

Salt in Europe: Historical Aspects and Economic Outlook

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INTRODUCTION

It is presumably easier to catch a black cat in a dark room, when the cat is somewhere else, than to embark on a survey like this. The task challenges the ingenuity of the person who has undertaken it; it is a race against time. To tell but a part of it would take a true historian several sabbatical years to research. Human origins seem to indicate that normal food was for a long time unsalted food, so there is no point in discussing the diet prevailing in hunter-gatherer societies or the changes which have occurred as those societies became more sedentary and civilised. The growth of the population at large has emphasized the need for food to be preserved by salting, apart from the use of salt as food seasoning. This could explain a growing interest for salt in these societies. The technology relating to rock salt mining and to salt brines and sea water evaporation goes back about 4000 years. In Europe, as in Asia (they both constitute the same mainland), salt has been obtained in various places from rock, sand, earth, sea, lakes, and springs, and, for a long time, man has devoted himself to the search for salt.

HISTORICAL ASPECTS

For an historian to do justice to this whole topic would require a complete book. Fortunately such a review exists. It is Multhauf's *Neptunes's Gift* (1978) which remains the latest major reference. Historical research over the past twenty years has produced such a wealth of new information as to merit a revision: will this happen? Wait and see. As far as we are concerned today, we must limit ourselves to three topics only — indeed it is doubtful whether anyone will again be able to cover the whole field in a single paper. These elected topics are:

- scarcity or plenty? the image of salt in Greek and Latin Antiquity,
- salt, its production and consumption according to various European travellers,
- table manners relating to salt; standing salts and salt cellars.

Scarcity or plenty?

There are many fields in which scholars have an excellent understanding, but I would take issue with them when they say that salt was a scarce commodity in Ancient Greece and Rome. Various documents make it evident that salt is a plain and plentiful substance and that everybody can get it. This is borne out by various quotations. Plato speaks ironically of a scientist who had devoted himself to a surprising panegyric of salt based on its utility (*Symposium*, 177) This scientist is supposed to have been Polycrates who vindicated jars, mice, and stones. Isocrates pokes fun at "orators praising house-fly, salt and such topics with forensic oratory" (*Elenes Egromion*). Salt, a trifle? Not at all, say the cons. Homer qualifies this substance as divine (*Iliad*, IX, 185-221). This objection is not valid. The poet extends this character to salt when Achilles sprinkles broiled meat. It is only a figure of speech. Moreover, in another passage, Homer evokes "people who have never seen the sea and do not use salt in their diet" (*Odysseus*, XI, 122-123). This is synonymous with a bogus country. When describing Attica in the beginning of the 2nd century A.D., i.e. several centuries later, Pausanias, the traveller, puts forward this country to be Epirus (*Periegesis*, I, XII, 5). It is presumably malice on his part. A number of sites where salt is mined or evaporated have been recorded by writers like Pliny the Older or Strabo who never expressed their views on the political importance of salt.

Salt plays an active role in daily life, more especially as a foodstuff or preservative but, in no case, is its significance more than that. This bare truth is evidenced in the literature. We shall confine ourselves to quotations of Theophrastes and Horace called as witnesses for their respective social systems. The former describes life in Greek cities in so far as they are more or less similar to each other. There is not only one viewpoint but his characters reflect, even when they are overdone for comic effect, the main features of daily life. Mankind appears hidden behind stereotypes or what it was like to be then. The shameless guy walks round the market place: "he pays a visit to inn-keepers, fishmongers and salt-provision dealers to levy outstanding interest" (*Characters*, VI). The unblushing one "cures with salt the meat which has been offered in sacrifice" (*Characters*, IX). The miser forbids his wife "to lend salt or a candle wick or cumin or oregano on the plea of economy" (*Characters*, X). This example is another illustration of the universal availability of salt at that time. The dolt "throws salt twice in the mess of pottage. He makes the lentils unedible" (*Characters*, XIV). The vile profiteer "who organises a reckoning meal asks to be reimbursed for the least he has had to pay: wood, lentils, salt, oil..." (*Characters*, XXX). The boor "stopping in the chief town asks for the price of salted fish and skins... He will bring back home salted fish from Archios" (*Characters*, IV). This merchant could have been an imaginary salt-provision dealer.

Horace's father is suspected to have been a 'salsamentarius' or a salt-provision dealer. Given that poets were traditionally of low social status, this does not bother Horace. It is vital for him to keep a natural sense of proportion and not let the myth usurp the position of the serious business of life and the trivial place of salt in daily life: "cum sale panis / latrantem stomachum bene leniet" (*Satires*, II, 2). Together with bread, salt satiates a starving stomach.

Horace mentions various sauces and mixtures: "garo de succis piscis Iberi" (*Satires*, II, 8). Spanish garon made of fermented fishes.

And he adds: "hanc ego cum malis, ego faecem primus et halec, / primus et invenior piper album cum sale nigro / inretum". The first in the world, I have found out a sauce in which apples and brine are mixed up together. I too have amalgamated white pepper and black salt for meat seasoning.

The best food implies salt as a taste enhancer as in the case of a boned crane which is served together with livers of fatted geese crammed with figs: "discepta ferentes / membra gruis, sparsi sale multo" (*Satires*, II, 8).

The pungent taste of salt is applied metaphorically to a telling wit: "at nostri proavi Plautinos et numeros, et / laudavere sales" (Poet. Art) Our ancestors praised Plautus for his sallies of wit. This point is developed by Pliny the Elder in his *Natural History* (XXXI, 41): "adeoque necessarium elementum est, uti transierit intellectus ad voluptates animi quoque; a sale enim appellatur..."

And so necessary is this basic substance that its name is even applied metaphorically to intense mental pleasures; they are called "sales" (wits).

Travellers tales are not always true

Comments made by European travellers who were living throughout the period from the second part of the Middle Ages to the beginning of the 19th century pave the way to another approach of the image of salt. They merely expressed the simple truth by living close to people working, marketing and consuming salt. Far from their mother country, these travellers paid special attention to this substance which was very familiar to them, in their diet at least. This geographical approach is twofold. The first alternative consists in selecting a place where salt used to be produced over centuries and in recording all contemporary references. In this respect, it is worthwhile to refer to a lecture by Herbert Schwarzwälder who has listed more than a hundred descriptions of the Lüneburg salt works between 1437 and 1840. None of their authors was a salt man. The second approach is preferable because it is not limited to a single place or subject. The following selection is neither casual nor arbitrary. It is restricted but not to such an extent that the various quotations would fail to exemplify these specific links between salt and man. When identifying salt, even at the antipodes, their response is in accordance with what has brought its name into repute.

No mention is made, on purpose, of experts being able to describe and to analyse technological patterns, to prevent wastage or to suggest improvements. Only a few names have to be mentioned: Heinrich Schickhart, I.W. and K.C. Langsdorf, Glenk Senior and Junior, Bernard Palissy, Tomas Lowndes, etc. This will make it evident that their works and writings are not ignored.

The methodology which has been adopted regarding these selected travellers is not very complicated. A set of five tables summarizes the results of our investigation based on their writings. The European personalities involved are presented in Table 1. Their remarks are collected under four headings: salt production, trade, profit, diet and health to which correspond Tables 2 to 5.

