
ARTICLES

Levantine Alkali Ashes and European Industries

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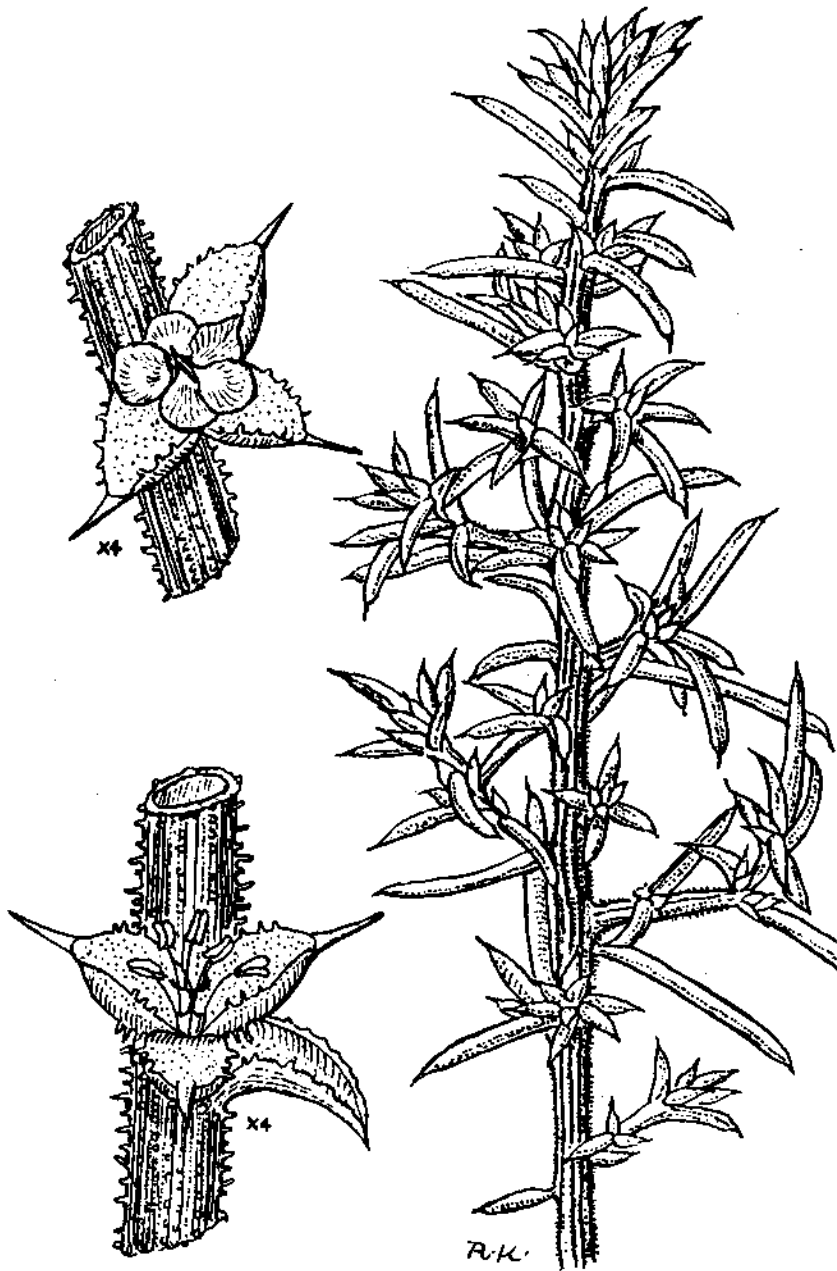
This paper will describe the European imports of a Levantine product that provided an indispensable raw material for soap and glass making from time immemorial. While it is true that these industries did not have an economic importance comparable to that of the textile industries, for example, they were still important, and the story of this import trade constitutes a very long chapter in European economic history, covering 1200 years in so far as the documents and other known data allow us to trace it. The paper will also refer to these industrial activities in various countries of Southern and Western Europe. The documentation on which it is based is rich, especially that in the archives of Venice which was a major centre of these industries and also of world trade.¹

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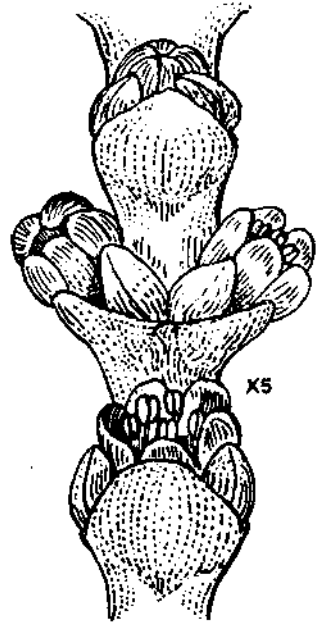
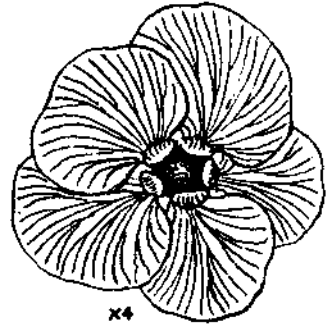
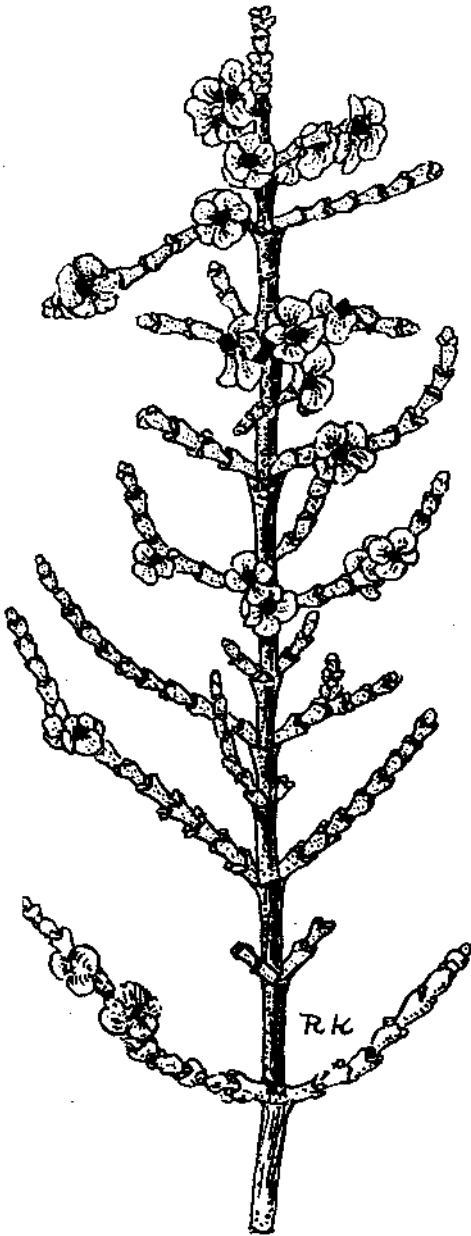
¹ Series of documents which are quoted throughout are the following: ASV (Archivio di Stato, Venice)
Maggior Consiglio. - M. C.



