyenvic were still part of the Société des Anciennes Salines Domaniales de l'Est which was also exploiting the Franche Comté saltplants. It was the inheritance of the Spanish buyers from 1842–43. The German part of Lorraine was producing 75,000 t of salt, that is to say 11.4% of a German production which from now on reached 673,000 t.

In a half century salt had become an abundant and cheap product but the capacity to produce was superior to the outlets. The saturation of the market was leading to a disastrous fall in prices. The commercial struggle between saltplants was making the fall still worse. However, from 1863 a syndicate had united all the Lorraine saltplants as an attempt to organize competition. The members accepted to limit their production and to sell it through a common establishment solely qualified to fix prices. But the price policy followed by Solvay had rapidly unsettled the function of the new syndicate.

SOCIAL TRANSFORMATIONS AND MODERNIZATION OF SALTPLANTS

Social changes

In 18th-century Westphalia, the modernization of the salt industry had followed a definitely antifeudal trend: e.g. to carry out a supply contract for the countries north of the Ruhr, they searched for new brines, but the market promoter left aside Sassendorf where old and powerful saltplant families held hereditary rights, and he directed his search towards Unna and Königsborn — two properties of the King of Prussia who, in 1774, took the saltplant under his own control.

The workers' situation also changed. In England the old saltplants using seasonal workers were superseded by big iron pans 20 ft^2 or more and 5 or

6 ft high. There, equipment was set up in wooden buildings which were also used for coal storage and workers' housings. For instance, in the Shields saltplants, a trader was employing over 1,000 workers in 1655 (Didsbury, 1977).

The railway revolution and the complete realization of French railways struck the west coast still harder: in 1866 the Normandy ports which seemed set to remain the best Atlantic salt markets, were being supplied by salt from the east. The first consequence was a slump in sales for the West salt and a collapse of their prices (Table 8). The crisis brought a depreciation in land value which was still harder for salt ponds as a whole. Nobody among the social categories who had long been involved in salt production, transport and trade was spared. In 1860 the railway line from Lyon to Moulins was opened in Bourbonnais. The West salts stopped their sales in the central regions where the new line was operating (Hocquet, 1991). The number of watermen on the river Loire fell drastically. The developing capitalism meant the end of a number of trades, salt-men, carriers, barge builders, watermen and the beginning of new — railway builders and railwaymen.

However, despite modernization, some obsolescent features were kept. Around 1850 the greater part of the works in Lorraine were old and shabby, the saltplants were working with 13 people in Moyenvic, 12 in Saleaux and only 6 in Vic. Many salt workers were still countrymen who owned their housed and fields and left the mines and plants in summer to take care of agriculture. Yet this half-peasant workforce was better paid than the others in the same department. In the small plants of the Seille Valley annexed in 1871 to the German Reich, since the saltplants which were mono-industries had an exclusive right on paid workers, the salaries of the 1,500 salt workers in 1913 were maintained lower than in mines, steel mills, the building trade or public works of the Metz region. In Dieuze the French managers who had stayed there had found it advantageous to take on unskilled peasants, easy to dismiss in case of crisis, living in nearby villages, working by the day in the fields or hired as hands in the plants (Roth, 1981; Voillard, 1981).

TABLE 8

Prices for a ton of Atlantic salt

1854 to 1863	15 F
1864	8.75 F
1866	7.50 F

Modernization of architecture

The constant technological changes in salt production soon brought about problems of inadequate and decaying industrial buildings as well as a devaluation of capital. For instance around 1740 in Salins, reports from the inspectors sent by the General Taxfarmers (Fermiers Généraux) insisted on the following points: the very large building was lacking open space, the woodpiles covered all the courtyard, the supplies of hay for the horses which worked the pumping machine to get brine were a permanent danger of fire. The saltplant was hemmed in by the torrent and the High Street, there couldn't be any extension, the traffic was blocked in the obstructed courtyard.

The new techniques first made possible the transfer of saltplants, no longer restricted to the proximity of brines. A system of pipes allowed the transport of brines and the Arc-et-Senans saltplant moved near the firewood supplies of the Chaux forest, on a vast expanse of flat land where it was easy to build.

In 1760, the Montmorot buildings were laid out according to geometrical design in large blocks around a courtyard used for piling wood. In order to make the loading and unloading of supplies easier, all the pans were set inside one building only. In 1774 the Architect Ledoux adopted the same principles: he distributed all the subsidiary works in a semi-circle and placed all the furnaces and pans along the diameter. The industrial buildings were low, without foundations and looked like sheds with strong frames. In each hall there were several furnaces under a huge framework, the axis of which was perpendicular to that of the furnaces. The only high building which was set aside on the river was the graduation house operated by enormous waterwheels. However, graduation fell out of use in its turn, as between 1823 and 1846, thanks to technical progress concerning borings, the use of salt springs was replaced by a more modern way of pumping the saturated brine produced by the dissolving of deep layers of salt. The boring wells hidden under their high wooden towers took the place of graduation buildings.

As the productivity of saltplants rose, the number of pans was no longer sufficient. New saltplants were settled close to the railways, five in all in Franche Comté after the 1871 War. Once more the ease of transport was proved to be the prominent fact for the location of saltplants, which became more and more independent of borings. On the new sites the laying-out of buildings was changed again. Compact buildings where the courtyard had now become useless were distributed along the railway line. The furnace sheds stretched in parallel, each furnace was covered with a two-sloped roof with its axis along that of the pan (Brelot, 1986).

The last change was linked to the appearance of the vacuum pan with triple effect and of the Prache and Bouillon engine which had two very high cylinders (14.50 m high). Whereas the old pan-house had been long and low, new high buildings now had to be made.

CONCLUSIONS

The salt industry underwent a rapid capitalist transformation in England, France and Germany during the eighteenth and nineteenth centuries. This process took the form of using new sources of energy, of discovering rock salt deposits, of deep drilling brine. It was encouraged by the building of new transport networks, by the fiscal policies and the contribution of State, and by the development of the chemical industry. The industrial revolution produced some great results in the field of the salt economy: France lost its former first place and the industrial salt of Northern Europe won the agricultural salt markets. In other words, the land boiling salt captured the old position of the sea solar salt.

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