TABLE 1
European travellers

Name	Period	Occupation	Country
Marco Polo	1271-88	Merchant	China etc.
B. de la Broquière	1455	Diplomat	Hungary
Caxton	1480	Editor	England
Pigafetta	1519-22	Knight of Malta	Around the world
Herberstein	1517-26	Diplomat	Russia
F.M. Pinto	1537-58	Merchant	China, Far East
Jean de Léry	1556-57	Minister	Brasil
Montaigne	1580-81	Writer	HRE, Italy
V. Scamozzi	1600	Architect	Lorraine
Margeret	1604-14	Musketeer	Russia
Tavernier	1632-58	Merchant	Persia
Chardin	1664-70	Merchant	Persia
Exmelin	1666-97	Surgeon	West Indies
Regnard	1681-82	Writer	Lapland
L. Lecomte	1687-92	Jesuit	China
Diderot	1773-74	Writer	The Netherlands
Vautrin	1777-82	Jesuit	Poland
Jan Potocki	1797-98	Diplomat	Caucasus
Stendhal	1810	Officer	Austria
Mollien	1817	Explorer	Senegal

TABLE 2
Salt production

Marco Polo	- Salt mining in the Talqan mountains (Afghanistan) - Salt pans in Junnan, brine producing wells in the same area - Salt pans in Kangzhu, Huaian - Sea salt
B. de la Broquière	- Salt mining in Transylvania
Caxton	- Salt springs in England
Herberstein	- Salt works near Staraja Russia - Salt pans near Pereslav, Rostov, Novgorod
F.M. Pinto	- Salt lakes in China
Jean de Léry	- Salterns in Brasil
Montaigne	- Salt works of Hall - Salt marshes of Ostia
V. Scamozzi	- Salt works of Rosières
Tavernier	- Salt mining in Persian mountains - Salt springs and salt works near Shiraz - Salt marshes near Ormuz
L. Lecomte	- Salt lakes in China - Sea salt
Diderot	- Salt refineries in Zealand
Vautrin	- Salt mining in Bochnia and Wieliczka - Salt springs in Galicia
Jan Potocki	- Saltern of Koschkotshu - Salt marshes of Kudutaskaia (Caspian Sea)
Stendhal	- Salt mine of Hallein
Mollien	- Salt marshes of Gandiolle

TABLE 3
Trade

Marco Polo	- Salt from Congzhu (Hopch) marketed in several provinces with large earnings - Idem for salt from Huaian
Herberstein	- Imports of salt in Lithuania, previously from England, now from Russia
F.M. Pinto	- Salt trade in Java (conveyed by Chinese junks) - Salt trade in Malacca (numerous junks) - Barns for fish salting and meat curing between Nankin and Beijin - Salted fish drops in value by comparison with fresh fish - The ships sailing on the Yang Tse Kiang evoke the Portugese lighters carrying just harvested salt
Tavernier	- Salted fish originating in the Gulf distributed everywhere within the Persian Kingdom - Dutch merchants use loading salt in Ormuz: they ship it from there up to Japan
Vautrin	- In the countryside, Jewish innkeepers are selling grain, cheese, salt and spirit to the consumer
Mollien	- Salt caravans in the Iolof desert - A barter agreement: Ualet salt for Fouta woven fabrics

The most important mines and salt works in activity over centuries in Europe are mentioned by our travellers:

William Caxton made his *Description of Britain* available to the British reader in 1480. Chapter 4 relates to marvels like salt springs. "There are salt

springs far from the sea which are salt all week long until noon on Saturday and fresh from then until Monday". Sunday closed. From the *Domesday Book* (which was produced between 1084 and 1086), the salt works in operation in Cheshire have been frequently described.

TABLE 4

Profits

Marco Polo	– Salt used for coinage in various provinces of China (Setshuan, Yunnan, etc.) – Salt taxation; its part in the Khan's income (the Khan has 80 tomnans a year thanks to salt over a total income amounting to 290 tomnans for 1/9 of his Empire)
Pigafetta	– A bushel of salt is sold 80 cathils in Borneo (a cathil is a silver coin equivalent to 2 pounds)
F.M. Pinto	– 1/3 of the salt manufactured near Mindo (?) returns 100,000 taels to the Emperor of China – Barter with salt can multiply the profit by 30 – Tribute in salt paid in South Asian kingdoms – Profitability of salt trade
Jean de Léry	– Capture of a Spanish caravel conveying white salt
V. Scamozzi	– The salt works of Rosières return nearly 30,000 ecus to the Duke of Lorraine; altogether, his six saltworks bring him a clear 300,000 ecus
Diderot	– Excise duties: the salt tax is mitigated and not levied by financiers in The Netherlands – part played by salted fish in Dutch foreign trade – 1½ pound of salt costs 15 liards (tax included) in the 1770s
Mollien	– The salt marshes of Gandiolle belong to the leading wife of the Cayor's King (Senegal)

The six Lotharingian salt works (Château Salins, Dieuze, Marsal, Moyenvic, Rosières and Salonne) were producing about 8000 t/year at the beginning of the 17th century (40% of the ducal earnings) whereas V. Scamozzi described the equipment of the salt works of Rosières. Here two paternosters were elevating the brine which was stockpiled in a tank (L = 40 feet, l = 20, H = 10) and from there conveyed to boilers (L = 30 feet, l = 20) made of copper. The salt works closed in 1740.

Montaigne mentioned two famous sites, Hall (Fig. 1) and Ostia. Salt manufacturing in the Hall valley was first referred to in a gift granted in 1232 by Albert of Tyrol. The saline closed in 1967. Montaigne observed several round pans, with a circumference of 30 "pas" (Hall had boiling pans exploiting concentrated brine brought from a two league distant spring) and was impressed by the huge quantities of wood used by the boilers. This is one of the main features of ancient salt works. Montaigne pointed out that the weekly production amounted to about 900 cakes of a half-muid each (Fig. 2). The conversion into metric tons is difficult. In the 16th century salt production in Hall reached nearly 12,000 t/year "which provides all Germany". Later on, travelling in

TABLE 5

Diet and health

Table salt	Marco Polo, Herberstein (salt in Russian diet), Jean de Léry, Montaigne (excessive consumption in Rovigo, Italy), Margeret, Tavernier, Regnard, Diderot, Vautrin, Mollien
No salt	Marco Polo (brakish water makes bread unpalatable), Herberstein (reluctance of Tatars to use edible salt), Chardin (the Persians do not use table salt), Regnard (in general the Lapps do not eat salt)
Meat curing	Marco Polo, Pigafetta (meat is getting putrid for lack of salt on board), Herberstein, Jean de Léry, Margeret, Tavernier (Persia), Diderot (Holland)
Fish salting	Marco Polo, F.M. Pinto, Herberstein, Margeret, Exmelin, Regnard, Diderot
Specialities	Marco Polo (raw liver served with salt and garlic (Yunnan), Jean de Léry (albacore barbecued with salt, salted whale's tongue), Montaigne (spiced and salted bread), Margeret, Vautrin, Mollien (couscous)
Seasoning	Marco Polo, Jean de Léry
Preservative	Montaigne (vegetable), Exmelin, Vautrin
Substitutes	Marco Polo (brine), Jean de Léry (buccaneering)
Cattle feeding	Tavernier, Mollien
Rituals	Margeret (salt and bread), Montaigne (salt cellars and standing salt), F.M. Pinto, Regnard (vindication of a kitchen-maid who has used too much salt in cooking during her lifetime...)
Bath	Marco Polo, F.M. Pinto, Montaigne

Italy, Montaigne saw the salt gardens located close to Ostia. The sea entered marshes and filled ponds served by channels. Their salt production was marketed in the Pope's States. These salt gardens have been mentioned several times by Greek and Latin writers. Titus Livius stated that Ostia had been founded at the estuary of the Tiber River and salt gardens set up in the vicinity: "in ore Tiberis Ostia urbs condita, salinae circa factae" (*Roman History*, I, 33). Both settlements were attributed by most of them to the legendary King Ancus Marcius. This reference makes clear how old they were. The so-called "Via Salaria" was used at that time to carry salt eastward and supply the Sabins with it. The primitive sea salt-making processes constitute a bone of contention but, in this particular case, the part played by man in managing sea water cannot be refused, the evidence being a network of channels (fossae) the early existence of which has been duly attested (see J. Carcopino, *Virgile et les origines d'Ostie*, 1968). The production was interrupted there in 1873.