Salsola soda L.



Salsola kali L.



Hammada scoparia (Pomel)

I. The Raw Materials for Soap and Glass Making

Soap and glass are among the most ancient "industrial products" used by mankind. The latter is of entirely inorganic composition, that is to say the raw materials used today are apparently much the same as those employed in Egypt 14,000 years ago², are of mineral nature. These are primarily silica (from sand or sand stones), limestone and alkali carbonates, largely sodium carbonate (plus other constituents). The latter component is found in natural deposits only in arid regions, remote from populated areas.³ "Natron" residue was left from the Nile floodings and contains Na_2CO_3 , CaCO_3 , NaCl and traces of copper oxide, responsible for the beautiful blue colour of ancient Egyptian glass.⁴ It seems that at the beginning of the first century A.D. natron was also shipped to Palestinian ports from Alexandria for glass manufacture in Galilee.⁵ But in the Middle Ages and later, the alkali carbonates were obtained by burning wood or plants.

Soap preparation required one component that is the same as that used for the manufacture of glass, namely, alkali carbonates, while the other components, the fatty acids, are contained in triglycerides which are found as fats in all animals and as oils

Senato, Misti. - Misti.

Senato, Terra. - S. Terra.

Senato, Mar. - S. Mar.

Giudici di petizion, Sentenze a giustizia. - G.P., Sent.

Giudici di petizion, Terminazioni. - G.P., Ter.

Cinque savi alla mercanzia, N.S. 145. - Savi, N.S. 145.

ASG (Archivio di Stato, Genoa)

Caratorum veterum. - Car. Vet.

ASPr (Archivio di Stato, Prato)

Fondo Datini. - Dat.

Le deliberazioni del Consiglio dei Rogati (Senato), serie Mixtorum, ed. R. Cessi-P. Sambin I-II (Venice 1960-61). - Misti ed. Cessi.

² W.M. PETRIE, in *Trans. Newcomen Society V* (1924), p. 72.

³ KIRK OTHMER, *Encycl. of Chem. Techn. I* (1947), p. 385.

⁴ *Op. cit.*, 3rd ed. 11 (1980), p. 807.

⁵ It was probably even shipped to European countries, see below.

in a great variety of plants. A third component used for soap-making in the preindustrial era was lime, which was obtained from limestone, in a process that we call today the "caustification" of alkali carbonates, because only caustic alkali may be used for the saponification of oils or fats, namely sodium hydroxide (NaOH) or potassium hydroxide (KOH), and not the carbonates (Na_2CO_3 or K_2CO_3).

To summarise, in the preindustrial era the following were the main raw materials used for glass and soap:

- plant ashes and limestone, for both;
- for glass: silica;
- for soap: fats and oils.

Some preliminary technical facts about the manufacture of soap should be recalled. As we have already said, alkali hydroxides (NaOH or KOH) must be used for the decomposition (saponification) of fats or oils. Today these products are obtained by the direct electrolysis of salt (NaCl) or potassium chloride (KCl), respectively. But in the last century they were still obtained (especially NaOH) by caustification of the alkali ashes (or carbonates) with lime, in the same way that they were obtained from plant ashes in the most ancient times. A clear reference to caustification for soap making is made by Galenus.⁶ Both the sodium and potassium salts of fatty acid provide effective soaps (as opposed to calcium and magnesium salts). The difference between them consists in the fact that sodium soaps are of solid consistency and may be formed into suitable shapes, whereas potassium soaps are liquid or gelatinous.⁷

The nature of the fatty acids obtained from fats or oils also has an influence on the consistency of the soap. Long-chain saturated acids, like stearic acid obtained from animal fat, produce harder soaps. Oleic acid, for instance from olive oil, gives a clean,

⁶ GALEN, *Opera omnia*, ed. Kühn, X (Lipsia 1825), p. 569.

⁷ KIRK OTHMER, 2nd ed., 18 (1969), p. 415.

white, odourless soap that is easily scented and also tends to give softer, more liquid soaps, unless a high proportion of NaOH versus KOH is used. The existence of solid and liquid soaps was known to Plinius who wrote in his *Naturalis historia*: "Sapo... fit ex sebo et cinere, optimus fagino et caprino, duobus modis, spissus et liquidus, uterque apud Germanos majore in usu viris quam feminis...".⁸ The Italian chemist Ballarati mentioned the possibility that the forest ashes used by the Germans were rich in potash and gave a gelatinous soap, whereas the Gauls used ashes of marine plants and obtained solid soaps.⁹ It is clear, therefore, that the composition of the plant ashes used, the amount of Na_2CO_3 and K_2CO_3 they contained, and, most important, their ratio, have a great influence upon the nature of the soap obtained.

Peculiarly enough, the ratio of K_2CO_3 to Na_2CO_3 is also very important for the glass industry. The main component of ancient and modern glass is silica (SiO_2), which constitutes between 65 to 75% of glass. The second major component is the alkali oxides, and the third, calcium oxides; but many other minor products, colorants, oxidizers, etc., were and are used. Minor amounts of extraneous matter (iron, copper, titanium, oxides, etc.) may impair the transparency and colour of glass. These impurities may be contained in the ashes, but much more frequently they are found in the sand used.¹⁰ The effect of potash in glass-making, besides influencing the final physical properties, is to increase the viscosity if melted at a given temperature, making the complex manufacture of glass more difficult.¹¹

Of course, in the gradual development of glass manufacture, changes in components and their ratios did not result in abrupt

⁸ PLINIUS, *Naturalis historia* XXVIII, 191 (ed. Harvard Univ. Press VIII, 1963, p. 128 f.).

⁹ M. BALLARATI, *Grassi e saponi* (Pavia 1908), p. 69.

¹⁰ KIRK OTHMER, 3rd ed., 11 (1980) p. 846.