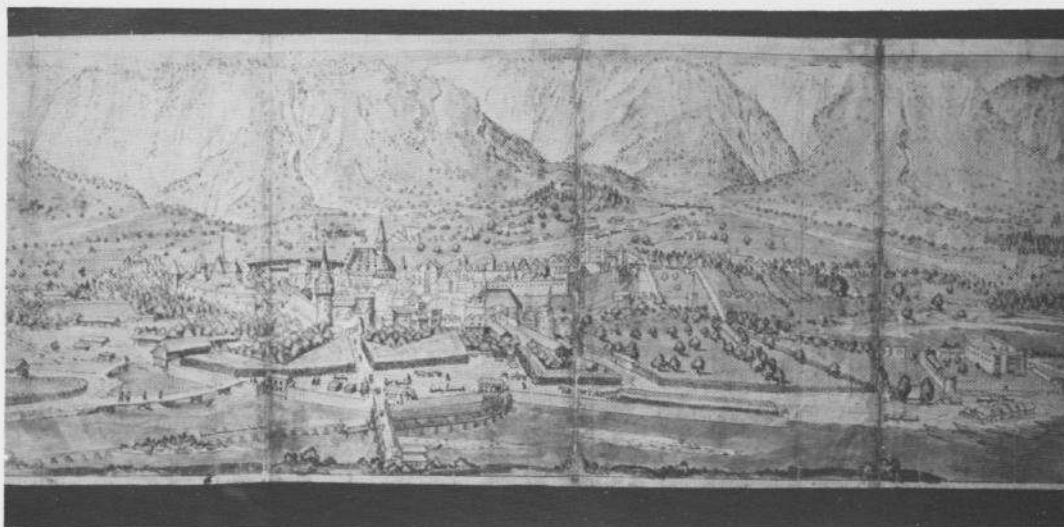


Fig. 1. Hall in Tyrol. Schwazer Bergbuch, Kodex Dip. 856.

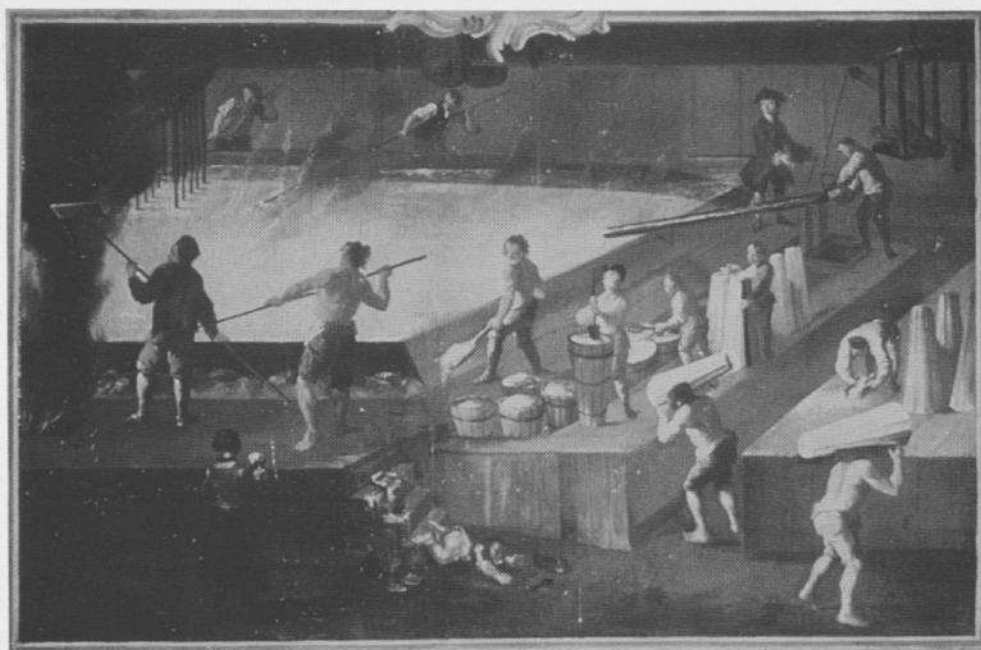


Fig. 2. Salt cakes manufacture in the XVIIIth century. Keltenmuseum, Hallein.

Salt boiling and salt mining seem to have been used in the early times too, where solar evaporation was poor or when the Mediterranean shores were very distant. Salt springs and salt rivers gave birth in France, Germany and Poland to 'briquetage' activities while in Spain and Austria the Celts were mining salt. Hallstatt is well-known as eponym of a period of their history. Salt at Hallein and Hallstatt had originally been mined. When Beyle alias Stendhal (Fig. 3) visited the former in 1810, he was impressed by crystallization (when a small branch is

dipped in brine, salt crystallizes on it) and by the "Rutsche" (Fig. 4) used by the workers and the visitors to descend into the mine.

More impressive were the mines of Wieliczka and Bochnia (both a few kilometres from Cracow). When H. Vautrin visited them during his stay in Poland (1777-82), he described the layers and the depth of the working level (800 feet); he observed the chapels where the altar, pillars and statues were all made of salt. He also indicated that the production was averaging 12,000 t/year. (In the beginning of the 17th



Fig. 3. Register with the mention of "Henri de Beyle". Gästebuch der erzbischöflichen Salzbergbaues Dürrnberg bei Hallein. ÖSAG.

century the production had risen to 24,000 t in Wieliczka and 8,000 t in Bochnia). He also reported that Wieliczka had been devastated by fire in 1648 and that the fire had burned for over two years. This salt mine became so famous that, at the end of the 18th century, its visit was recommended to all travellers. In his guide-book (1793), Hans Ottokar Reichard talked about the descent thanks to the slings tied to a long rope used to draw out the salt. Vautrin, like Montaigne, paid some attention to the Polish wood consumption which was very high due to salt making and large exports. He also referred to salt springs existing in Galicia. In this area, the salterns of Halicz had been seized by Casimir the Great.

Russia was also famous for its salt resources, one of the most important being a salt river at Staraja Russia. People used to boil its water for centuries. These salt works were mentioned by Herberstein, and other salt rivers and lakes as well. Salt boiling contributed to the fortune of families and cities. Herberstein observed judiciously that the saline was constituting a separate town, even built up close to the town on which it depended. His remark relating to Novgorod is valid for many other places, like Lüneburg. Staying there in July 1561, Giovanni Commendone was impressed by a wall made of stones, isolating the salt facilities from the other districts of the town. Various hazards were to be avoided, more especially fire and robbery.