¹¹ KIRK OTHMER 1. c.; G.W. MOREY, *The Properties of Glass* (New York 1954), p. 77; S.R. SHOLES, *Modern Glass Practice* (Chicago 1952), p. 32.

changes of properties, because unlike soap, glass is not a chemical compound, but a solid solution of its components.¹²

II. The Period of the Crusades

The ashes of certain plants which grow in the Levant on saline soils, such as the fringes of the desert or the sea coast, were used for industrial purposes in that region and exported to Europe in the period of Roman rule and later at the dawn of the Middle Ages, and a high percentage of sodium carbonate was recognized to be of great value in the production of high-quality soap and glass. The Arabic geographer al-Mukaddasi, who wrote his work in (about) 985, mentions *ushnān* as an export of the province of Aleppo.¹³ This was *Haloxylon articulatum*, today called *Hammada scoparia*, and *Anabasis*, plants that are still widely used in Near Eastern countries. Very probably the term included *salsola* and other plants belonging to the large family of the *Chenopodiaceae*, which is also to be found in various regions (mainly coastal) in Europe.¹⁴ *Ushnān* is the name in literary Arabic, but in the vernacular it is still called *Kali* in the Near East to this day. In the Middle Ages, it was used for the fulling of textiles,¹⁵ and more extensively for the production of soap and glass, and the advanced level of the ancient glass industry was certainly due to a great extent to the quality of this raw material.

Even in Roman times these ashes were apparently exported

¹² W.A. WEIL - E.C. MARBOL, *The Constitution of Glasses I* (New York 1962), p. 249.

¹³ *Aḥṣan at-takāsim*, ed. de Goeje (Leiden 1906), p. 181. The name, which means both the plant and its ashes, is also spelled *ishnān*, see E.W. LANE, *Arabic-English Lexicon I*, p. 62 and cf. on its meaning R. DOZY, *Supplément aux dictionnaires arabes I*, p. 25 f.

¹⁴ On its identification see M. ZOHARY, *The Plants of the Bible* (Cambridge University Press 1982), p. 151 and on its use today Cl. BAILEY - A. DANIN, "Bedouin Plant utilization in Sinai and the Negev", (in) *Economic Botany* 35 (1981), pp. 149, 161; cf. G.E. POST - J. DINSMORE, *Flora of Syria, Palestine and Sinai* (Beirut 1932-1933) II, pp. 445, 452.

¹⁵ Cf. *Ushnān al-kaṣṣārīn* EDRISI, *Description de l'Afrique et de l'Espagne*, ed. transl. R. DOZY-M.J. DE GORJES (Leiden 1866), p. 37, note 1.

to certain European countries where centres of the glass industry had developed. When the economic unity of the Mediterranean broke up after the Arab conquests, the imports were discontinued and the European glassmakers had to use ashes from their own forest and meadow plants which rendered less valuable fluxants. In the Rhineland, in the Merovingian period, Syrian ashes were still used for the production of glass. But the analysis of glass manufactured in that region in the VIIIth-IXth centuries shows that producers had to make do with the ashes of local forest plants.¹⁶ The same observation has been made by archaeologists studying old English glass. Whereas Anglo-Saxon glass was produced by the fusion of silica and the ashes of sea plants, they maintain that the glass that can be dated to the ninth and tenth centuries has a high potassium content and was more susceptible to decay: obviously they must have been using ashes from bracken and woodland.¹⁷ The archaeologists speak vaguely about ashes of plants from the sea coast and of those of the forests. The former must have been Levantine ashes, for those of the plants of the European coasts obviously could still be obtained. Ashes from beech wood (*fagus*), containing a high level of potash, were used and in the German-speaking countries, the glass produced from it was called *Waldglas*¹⁸ and in the French-speaking countries, where ashes of fern (*filix*) were used, *verre de fougère*.¹⁹ At the end of the tenth century and in the first half of the eleventh century, local ash was used everywhere, as is clearly borne out by the description of glassmaking provided by the Byzantine monk Theophilus, who after long travels settled in Cologne in

¹⁶ D.B. HARDEN, (in) SINGER-HOLMYARD-WILLIAMS, *A History of Technology II* (Oxford 1956), p. 325.

¹⁷ J.R. HUNTER, "The Medieval Glass Industry", (in) *Medieval Industry*, ed. D.W. CROSSLEY (Council for British Archaeology, Research Report no. 40) (London 1981), p. 145.

¹⁸ W.B. HONEY, *Glass* (London 1966), p. 2.

¹⁹ J. BARRELET, *La Verrerie en France de l'époque gallo-romaine à nos jours* (Paris 1953) p. 32.

the first half of the eleventh century and here wrote his work.²⁰ The German glassmakers and soap manufacturers used ashes of plants from Eastern Europe and tallow. This is also documented in various commercial treaties between German traders and certain Russian princes like those of Polozk, Witebsk, Smolensk and Novgorod, in the thirteenth century.²¹ It goes without saying that the use of these raw materials resulted in the decay of the glass industries in Northern and Central Europe.

Meanwhile new centres of the glass industry developed in Italy and followed another trend. Remnants of glass found in Torcello can be dated to the seventh or eighth century.²² In the tenth and eleventh centuries there were glass factories in Venice, as is illustrated by the references to glassmakers in documents of the years 982, 1083, 1090 and 1092.²³ At the same time, another centre of the glass industry had come into being in the Ligurian town of Altare.²⁴ But what raw materials were used there? The Venetian scholar B. Cecchetti concluded from a document of 1072 that Egyptian ash was used in Venice, but the document (which he had in mind although he does not refer to it) undoubtedly refers to alum.²⁵ However, since trade with

²⁰ *On diverse arts, the Treatise of Theophilus*, transl. by J.G. HAWTHORNE and C. St. SMITH (Univ. of Chicago Press 1963), p. 49 cf. p. XVI.

²¹ W. RENNKAMP, *Studien zum deutsch-russischen Handel bis zum Ende des 13. Jahrhunderts*, Nowgorod und Dünagebiet (Bochum 1977), p. 171, 347 f.

²² L. LECIEJEWICZ - E. TABACZYŃSKA - S. TABACZYŃSKI, *Torcello, scavi 1961-1962* (Rome 1977), p. 63 ff., 72 f.

²³ A. GASPARETTO, *Il vetro di Murano dalle origini ad oggi* (Venice 1958), p. 43; A. SANTI, *Origine dell'arte vetraria in Venezia e Murano, cenni storici* (Venice 1886), p. 16.

²⁴ L. ZECCHIN, "Sull'origine dell'arte vetraria in Altare", *Vetro e Silicati IX* (1965), p. 19 ff.