Even when they are impressed by the basic features relating to the production and the distribution of salt, most of the travellers make superficial comments. Technological improvements or self-sufficiency in salt are far from their preoccupations. The same situation prevails regarding salt marketing and the profitability of transactions either for the merchant or for the king (through taxation). A few exceptions are nevertheless noticeable as far as trade and profit are concerned.

Marco Polo, the Venetian adventurer of the 18th century, has left us an interesting account of his experiences. In certain parts of the Chinese empire, he discovered that salt coinage was in general use. "Their gold is formed into small rods and passes according to its weight without being stamped. The smaller currency they make use of is thus prepared. In this country there are salt springs from which they manufacture salt by boiling it in pans. Salt is formed into cakes of the weight of half a pound. Eighty of these cakes are needed to pass for a 'saggio' (Venetian coinage)".

Marco Polo also emphasized the importance of salt taxation in the grand Khan's empire. The grand Khan has 80 tomans a year thanks to salt manufacture over a total income amounting to 290 tomans for 1/9 of his empire. Marco Polo reminded his reader that he had been entrusted several times by the grand Khan to survey the fiscal management of



Fig. 4. The "Rutsche". Keltenmuseum, Hallein.

salt. Its consumption was directly related to population and offered an appropriate base for taxation. The Authorities, and the merchants, were in a position to make considerable profit because people used to regard salt as necessary. Besides his own experiences in China, Marco Polo, as a Venetian merchant, had some knowledge of the salt politics which emerged when Venice began to negotiate agreements and to supply the various Italian cities with it. See *Le sel et la fortune de Venise* by Jean-Claude Hocquet. Interesting too with regard to the control of salt production is a remark made by V. Scamozzi touring in Lorraine. In 1600, the salt works of Rosières returned nearly 30,000 ecus to the Duke. All together the six salines operating in his state brought him a clear 300,000 ecus. At that time salt earnings amounted to approximately 40 per cent of his income.

Staying in The Netherlands, Diderot observed that the salt tax was proportionate to the value of this commodity and, above all, this tax was not

levied by financiers. Comments on the French "gabelle" would need too much time. But let us say this tax has been called the most hated of all taxes and a major cause of various riots. In his *Rules for the Reduction of a Great Empire*, 1773, Benjamin Franklin did not hesitate to tease its collection system. "In laying these taxes, never regard the heavy burthens those remote people already undergo... Forget the restraints you lay on their trade for your own benefit and the advantage a monopoly of this trade gives your exacting merchants... To make your taxes more odious, and more likely to procure resistance, send from the capital a board of officers to superintend the collection, composed of the most indiscreet, ill-bred and insolent you can find." This satire of the French system is self-explanatory.

Free trade has various advantages. Tavernier praised the Dutch merchants who used to load white salt in Ormuz and to carry it from there up to Japan. And Mollien mentioned the salt caravan he met in the Iolof desert. The largest number of remarks inspired by the travels and peregrinations throughout the world relates to salt in the diet indeed. Most of our witnesses have mentioned it as cooking salt or as preservative for fish salting and meat curing. Salt is indispensable for human beings and for cattle too. This was stated by Pliny the Older: "pecudes armentaque et jumenta sale maxime sollicitantur ad patus". Sheep, cattle and draught animals are encouraged to pasture in particular by salt. And he concluded: *vita humanior sine sale non quit degi*". A civilized life is impossible without salt (see *Natural History*, XXXI, 88).

In comparison with its usage in human and animal diet, all other outlets were casual and negligible until the birth of modern chemistry. When the chemists, among others Nicolas Leblanc, took notice of salt as a raw material in the second part of the 18th century (see *Le sel et la naissance de l'industrie chimique* by Gerard Emptoz), they gave an incredible momentum to its consumption. The problem of acquiring scarce salt for culinary requirements was rapidly surpassed. Plenty of salt was available everywhere and facilitated the adaptation of the supply to increasing demand. The growth of the salt district of Cheshire "from a pastoral region" to its present importance was stimulated by chemical industries. The need to have a supply of this substance "convenient of access and moderate in price" resulted in the removal of the duty from salt in 1825 and improved means of communication led to a further large increase of salt sales in the UK. The influence of the strides made in alkali manufacture is evident in salt figures.

Salt, table manners and salt cellars

Considering the attitude of Brazilian "savages" when they are eating and more especially how they use salt, Jean de Lery observes that "they do not salt the meat or the fish or other food before raising it to their mouth as we do. They take each piece separately and accompany the corresponding mouthful by dipping two of their fingers into the "jonquet" (a mixture of salt and pepper) which they use as seasoning." Although De Lery lives far from his mother country, he remains attached to the French uses and manners, in particular with regard to food salting. For centuries salting has been subjected to precise rules which cannot be transgressed in European civilisation. Their violation is possible only to an ill-bred man. To be well brought up means, among other manners, that it is forbidden to dip either the fingers or the food into salt.

How to behave well is enacted since the Middle Ages in courtesy books such as the *Book of Curtesye* issued by Caxton in the 15th century (Early English Text Society, London 1868). The standards have sometimes evolved. General considerations on this large topic are not advisable in this lecture. People who are interested in this matter will refer to *Über den Prozess der Zivilisation* by Norbert Elias. In the case of salt, manners have remained unchanged from that time. Various examples are to be quoted from such books. *Die Hofzucht* given by Tannhäuser in the 15th century is a famous poem on manners in which a stanza is devoted to salt and salting: "Who is fond of mustard and salt / Has to avoid carefully / To get soiled for his fingers into them / His reputation will sully."

In the *Babees Book* edited by Furnivall (Early English Text Society, London 1868) the same instruction is given to young people: "Enfant, garde qu'en la salière / Tu ne mettes point tes morceaux / Pour les saler, ou tu deffaulx, / Car c'est deshonneste manière."

A similar approach is recommended by Erasmus in his well-known treatise *De civilitate morum puerilium*, 1530: "Three fingers stamped in salt constitute, as people say, the canting arms of the villein. One must pick up salt with the sharp end of his knife. Who is sitting too far from the cellar has to ask for salt in holding out his plate." Or by C. Calviac in his *Civilité*, 1560: "Quant l'enfant voudra du sel, il en prendra avec la pointe de son cousteau et non point avec les trois doigts."

Last but not least, Jean Baptiste de la Salle insists on his directions to Christian pupils neither to dip their fingers into the sauce or salt nor to lick them before or after this reprehensible use. It is interesting to observe that la Salle was not a tutor in charge

of the children of the aristocracy; he was addressing lower classes. Everybody can better his social status by getting a good education. Courtesy makes more sense than money as far as gentlemen are concerned. *Les règles de la bienséance et de la civilité chrétienne* by la Salle has encountered great success over the decades. In the 1774 edition, the instruction regarding salt is simple: "On ne doit jamais prendre du sel avec les doigts". Never use fingers for salt.