²⁵ B. CECCHETTI, "Sulle origini e sullo svolgimento della vetreria veneziana e muranese", (in) B. CECCHETTI - V. ZANETTI - E. SANFERMO, *Monografia della vetreria veneziana e muranese* (Venice 1874), p. 7. The document is that published by R. MOROZZO DELLA ROCCA - A. LOMBARDO, *Documenti del commercio veneziano nei secoli XI-XIII* (Rome 1940), no. 11 (I, p. 10 f.) (nove sporte di allume da Alessandria). In that period, alum was an important export from Egypt, see Ibn Mammāti, *Kawānīn ad-dawāwīn* (Cairo 1943), p. 328 f. - Were the ashes of plants growing in the "Levante" of Spain perhaps used in Italy? D. Goitein lists "potash alum" as a commodity exported in that period

the Moslem Levant was expanded in the second half of the tenth century, it may be that some shipments of Levantine ashes containing high levels of sodium carbonate arrived in Venice and other towns of Italy. However even the products of the Italian glass factories of the Crusader period were rather crude vessels.²⁶

One cannot of course estimate the volume of the activities of these producers to determine whether they constituted real industries. But the soap factories probably did. In England, Bristol was a great centre of soap making in the second half of the twelfth century, so that a Latin author of that period could write: *Apud Bristollum nemo est qui non sit vel fuerit saponarius*.²⁷ In the thirteenth century, the soap industry also flourished in London and Coventry.²⁸ In Italy, Savona had an excellent soap industry,²⁹ as did Venice and its province. This is clearly shown by the frequency of the family name *Saponarius* or *Savonario* in documents of the period of the Crusades and of the first years of the Trecento.³⁰ Another testimony to the existence

from Spain, see *Letters of Medieval Jewish Traders* (Princeton University Press 1973), p. 25, but since this article does not appear in the documents which he translates one cannot know what he had in mind.

²⁶ G. LUZZATTO, *Storia economica di Venezia dall'XI al XVI secolo* (Venice 1961), p. 68; L. ZECCHIN, "Prodotti vetrari nei documenti veneziani (1268-1331)", *Rivista della Stazione Sperimentale del Vetro* (Murano) VIII (1978), p. 160.

²⁷ Chronicle of RICHARD of DEVIZES, *De rebus gestis Ricardi primi* (*Rerum Britannicarum medii aevi scriptores* 82, part III) (London 1886), p. 438 and cf. on the author p. LXXII.

²⁸ F.W. GIBBS, "The History of the Manufacture of Soap", *Annals of Science* IV (1939/1940), p. 171.

²⁹ I. SCOVAZZI - F. NOBERASCO, *Storia di Savona* (Savona 1926-1928) I, p. 259.

³⁰ In the second half of the eleventh century Johannes Saponarius was patriarch of Grado, see JACOPO FILIASI, *Memorie storiche de' Veneti, primi e secondi*, 2nd ed., VI (Padua 1812), p. 386; the name Pancracius Saponarius is to be found in documents of 1157, 1167, and 1179, see MOROZZO DELLA ROCCA-LOMBARDO, *op. cit.*, no. 127, 185, 186, 304. That of Johannes Savonarius in a document of the Rialto of 1243, see *op. cit.*, no. 762, and Jacobus Saponario, a Venetian too, is to be found in a document of 1180, see *op. cit.*, no. 372. A Joh. Savonarius appears in documents of the years 1305 and 1306, see *I capitolari delle arti veneziane*, ed. G. Monticoli - G. Besta I (Rome 1896), p. LXXII, f.; M.C., *Magnus et Capricornus*, f. 5a. Petrus Savonarius is known from documents of 1294, 1305, 1307 and 1317, see *Deliberazioni del Maggior Consiglio di Ve-*

of the soap industry in Venice is the name given to a canal in the first half of the thirteenth century — the Rio Saponario in S. Cassiano.³¹ In that district of Venice, there were apparently several soap factories located over a very long period. The data that have come down to us, however, leave little doubt that in this period the European soap industries used the ashes of plants that grew in their countries almost exclusively. The use was so intensive that there was large-scale destruction of woodland in some regions of France for instance. In England by the end of the thirteenth century, Russian ash was being used.³²

Despite the lack of high-grade raw materials both the soap and glass industries developed at a reasonable pace. In the middle of the thirteenth century, the glassmakers' guild in Venice was a sizeable one³³ and they also began to export glass and glass vessels.³⁴ Another sign of the high reputation that this Venetian industry already had in those days is the fact that Venetian glassmakers were in demand elsewhere and emigrated to many other

nezia, ed. R. Cessi, III (Bologna 1934), p. 366; M.C. Magnus et Capricornus 1. c.; Misti, ed. Cessi-Sambin I, p. 120, 181. Nicolo Savonario appears in documents of 1312 and 1317, see *Museo Correr*, MS. Cicogna 3248 (= 2986), no. VII, a writ of the Doge Marino Zorzi, cf. Catalogue MSS. Cicogna V, f. 118b; Misti, ed. Cessi-Sambin, I, p. 181. Dominicus a Sapone is to be found in a notarial act of the year 1314, see *Domenico prete di S. Maurizio, notaio in Venezia*, ed. M. Fr. Tiepolo (Venice 1970), no. 407. Angelo Savonario, at the beginning of the fourteenth century had much property in Venice, including houses in the parishes of S. Geremia, S. Giovanni Crisostomo, S. Ermagora (this latter today called S. Marcuola) (at the corner of the Canal Grande and the Canal of Canareggio, cf. G. TASSINI, *Curiosità veneziane*, 6th ed., Venice 1933, p. 413), see ASV, Proc. di S. Marco, Misti, b. 134. Franciscus Savonarius is mentioned in a deed of 1319, see Misti, ed. Cessi-Sambin I, p. 214 and finally Marcus Saponario lives in 1330, see *op. cit.*, p. 424.

³¹ G. GALLICCIOLLI, *Delle memorie venete antiche, profane ed ecclesiastiche* (Venice 1795) I, p. 196; MOROZZO della ROCCA-LOMBARDO, *op. cit.*, no. 651 (of a 1231).

³² GIBBS, *art. cit.*, p. 172., W. STIEDA, *Revaler Zollbücher und Quittungen* (Halle a. S. 1887), p. XCIX note 6.

³³ See B. CECCHETTI, *Sulle origini e sullo svolgimento della vetraria veneziana e muranesa*, p. 7; *idem*, "Le industrie in Venezia", *Archivio Veneto* IV (1872), p. 625.

³⁴ L. ZECCHIN, "Vetriere muranesi dal 1276 al 1200", *Riv. Staz. Sper.* I (1971), no. 4, p. 18; *idem*, "Fornaci muranesi fra il 1279 ed il 1290," *Journal of Glass Studies* XII (1970), p. 81.

Italian towns despite the prohibitions promulgated by the government.³⁵ However there was no major expansion before the end of the thirteenth century.

III. The Imports of Levantine Ash

Certain Venetian documents which refer to the import of "allumen" and date from 1233 and 1255, are rather puzzling.³⁶ It may really have been alum, but in documents of the last quarter of the thirteenth century there are references that establish beyond doubt the importation of Levantine ash into Venice.³⁷ This raw material was imported from both Syria and Egypt in the last years of the thirteenth century,³⁸ but the greater part came from Syria.

It seems that from ancient times the Bedouin collected these plants in the Syrian desert and brought them to the towns to sell them. Most of these were probably the *ushnān* that grows on the fringes of the desert and is on sale in all Levantine markets to this day. But undoubtedly the Bedouins collected more than one herb, and the trade was conducted over many centuries. The Bedouin of Northern Syria sold the ashes of plants which they had burnt in the form of solid lumps (in Arabic vernacular *haġer*, i.e. stone) or pebble (*zerab*). The residue, which was rich in inorganic components (obtained by drying the plants without burning them) (*zahra*), was also sold and used for soap making.³⁹ In more modern times the Bedouin came to Aleppo ten times

³⁵ *I capitolari*, ed. Monticcolo-Besta, II, part a (Rome 1905), p. 88 f.

³⁶ R. PREDELLI - A. SACERDOTE, *Gli statuti marittimi veneziani fino al 1255* (Venice 1903), p. 73, 160.

³⁷ L. ZECCHIN, *Vetriere muranesi dal 1276 al 1300*, p. 19; idem, "Cronologia vetraria veneziana e muranese dal 1286 al 1301", *Riv. Staz. Sper.* III (1973), p. 64.

³⁸ *Deliberazioni del Maggior Consiglio*, ed. Cessi, III, p. 298. The medieval documents referring to imports from Egypt leave us in doubt, however, whether ashes containing alkali carbonates were really meant or perhaps natron.

³⁹ See ALBERT DE BOUCHIEMAN, "Une petite cité caravanière: Subné" (*Documents d'études orientales de l'Institut français de Damas* VI) (Damascus s.d.), p. 77 f.

a year in great caravans to sell these ashes.⁴⁰ The caravans were called "caravans of the *keli*" (North Syrian form of kali).⁴¹ The Bavarian physician and botanist Leonhart Rauwolff, who stayed in Tripoli in 1573, has left us a very interesting account of this trade in his day. He describes how the Bedouin obtained two kinds of *shinan*, (i.e. *ushnān*) by burning plants on a mountain near the town. They sold the products to the Venetians who eagerly acquired entire ship loads.⁴² There were also "*ushnān* mills" in Damascus where the ashes were prepared, as can be learned from the description of the town by Ṣalāḥ-ad-dīn al-Kutubī, an author of the fourteenth century.⁴³ The well-known French traveller, Volney, who visited Southern Palestine at the end of the eighteenth century, also recounts how the Bedouin used to supply the soap factories of Ghaza with "kali".⁴⁴

According to Turkish documents dating from the sixteenth century, the sale of these ashes was a monopoly in Syria. A great part of it was destined for sale to European merchants,⁴⁵ but there can be no doubt that the monopoly had been established a long time before the conquest of Syria by the Ottomans. Many Venetian documents show that the predecessors of the Ottomans, the Mamluks, also sold this product to the European merchants. The fact the Venetians often bought the ashes from the Mamluk authorities, such as the governor of Tripoli or of some other Syrian town, or were even compelled by them to buy them,

⁴⁰ *Op. cit.*, p. 89.

⁴¹ *Op. cit.*, p. 88. The literary form is *kily*.

⁴² *Aigentlich beschreibung der Reiss* (Lavingen 1583), p. 37. On the two kinds of *ushnān*, see below.

⁴³ MS. Istanbul, Topkapu Saray, R. 2027 (8966), f. 55a f. (We have quoted a copy made by Dr. Y. Sadan of Tel Aviv University, who, believes that this treatise was meanwhile published from another MS. by Ṣalāḥ ad-dīn al-Munadjjid).

⁴⁴ C. - F. VOLNEY, *Voyage en Egypte et en Syrie*, publ. par J. Gaulmier (Paris 1959), p. 347 f.

⁴⁵ J. v. HAMMER, *Staatsverfassung und Staatsverwaltung des osmanischen Reichs* (Vienna 1815) I, p. 228; R. MANTRAN - J. SAUVAGET, *Règlements fiscaux ottomans, Les provinces syriennes* (Paris 1951), p. 22 ff., 69.

or also heeded their permission to export them, leaves no doubt of this.⁴⁶ The documents referring to a Venetian embassy to the sultan of Cairo in the year 1449 are explicit: in the negotiations in Cairo the sultan insisted that the Venetians must buy ashes from his stocks, until a compromise was reached, whereby the Venetians undertook to buy a certain quantity from the governor of Tripoli every year.⁴⁷ But even in later years the Venetians were still compelled to buy ashes from the Mamluk authorities.⁴⁸ The Mamluks of course ruined the local industries in this way by depriving glass and soap makers of the raw materials. They also harmed the industry in other ways, for example by the imposition of taxes on the sale of the raw materials as well as compulsory purchases.⁴⁹

The European merchants were eager to purchase the Levantine ashes, however. Venetian documents refer to shipping ashes from Syria and Egypt to Crete in 1296⁵⁰ and in 1300,⁵¹ or directly to Venice from Egypt.⁵² At the end of the thirteenth century and the beginning of the fourteenth century Alexandria was a major market for these ashes.⁵³ When the papal embargo on trade with the Moslem Levant was strictly enforced in the first half of the fourteenth century, some shipments could certainly still be obtained via Cyprus, Crete, or Little Armenia.⁵⁴

⁴⁶ See G.P., Sent. 54, f. 40a 71, f. 55a ff. 124, f. 63b ff.; G.P., Cap. publ. VII, f. 2a.

⁴⁷ See the sources quoted in E. ASHTOR, *Levant Trade in the Later Middle Ages* (Princeton University Press 1983), p. 307.

⁴⁸ See *op. cit.*, chapter VII and the sources quoted in note 112.

⁴⁹ Corpus Inscr. Arab. II, part 1, Syrie du Nord par M. Sobernheim (Cairo 1909), p. 59 f. (where the material is called b'l's). Cf. E. ASHTOR, "Le Proche-Orient au bas moyen âge — une région sous-développée", *Istituto Franc. Datini (Prato), Settimane di studio* 1978 (Florence 1983), p. 404 f., 419.

⁵⁰ MISTI, ed. Cessi-Sambin, I, p. 4.

⁵¹ Pietro Pizolo, *notaio in Candia*, ed. S. Carbone, I (Venice 1978), no. 321; *Deliberazioni del Maggior Consiglio*, ed. Cessi, III, p. 398.

⁵² MISTI, ed. Cessi-Sambin, I, p. 104.

⁵³ Zibaldone da Canal, ed. A. Stussi (Venice 1976), p. 66.

⁵⁴ A. STUSSI, *Testi veneziani del Duecento e dei primi del Trecento* (Pisa 1965), p. 103; *Lettere di mercanti a Pignol Zucchello*, ed. Morozzo della Rocca (Venice 1957), p. 32.