This question would be highlighted from the standpoint of a behaviourist. There is not too much time left for psychological care of the child (habit formation). But a certain form of conditioning needs few comments. Instead of instilling manners in a positive way, some German teachers of the 16th century chose rules absolutely contradictory to a good education. This refers to the so-called "grob-anische Umkehrung" which is based on *Grobianus* by Kaspar Scheidt (Worms, 1551). The instruction becomes: dip in salt with full fingers. Such a satirical mood has been adopted by Jonathan Swift in a late pamphlet which was published after his death in 1745. Entitled *Directions to Servants*, this book sums up all the deeds of the "Servantry", speculating upon the curiosity of one who is not yet in a position to get servants and upon the mischievousness of one who is still attending some gentleman. The part played by salt in households is also attested here by several reverted rules:

- A servant relates all that happens to his master. Could it be the cook? Throw a handful of salt or soot in her pot...

- Do not spoil the salt which has been spread on the table. Recover it when you take up the table-cloth and throw it off in the salt-cellar...

- When filling the cellar, ram down the salt with your wet palm...

- When serving broth or groats, do not forget to put salt with your fingers on the edge of the plate. The use of a spoon or a knife is hazardous. Falling salt is a bad omen. Above all, do not neglect to suck your fingers before handling salt...

Talking about salt in the diet inevitably introduces the subject of salt-cellars or ceremonial salts standing on the table of well bred and well born people. The pre-eminence of salt as food and as symbol, when laying the table, is enlightened by the various masterpieces among which the ceremonial salt produced by Benvenuto Cellini (Fig. 5). In March 1540, Benvenuto Cellini was working in Rome, pensioned by Cardinal Hippolyte d'Este who asked him for an outstanding salt. Details about the carrying out of this project are known thanks to this very goldsmith who wrote a kind of diary. The project was initially discussed with Luigi Alamanni and Ga-

brielle da Cesano. The former suggested to represent Venus and Cupido, the latter Amphitrite surrounded with Tritons. The artist decided in favour of two figures personifying on the one hand the Ocean, on the other hand the Earth, both sitting with their legs intertwined. The Ocean, represented by a man, held a ship designed to keep a large quantity of salt. The feminine figure, in its prime, rested its hand on a temple where pepper should be put. The draft was moulded with wax and shown to the Cardinal of Ferrare.

Later on, Benvenuto Cellini was introduced to King François I. When the French king lodged his request to get a magnificent standing salt, the goldsmith showed him the above-mentioned moulded figures. The king was enthusiastic and immediately instructed his officers to supply Benvenuto with a large quantity of gold: a thousand ecus of standard weight. Then Benvenuto undertook his work with his assistants. The goldsmith's work as a whole was erected from an oval shape, some parts being enamelled. Both figures were represented naked. Between them, a nice ship designed to carry salt, "une nef d'un travail exquis pour le sel". François I was very admiring when he saw the masterpiece. Surprisingly, he ordered Benvenuto to take it back home for the time being. The artist invited a bunch of friends for a party. During the lunch, this ceremonial salt was standing on the table. A merry

lunch, indeed.

In 1570, King Charles IX offered this chef d'oeuvre to Archduke Ferdinand. The latter made no bones about accepting. Salt keeps friendship alive.

Now we have to come back to Horace: modo, sit mihi mensa tripes et concha salis puri. Provided that I get a shell full of pure salt... (*Satires*, I, 3); cui paternum / splendet in mensa tenni salinum. When the inherited salt cellar shines on the table... (*Odes*, II, XVI: ad Grosphum).

Roman salt cellars of cylindrical shape with three claw-feet belong to the Musée du Louvre. With the Romans as with the English and French landlords of the Middle Ages, the salt cellar was a handsome piece of silver. This example was imitated by the merchants and sailors of the 16th century. Only the poorest people were doomed to eat their salt out of a shell (*concha*). Such a silver salt cellar was handed down from generation to generation as mentioned by Horace (*paternum salinum*). Besides, a well-made piece of silver stood up to many decades of use.

A salt cellar formed an ornament and, duly gilded, the ceremonial salt appeared as the supreme chic of a fashionable table. Silver was *de rigueur* at the dinner. More recently, small so-called "trencher salts", placed beside each plate, were circular, octagonal or hexagonal in outline. The Worshipful Company of Goldsmiths, London, offers magnificent examples of such masterpieces although they cannot



Fig. 5. Ceremonial salt by Benvenuto Cellini. Kunsthistorisches Museum, Vienna.



Fig. 6. Standing salt, 1542. The Worshipful Company of Goldsmiths, London.

compete with that of Benvenuto Cellini, from long ago in Vienna:

Standing salt, 1542 (Fig. 6).

The shallow receptacle of the salt is enclosed within a cup-like section reminiscent of late medieval hour-glass salts.

The Gibbon salt, 1576 (Fig. 7).

Four ionic columns enclose a central cylinder of rock crystal in which is mounted a figure of Neptune supporting the cellar.

Ceremonial salt, 1601 (Fig. 8).

This drum-salt also makes use of a rock crystal. When Queen Elizabeth died in 1603, the age of ceremonial silver was far from extinct.

Ceremonial salt, 1662 (Fig. 9).

Samuel Pepys was shown the splendid spoon-

shaped salt to be given to Queen Catherine of Braganza. In his diary, he mentioned that this was a silver salt the central part of which was of rock crystal. While the stepped base stood on lions couchant. Four great eagles with wings displayed and four small hounds seated on orbs decorated the flat top with the well for the salt. When the Queen returned to Portugal in 1692, she sold the salt.

Sugar casters and salts (rather than salt cellars) are sometimes confused. It is a mistake. In recent auctions, silver salts have been offered to connoisseurs at fairly high prices. A silver salt made in 1710 by Philippe Jacques Langlois (Paris) was set up for sale in December 1990. Its price was estimated at around \$ 100,000. Another one, attributed to Jean Allier (Nimes), a silversmith working before 1674, was auctioned at a higher price. A number of ewers, plates, salts and other silver pieces were melted down, as ordered by King Louis XIV, to subsidize his armies.



Fig. 7. The Gibbon salt, 1576. The Worshipful Company of Goldsmiths, London.



Fig. 8. Ceremonial salt, 1601. The Worshipful Company of Goldsmiths, London.

In the olden days people used to say that in order to know somebody well, one had to eat a bushel of salt in his company. This means that, besides gilded and silver salts, pewter (Figs. 10 and 11) and ceramics (Figs. 12 and 13) have played their part in households as standing salts and cellars. And wood boxes too, in the kitchen...; but I must not go on. Overturned salt-cellars bring bad luck. When that happens, we should throw a pinch of salt over the left shoulder into the eyes of the devil. This is just what we should do before starting the second part of this paper for, within the framework of the coming economic outlook, the data about salt looks like spilled salt and the devil holds the figures.



Fig. 9. (Top right). Ceremonial salt, 1662. The Worshipful Company of Goldsmiths, London.