The importance that the government of Venice attached to the purchase of the Levantine ashes may be inferred from a decree enacted in 1308, when it was stipulated that cogs departing from Alexandria, Damietta or Tinnis for Venice should load only this commodity.⁵⁵ This decree shows clearly that the supply of sufficient quantities of the Levantine ashes was considered to be a vital matter for the Venetian economy. On the other hand, it was also forbidden to export this raw material from Venice. The prohibition was made first in 1275⁵⁶ and again in 1282,⁵⁷ but it was revoked in the year 1283⁵⁸ and then re-enacted in 1315.⁵⁹ More convincing evidence of the importance of Levantine ashes for the economy of Venice is a law promulgated in the same period to forbid the use of fern ashes for glass-making — only Levantine ashes were permitted and the authorities rarely made an exception.⁶⁰

The ashes of the Levantine plants from which the alkali car-

56 f.; L. ZECCHIN, "Cronologia vetraria veneziana e muranese dal 1302 al 1314," *Riv. Staz. Sper.* III (1973), p. 122.

⁵⁵ Misti, ed. Cessi-Sambin, I, p. 129.

⁵⁶ M.C., Fractus, f. 52; quoted by B. CECCHETTI, "Delle origini e dello svolgimento dell'arte vetraria muranese, nuove ricerche", *Atti del R. Istituto Ven. di scienze, lettere ed arti*, ser. IV, vol. I, p. 21.

⁵⁷ M.C., Avogaria di comun, Bifrons, f. 12a; cf. CECCHETTI, *ibidem*.

⁵⁸ M.C., LUNA (copy), f. 79a f.

⁵⁹ L. ZECCHIN, "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1348 al 1438", *Riv. Staz. Sper.* XI (1981) p. 77. What ZECCHIN says, in "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1233 al 1347", *Riv. Staz. Sper.* X (1980), p. 173 about a renewal of the decree in 1285 is mistaken — this reenactment dates from 1282. The same error is made by CECCHETTI, *Sulla storia dell'arte vetraria muranese* (Venice 1865), p. 10.

⁶⁰ M.C., Magnus et Capricornus, f. 11b (a. 1306), printed by CECCHETTI, *op. cit.*, p. 32 and quoted by L. ZECCHIN, "Cronologia vetraria veneziana e muranese dal 1302 al 1314", *Riv. Staz. Sper.* III (1973), p. 120. A glassmaker who obtained sodium carbonate from a mixture of Levantine ashes and that of fern was granted exceptional permission to use it in 1318, see M.C., Clericus Civicus, f. 136a and L. ZECCHIN, "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1233 al 1347", *Riv. Staz. Sper.* III, p. 174; *idem*, "Cronologia vetraria veneziana e muranese dal 1315 al 1331", *Riv. Staz. Sper.* III, p. 166 f.

bonates for the production of soap and glass were obtained had a variety of Venetians names: *cenere*, *botassa*, *allumen* and most commonly *lume* (from *allumen*) or *lume catina* (or *catino*) or *lume de savon*.⁶¹ In Tuscany they were called *cenere grevellerà*⁶² or *soda da bicchieri*.⁶³

But of far greater importance for our subject is that in the first half of the fifteenth century a method of purifying the ashes to obtain a high-grade alkali carbonate was known in Italy.⁶⁴ The greatest progress was probably made in Venice, but elsewhere the use of Syro-Egyptian ashes for the production of soap and glass was widely used as well.⁶⁵

IV. Chemical Aspects

One must not be misled by the use of the term "soda" and "potash" in the sources of the later Middle Ages and the Early Modern period. Both words were very often used without any clear distinction or even a basic knowledge of their chemical meaning. The terms "potassium carbonate" and "sodium carbonate" were used in a confused way, as thorough research

⁶¹ See the texts quoted in notes 175-180 of E. ASHTOR, "Le Proche-Orient au bas moyen âge — une région sous-développée". The word *lume* (which is Venetian vernacular) is used by the Syro-Palestinian Arabs down to the present. *Catina* was sometimes pronounced *catina* and others *cátina*. For *lume catina* see also *Misti* 34, f. 110a. In fact, the term *lume* was also used for other products, such as burnt tartar called *lume di feccia*, sodium chloride was called *lume di gemma*; *lume scaiola* means the crystalline form of calcium sulphate.

⁶² FR. B. PEGOLOTTI, *La pratica della mercatura*, ed. Evans (Cambridge Mass. 1936), p. 380. The Florentine author also lists among the Oriental commodities *sale arcali* (i.e. *kali*), see p. 296 and cf. Evans p. 428 f.

⁶³ GIOVANNI DA UZZANO, "La pratica della mercatura", (in) Pagnini, *Della decima* IV (Lisbon-Lucca 1746), p. 25; *El libro di mercatantie*, ed. Borlandi (Turin 1936), p. 22.

⁶⁴ L. ZECCHIN, "Ricette vetrarie d'ispirazione muranese nel Quattrocento," *Riv. Staz. Sper.* XI, p. 265.

⁶⁵ See the text quoted in note 63 from Giov. da Uzzano referring to the customs to be paid on import into Florence. Cf. L. ZECCHIN, "Ricette vetrarie toscane nel Quattrocento", *Riv. Staz. Sper.* XI (1981), p. 214.

in this field was not to be made before the beginning of the nineteenth century. It seems that the first observations on the difference between the crystals obtained from soda and potash were made by G.E. Stahl in 1702.⁶⁶ Later, in the middle of the eighteenth century, Henri Duhamel carried out studies on *salsola kali* ("common saltwort"),⁶⁷ but it was not before 1807 that a chemist established the exact distinction between the two elements; potassium and sodium. Humphry Davy separated a "new element by electrolysis of caustic potash and gave it the name "potassium" and the chemical symbol K (Latin *Kalium*), from the Arabic *kali* or *keli* — that is the ash of the plant from which the alkali metal compounds were obtained. In the same way, he discovered the sister alkali which he named sodium, whose symbol is Na (*Natrium*, from *natron*).

Although the technicians of the Middle ages had no knowledge of the chemical composition of the ashes they used for the production of soap and glass, they were well aware of the differences in behaviour due to their composition. They used to purify the ashes by a process of solution, filtration, concentration and crystallisation, obtaining a mixture of white salts, mainly Na_2CO_3 and K_2CO_3 which they called "the salt", and they could compare the total amount of alkali carbonate contained in the various ashes.⁶⁸ They had no way of measuring the ratio of $\text{Na}_2\text{O}/\text{K}_2\text{O}$, but they knew very well the technical effect of this ratio. The same is true for the soap and glass producers of the sixteenth and seventeenth centuries. At the end of the seventeenth century Haudicquer de Blancourt, in his work on the glass industry, emphasizes that the difference between various ashes was due to

⁶⁶ M.E. WEEKS - H.M. LEICESTER, *The Discovery of the Elements* (San Francisco 1967), p. 438.

⁶⁷ G. TROOST, "Description of the American Petalite from Lake Ontario", *Acad. Nat. Sc. (Philadelphia)* III (1824), p. 234 ff.

⁶⁸ G. ROSSETTI, *Notandissimi secreti de l'arte profumatoria*, ed. Fr. Brunello - Fr. Facchetti (Vicenza 1973), p. 47, 164.

the diversity of the plants and of the regions in which they grow, "and even to the mixture of heterogeneous salts".⁶⁹

Modern chemists who have undertaken research on soap-making have made various observations on the Levantine ashes in their historical introductions. E. Marazza claims that the salsola soda ash contains 41% of Na_2CO_3 and those of salsola kali 44%, and he also states that the ashes of saline plants which grow in Spain and were used for soap-making (and glass), such as those coming from the region of Alicante, Cartagena, and Malaga, contain 25-30% Na_2CO_3 or even much less, such as 6-10%. He also mentions other ashes known from ancient times as "soda of Vareque" and collected on the Mediterranean coast of France, which are supposed to be those of algae (*Fucus serraltus*, *Fucus vesiculosus*, etc.).⁷⁰ V. Scansetti claims that the Spanish plants contain only 20-25% sodium carbonate and those growing on the coast of Southern France 10-15%.⁷¹

We therefore thought it would be useful to analyse the ashes obtained by burning some plants of the Chenopodiaceae family, which grow spontaneously in arid or semiarid zones in areas now within the borders of Israel. Before doing that we took branches of beech wood (*Fagus Silvatica*) from the forest of the plateau of Cansiglio (in the province of Treviso in Italy). This is now a mixed forest of beechs and firs, whereas in the past it was a pure beech forest, covering about 15-20,000 ha, situated about 60 km north of Venice. In the past it was maintained with lavish care by the government of the Republic of Venice and called "la foresta da reme del Cansiglio", because its timber was used for the construction and outfitting of ships. It could also have provided a very abundant and easily accessible sources of ash. The analysis gave the results reported in Table I.

As can be seen, the total amount of alkali is negligible, and the

⁶⁹ HAUDICQUER DE BLANCOURT, *De l'art de la verrerie* (Paris 1697), p. 51.

⁷⁰ E. MARAZZA, *L'industria saponiera* (Milan 1907), p. 7 ff.

⁷¹ V. SCANSETTI, *L'industria dei saponi*, 5th ed. (Milan 1933), p. 5.

TABLE I

BEECH OF THE CANSIGLIO FOREST*

Ashes, % of wood		2.7%
Ashes, composition, % of weight		
	Na ₂ O	0.11
	K ₂ O	1.1
	CaO	34
	MgO	6.5

* This Table contains the analysis of plant ashes collected by G. Cevidalli.

Experimental detail: plants dried at 40° for two days, ashes obtained by burning at 500°-550° for six hours.

Caution: ashes dissolved in dilute HCl, then analysed by atomic absorption spectrophotometry, Perkin Elmer 405.

Cl⁻ — Vohlard method.

SO₄⁻ — BaSO₄ gravimetric

SiO₂ — Feigl and Krumholz method.

ratio of Na₂O/K₂O is 0.1. Although such a small sample from a vast forest is certainly not representative we can conclude that these ashes would be a most unsuitable raw material for making either glass or soap, which may well be the reason that Venice did not use them for its industries.

In order to establish the quality of Levantine ash, we decided after consultation with botanist colleagues to analyse two small bushes both belonging to the Chenopodiaceae family: *salsola kali* L. and *salsola soda* L. We believe that these were indeed the two plants described in the second half of the sixteenth century by the German botanist (and physician) L. Rauwolff in the chapter of his travelogue dealing with his visit to Tripoli, Syria.⁷² The chapter contains a long passage on the Levantine ashes which were used in Europe as raw materials for soap and glass-making. Although he called them by the Arabic name *shinan* (that is *ushnān*), the fact that he records that they were burnt into ashes near Tripoli suggests that they grew in that region, on the sea coast, and not on the fringes of the desert. Two further facts were decisive for our choice. On one hand, the Arabic name of at least one of

⁷² *Aigentlich beschreibung der Reiss*, 1.c.

the plants used was (and is) "kali" and, on the other Haudicquer de Blancourt stated ⁷³ that this plant was the same as the one called by other names by various authors: "alkali, soda, salicornia, anthilloides, kelp, antillis". And Karl Linnaeus in his fundamental work 'Critica Botanica' adopted some "barbarous names", that is names used outside of Europe, and among them *kali*, now known as *salsola kali* L.

Salsola kali and *salsola soda* are small annual bushes (20-60 cm), belonging to the Chenopodiaceae family, and are not very different, at least for a non-specialist, from one another. Both grow on the sandy sea shores of the Acre and Sharon plains; *salsola kali* also grows in the western Negev and in the vicinity of the Dead Sea.

A *salsola kali* specimen was collected from the northern coastal plain of Israel, near the town of Acre. The *salsola soda* was taken from the *herbarium* of the botanical department of our university. It had been collected in the same location mentioned above.

The results of analysis are shown in Tables II and III. On the basis of this analysis, Professor Michael Zohary expressed verbal doubts that *salsola soda* could have been used in the Middle Ages and at the beginning of the modern period for ash production, as it is today a rather rare plant. Since in the Near East even in our day ashes are still used for soap-making, he believes that these are ashes of the *Hammada scoparia* (formerly known as *Haloxylon articulatum*). This plant also belongs to the Chenopodiaceae family and grows in deserts, in the lower Jordan Valley, the Negev, etc., and also on alluvial soils⁷⁴ (see fig. 3). So we also took a sample of this plant from the university *herbarium*. It had been collected in the Negev, in the Wadi 'Ashūdj.

Analysis follows in Table IV.

⁷³ HAUDICQUER DE BLANCOURT, *op. cit.*, p. 53.

⁷⁴ M. ZOHARY, *Flora Palaestina* (Jerusalem 1966) I, p. 164, 170.