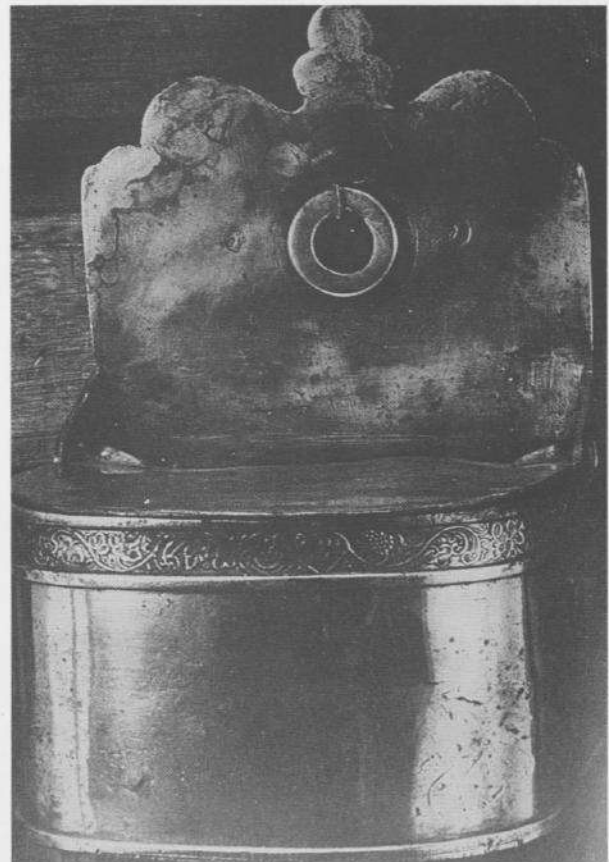


Fig. 10. (Bottom right). Salt box (pewter). Private collection



Fig. 11. Salt box (pewter). Musée de Cluny, Paris.



Fig. 12. Double salt (Frankental), 1762–75. Collection CSME.

ECONOMIC OUTLOOK

Owing to the flat state of the market, the second part of this paper will focus on salt business and factors affecting sales. Issues of concern will be highlighted in addition to statistical comments. In 1990, Community production of crystallized salt was about 20 Mt. Sales amounted to less than 18 Mt. The corresponding figures for Western Europe reached 21.3 Mt (production) and 18.8 Mt (consumption) respectively. Over-capacity remains one of the main features of the salt industry together with a demand fluctuating with economic and climatic conditions.

Between 170 and 190 Mt of salt (including salt in brine) are produced in the world each year. World resources of salt are virtually unlimited. The oceans comprise an inexhaustible supply of salt and so do the deposits of rock salt, which correspond to geological seas. Nearly every country in the world has salt deposits (rock salt, vacuum salt) or solar salt evaporation facilities of various sizes. A well-known exception in Europe is the Nordic countries.

World salt capacity is estimated to represent 251



Fig. 13. Standing salt, XIXth century. Collection CSME.

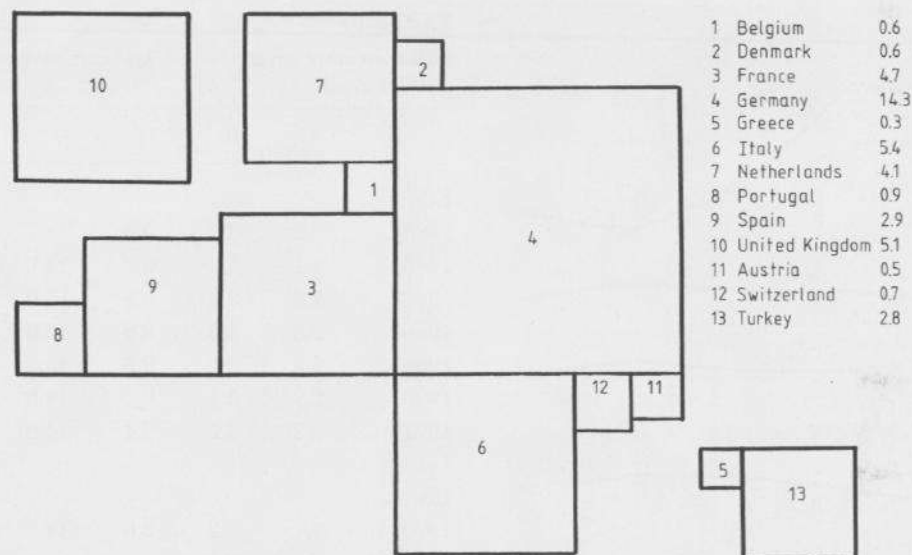


Fig. 14. Current production capacity in western Europe.

Mt (including salt in brine) according to the US Bureau of Mines. From a geographical point of view, this amount can be broken down as follows:

North America	25.8%
Latin America	10.0%
Europe	38.2%
Africa	2.2%
Asia	20.5%
Oceania	3.3%
Total	100 = 251 Mt

Production

As far as Western Europe is concerned, an anamorphosis is showing current production capacity (excluding salt in brine) (see Fig. 14). Crystallized salt production in the EC averaged 22.2 Mt over the recent six year period. Detailed figures are included in Table 6. The downward trend prevailing for this period results from the influence of climatic condi-

TABLE 6

Crystallized salt production in the EC (in 1000 tons)

	Rock salt	Solar salt	Vacuum salt	Total
1985	12,049	3,697	8,814	24,560
1986	11,806	3,728	8,284	23,818
1987	11,176	3,725	8,332	23,233
1988	8,456	4,068	8,869	21,393
1989	7,707	3,714	8,721	20,142
1990	7,851	3,300	8,722	19,873
Capacity used	49%	76%	74%	60%

Source: ECSS

tions on demand for sea salt and rock salt. Production of salt from solar evaporation is dependent on favourable weather (sunshine and wind). Production of rock salt is widely affected by winter — which can be severe or mild — because this type of salt is mainly used as road salt (except in Germany). The de-icing market is a constant source of concern to salt manufacturers because demand fluctuates widely with the weather. In so far as we can assume that the sales of road salt average 4.9 Mt per campaign, we can make it evident through the recent variations how different the requirements are:

1985-86	133	1988-89	49
1986-87	138	1989-90	36
1987-88	83	1990-91	88
4.9 Mt = 100			

Such ups and downs in demand have an important impact on salt mining and affect salt sales as a whole (de-icing activities have a relative impact on food grade salt as regards domestic winter service).

Consumption

Taking into account the principal sectors for crystallized salt, the break-down in percentage terms of quantities marketed in 1990 in Western Europe can be shown as follows:

Food grade salt	14.3%
Miscellaneous industries	18.9%
Chemical industry	54.1%
Subtotal	87.3%
Road salt	12.7%

Recent data on salt sales (including imports)

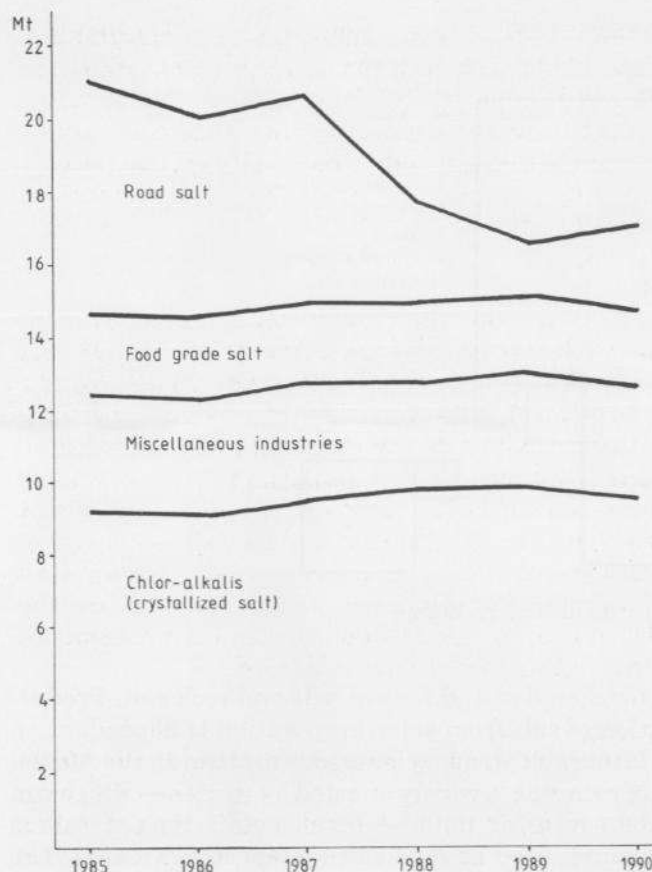


Fig. 15. Salt consumption in the EC.

within the Community are given in Table 7 and illustrated in Fig. 15.

Food grade salt

In Western Europe sales of food grade salt amounted to 2,710 kt in 1990. It is worthwhile remarking that sometimes fairly high tonnages of salt are used in other sectors than that of human consumption strictly speaking, even if they are recorded under this heading. Sales of food grade salt do not correspond to 'dietary use' of this type of salt and even less do they mean 'intake'. Calculations on a per capita basis from one of the EC Member States illustrate this remark well:

Sales of food grade salt	19–20 g/day
Dietary use of this type of salt	13–14 g/day
Dietary salt intake	7–8 g/day

Reliable experts are almost unanimous in admitting that in most European countries, the average salt intake amounts to 8 g/day per capita. The INTERSALT study makes this point clear (see Table 8). This average corresponds to an optimum rate

TABLE 7

Salt consumption in the EC and comparison with the US (in million tons)

	A	B	C	D	E	F
EC						
1985	2.2	3.2	9.3	14.7	6.4	21.1
1986	2.2	3.2	9.2	14.6	5.6	20.2
1987	2.2	3.3	9.5	15.0	5.8	20.8
1988	2.2	3.0	9.8	15.0	2.8	17.8
1989	2.2	3.1	9.9	15.2	1.4	16.6
1990	2.2	3.1	9.5	14.8	2.2	17.0
1991 ¹	2.2	3.2	9.4	14.8	5.0	19.8
US						
1990 ²	1.1	9.2	3.8	14.1	10.5	24.6

A, food grade salt; B, miscellaneous industries; C, chemical industry; D, subtotal (A+B+C); E, road salt; F, total (D+E)

¹Estimate; ²About 80 % of US salt consumption for chloralkalis relates to salt in brine

Source: ECSS and SI

which was even put forward by WHO. Nevertheless the 'non salt' supporters continue to request a decrease in this quantity either by trying to discourage people from using discretionary salt, or by advising the food industry to decrease the salt content of various foodstuffs.

Food industries are doing well but households are curtailing their requirements in cooking salt. A recent EC Directive relating to nutrition labelling could pave the way to a further shrinkage of the demand.

Miscellaneous industries

In this sector, which includes agriculture, water softening and other outlets, sales amounted to 3,557 kt in 1990. Water softening is said to be buoyant again, in spite of a variety of attitudes and techniques regarding water hardness. In most of the EC countries water is of good quality except for its hardness. And hard water means scaling, increases in energy consumption and in the utilization of washing agents. Salt is not used as a water softener but as a regenerating agent for the ion exchange resins used in small scale softening (unlike central softening). Growth in demand in this sector depends on the objective information given to the households and the improvement of the living standards. The development of technologies which compete with ion exchange-based equipment is weakening its marketing's position and curtailing sales of special salts.

TABLE 8
Dietary salt intake (g/day per capita)

	Median value*	Mean value*	SD*
Belgium			
Charleroi	7.8	8.3	3.2
Ghent	8.4	8.7	3.2
Denmark	8.0	8.2	3.0
Germany			
Bernried	9.5	9.8	3.5
Heidelberg	10.0	10.1	3.5
Italy			
Bassiano	10.3	10.9	3.7
Gubbio	10.0	10.3	3.6
Murano	10.0	10.2	3.5
Naples	9.5	9.9	3.0
The Netherlands	8.6	8.8	3.1
Portugal	10.3	10.7	4.3
Spain			
Manresa	9.7	10.7	3.7
Torrejon	10.3	10.8	3.9
U.K.			
Belfast	8.8	8.9	3.3
Birmingham	8.8	9.0	2.7
South Wales	8.9	8.9	3.2

*Data on urinary sodium are expressed in NaCl equivalents.
Source: INTERSALT

Chemical industry

Sales of crystallized salt amounted to 10,187 Kt in 1990. By far the biggest market for salt is chloralkali manufacture by electrolysis. Three technologies are currently used (mercury-cell, diaphragm and membrane) and they may be supplied with salt in the form of brine or as crystallized salt, dissolved on site. The relative decrease affecting mercury cell technology should reactivate the demand of salt in so far as the demand is buoyant and support the substitution of the former by membrane. For the time being the situation remains unchanged as regards membrane cell technology:

Mercury cells	67%
Diaphragm	27%
Membrane	6%

The changeover to membrane technology was stimulated in Japan by regulations eliminating mercury electrolysis. In Europe this development is progressing very slowly.

After having slightly increasing during the 1987–1989 period, chlorine production is decreasing again and the big producers are expecting a new drop in

1991. Around the year 2000, the total consumption of the paper industry will only amount to about one third of the chlorine used in 1980. As far as water treatment is concerned, the drop in demand will be about the same. The PVC sector seems to be the only important outlet for chlorine for which an increase remains possible.

Road salt

This sector is the most variable as already mentioned before in this paper. Only 2,394 kt were sold in 1990. The figures available for the 1990–91 winter campaign (4,317 kt) are showing a relative increase.

The debate regarding environmental aspects is going on more objectively. Comprehensive studies have shown the excellent cost effective ratio of salt spreading and emphasized the decreased number of accidents after the roads have been duly serviced with salt. Salt producers would like to share the burden of holding stockpiles with local authorities and highway maintenance services.

Foreign trade

Intra-EC trade averaged 3.4 Mt over the 1987–1989 period. Total exports decreased from 5.4 Mt in 1987 to 4.5 Mt in 1989 (including intra-EC trade). Imports originating in third countries decreased from 0.6 Mt to 0.5 Mt.

Eastern Europe

Little data is available on salt activities in Eastern Europe. The trends affecting domestic demand are far from being like those currently prevalent in Europe and the USA. Salt fluoridation in Hungary is a very positive response to the prevention of dental decay. Production figures are given in Table 9.

It would seem that salt in brine should be included in these statistics but some may remain questionable for well informed observers. For Czechoslovakia, tonnages vary largely from one source to another. The British Geological Survey indicates 338 kt for 1987 and 350 kt for 1988. As far as the USSR is concerned, the April 1990 issue of *Industrial Minerals* quoted 29.5 kt of which 18.5 kt is rock salt and 11 kt is salt in brine. Some of these countries are sizeable exporters of salt: Poland, Rumania and the CIS. But the demand for salt is unlikely to expand everywhere and more especially in the chloralkali industry. And political events can affect economic trends.

Forecasts

Chlor-alkalis

The chlor-alkali sector is dominated by the inter-

TABLE 9
Eastern Europe (in 1000 tons)

	1987	1988	1989
Albania	70	72	70
Bulgaria	92	91	90
Poland			
Rock salt	1,231	1,247	994
Others	4,944	4,800	3,700
Rumania	5,395	5,400	5,500
Czechoslovakia	87	85	84
Ex-USSR			
Rock salt	15,400	14,800	16,500
Others	11,000	11,000	11,000
Ex-Yugoslavia			
Rock salt	153	127	134
Solar salt	68	58	50
Others	283	200	184

Sources: BGS — World Mineral Production, Welt-Bergbau-daten '90.

related challenges of stagnating chlorine demand and growth in demand for caustic soda. The environmental pressure on chlorine usage is unbalancing the chlor-alkali business. The paper and pulp industries are particularly affected as are PVC and chlorinated solvents. European production grew modestly in 1987–89 after two or three bleak years. A new decline is in sight. Will the downward pressure on chlorine demand continue in the near term?

By the year 2000, the pulp and paper industry will consume only one third of the chlorine it used in 1980. Reduction in the water purification field could be of the same amplitude. Certain experts believe that all chlorine usage in the Scandinavian pulp and paper industries will be eliminated. Alternative technologies (oxygen delignification, hydrogen peroxide and ozone bleaching) are being developed. The loss of the chlorine market in the Nordic countries will be complicated by a build-up of demand for caustic soda. The same experts believe caustic from soda ash (causticisation of soda ash) capacity will soon be built in Sweden and Finland.

The second significant outlet for chlorine, solvents and CFCs, accounts for 8% of the world demand. Environmental pressures have caused chlorine usage to decline. But the shrinking demand regarding most of the solvents could be offset by increased demand in intermediate areas (manufacture of phosgene used in polycarbonate and polyurethanes production, manufacture of allyl chloride).

PVC represents the largest end-use sector for chlorine, taking more than 27% of global demand.

Once the effects of recycling have been absorbed, the main driving force will be presumably PVC production. Experts are also reporting on producing chlorine at its place of use because of the higher transportation costs and the expensive safety regulations.

The on-site chlorine production could mainly be based on crystallized salt, provided that Europe's transition to the membrane process be speeded up. But there will be some disruption in the market as producers convert to membrane technology.

If PVC demand recovers, the chlorine needed will stimulate caustic capacity. The market can be expected to react in various ways to offset the caustic shortfall. But substitutes or new technologies that either replace or reduce the need for caustic soda will curtail the growing requirements. Chlor-alkali production in Eastern Europe needs large investments to bring it up to Western standards. But, in the medium term, the demand for caustic soda throughout this area should show signs of improvements. In the meantime, it is expected that the caustic supply will continue to be tight over the next years.

Nutrition

The downward trend affecting food grade salt consumption is still a matter of concern for salt manufacturers mainly because of negative attitudes based on non-scientific approaches.

Adequate nutrition labelling of foodstuffs constitutes a priority for the Community. Since the lack of precise rules may lead to the consumer being confused, the EC Commission has decided that the situation should be clarified legally. A Council Directive on nutrition labelling for foodstuffs was issued on September 24th, 1990. For the time being sodium labelling is optional. But the anti-salt lobby will presumably apply for compulsory labelling in the coming years, assuming that "the association of blood pressure with sodium intake is substantially larger than generally appreciated". In selecting different studies, irrespectively of their standards, to obtain "a quantitative estimate of the effect of sodium intake on blood pressure", they will emphasize the importance of sodium restriction in the population at large and recommend both low sodium food and sodium labelling. Such a message was delivered in April 1991 in the *British Medical Journal*: "Labelling of salt content of foods and, above all, reduction of the amount of salt added by the manufacturers to processed food is a vital public health objective...".

Considering that sodium should be declared within this framework, what is the evidence to support the premise that salt intake is hazardous to the population at large? No scientific evidence does exist

for a relationship between blood pressure and dietary salt intake (see a number of experimental and non-experimental studies like INTERSALT). Are there potential hazards as a consequence of a further reduction of dietary salt intake? Recent data based on physiological grounds indicate that a life-long restriction of salt cannot be assumed to be innocuous for the general population.

Good health calls for an adequate intake of all nutrients. It is important to avoid a situation where misconceived regulation leads to nutritional deficiencies as a consequence of less palatable food. There are concerns about calcium, magnesium and iron. A variety of products which are a valuable source of calcium rely upon salt. Moreover, salt is used in several countries as carrier of iodine and/or fluoride. In that case, sodium restrictions would have a negative impact on preventive steps recommended by WHO and taken by national Authorities.

CONCLUSIONS

An illumination (Fig. 16) from the Austrian National Library (Vienna) shows the Great Architect devoting himself, compasses in hand, to the creation of the world. The same patterns which, later, inspired Benvenuto Cellini are to be found here: the earth and the sea, containing huge reserves of salt. Since the very beginning of the world, when the "primitive soup" (J.B.S. Haldane) was still boiling, salt was already there. While the chemical transformation of mineral and organic matter has accelerated over the ages, salt has moved progressively from the earth to the sea. Now inexhaustible reserves of salt give us confidence for the future of life. There will be no lack of this universal substance God has provided.

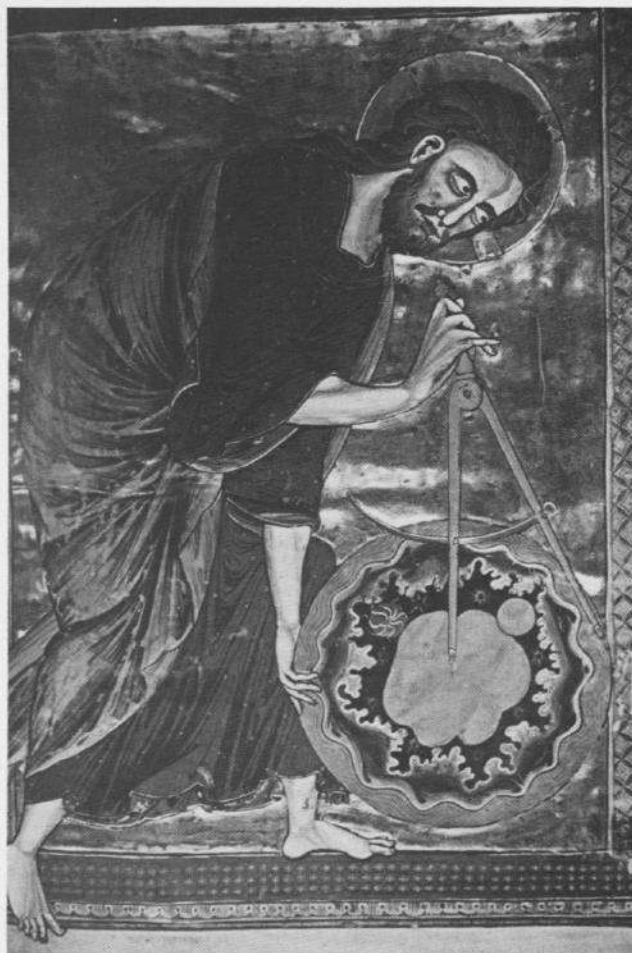


Fig. 16. The creation of the world, XIVth century. National library, Vienna.

**ROCK MECHANICS AND STRUCTURAL
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