TABLE II

SALSOLA KALI

Ashes: 26%	
Ashes analysis	% Weight
Na ₂ O	14.3
K ₂ O	15.5
CaO	14.4
MgO	9
Cl ⁻	1.4
SO ₄ ⁻⁻	5.5
SiO ₂ (qualitative)	< 1

TABLE III

SALSOLA SODA

Sample 1 — Ashes 23%		Sample 2 — Ashes 20%	
Ashes analysis	% Weight		% Weight
Na ₂ O	44		42
K ₂ O	6		7.5
CaO	3.3		3.8
MgO	1.6		2
Cl ⁻	3.2		2.8
SO ₄ ⁻⁻	0.8		1
Si ₂ O (qualitative)	< 1		< 1

TABLE IV

HAMMADA SCOPARIA

Ashes 11%.	
Ash analysis	Weight %
Na ₂ O	9.8
K ₂ O	7.8
CaO	22.6
MgO	12.6
Cl ⁻	0.8
SO ₄ ⁻⁻	4
SiO ₂ (qualitative)	< 1

Before commenting on these results, we shall first consider the analysis of other ashes that have been examined in the *Stazione Sperimentale del Vetro* (Experimental Glass Laboratory) in Murano, with its very kind permission. These include a) ashes obtained from ferns (whose specific species we do not know) growing on the Lido of Venice; b) "Soda di Catania", obtained from plants growing in that area of Sicily; c) "ashes of Vareque", from the Mediterranean coast of France and believed to be produced by marine algae. The results of the analysis are given in Tables V-VII.

In the following comments we shall attempt to sacrifice scientific precision to clarity; we will calculate the ash composition by attributing all the Cl^- to Na_2O (when enough is present) the remaining Na_2O being considered as belonging to Na_2CO_3 and all K_2O as K_2CO_3 , except for the Vareque ashes (see below). Obviously plant composition may change, according to place of origin, climate and microclimate, age, etc., and therefore large numbers of samples really need to be collected and analysed. As this is beyond the scope of the present research, the following comments should be taken with some reserve.

The six group of ashes examined can be schematically divided into three main groups:

- I) The ashes of fern: these are relatively rich in alkali carbonates (about 30%), but practically all is due to potash, and none to soda, making them unsuitable for either glass or (solid) soap. This was obviously the reason for the repeated prohibitions of their use by the Venetian government (see above and below).
- II) The ashes of salsola soda contain almost 80% of alkali carbonates, predominantly sodium carbonate. The weight ratio of $\text{Na}_2\text{O}/\text{K}_2\text{O}$ (subtracting NaCl) is — in these two samples — respectively 6.85 and 5.2. This is an excellent raw material both for glass and soap, and much more suitable than the following group.

TABLE V

FERN ASH

	Weight %
Na ₂ O	0.41
K ₂ O	25.5
CaO	17.9
MgO	8.1
Cl-	3.37
SiO ₂	8
Al ₂ O ₃	1.4
Fe ₂ O ₃	0.75
MnO	0.5
P ₂ O ₅	4

TABLE VI

SODA DI CATANIA

	Weight %
Na ₂ O	23
K ₂ O	9.6
CaO	9.3
MgO	2
Cl-	8.23
SO ₃	1.1
S--	0.04
SiO ₂	1.35
Al ₂ O ₃	1.35
Fe ₂ O ₃	1.32
P ₂ O ₅	0.58

TABLE VII

"VAREQUE" ASHES

	Weight %
Na ₂ O	19.8
K ₂ O	17.5
CaO	9.17
MgO	6.75
Cl-	15.5
SO ₃	20.82
SiO ₂	3.50
CO ₂	5

III) We include in this group the ashes of *salsola kali*, of *Hammada scoparia*, the soda of Catania and Vareque ashes. These last are very rich in sodium chloride. It is difficult to comment on their composition, because the amount of CO_2 (the only case where this direct analysis is made) is highly insufficient to balance the $\text{K}_2\text{O} + \text{Na}_2\text{O}$ (after subtracting NaCl), if they were present as carbonates. Tentatively one may calculate the amount of their carbonates as between 15 to 25 %, largely potash, the ratio $\text{Na}_2\text{O}/\text{K}_2\text{O}$ (with the caution due to above considerations) being about 0.3. Very probably ashes of this composition were not suitable for producing a good quality glass, although they could perhaps have been used for manufacturing inferior quality semi-solid soaps made from animal fats, but certainly not for those made from olive oil.

There is some resemblance between the ash of *salsola kali* and di Catania. The Catania soda is much richer in table salt and the total amount of alkali carbonate (about 41 %) is slightly lower than in the *salsola kali* (45 %). On the other hand, the ratio of available Na_2O to K_2O is much higher in Catania ashes (1.6) than in *salsola kali* (0.84). Both these ashes are undoubtedly greatly inferior to the outstanding *salsola soda*, but perhaps by adopting different techniques they could have been used for various kinds of glass and soap.

The ashes of *Hammada scoparia* have a ratio of Na_2O to K_2O of 1.16, intermediate between the two discussed above. The total amount of alkali carbonates is rather low (27 %), slightly more than half of that of *salsola kali*. This means that almost double the amount of ashes would have to be used to obtain the same amount of soap. In today's terms, we could say that transport costs would have discriminated heavily against this raw material.

After analysing the composition of all these plants, one asks oneself which was used in Syria in the Middle Ages and in the

early Modern period for producing the ashes to be exported as raw material for the European soap and glass industries. Again we should turn first to the statements of same authors of those times.

Giovanventura Rossetti says that the ashes used for making soap from oil were a mixture of one part Levantine ash and one part ashes of local plants. But when calf or pig fat was used, he says, two parts of ashes of "cervo" (*quercus cerri* L.) and half a part of Levantine ashes were used.⁷⁵ This statement suggests that in the middle of the sixteenth century Levantine ashes were so rich in Na_2CO_3 that it was possible to mix or "dilute" them with European ashes, containing a negligible amount of this alkali.

Haudicquer de Blancourt⁷⁶ in 1697 described a very ingenious and sophisticated technique used by the Orientals. They dissolved the ashes in water and sprinkled the solution on the burning bushes, obtaining by this partial recycling an enrichment of the more soluble alkali carbonates in the ashes eventually produced. But it is worth noting that the very precise Rauwolf did not allude to this method of improving the quality of the ashes.⁷⁷

Since Professor Zohary has pointed out that the salsola soda is now a rare plant and it is the *Hammada scoparia* that is mainly used by Levantine populations for domestic use, the following conjectures may be made, with no claim that they have been proved by the facts known so far.

The plants used since ancient times in Syria were a mixture of several *Chenopodiaceae*, among which the salsola soda was probably predominant. The continuous destruction of this plant in the delicate desert ecosystem, made it more and more difficult to find the plant. The sophisticated technique used by the Bedouin

⁷⁵ ROSSETTI, *op. cit.*, p. 47, 65.

⁷⁶ HAUDICQUER DE BLANCOURT, *op. cit.*, p. 51.

⁷⁷ RAUWOLFF, *op. cit.*, 1.c.

at the end of the seventeenth century (and never referred to before that time, as far as we know) was dictated by the necessity of overcoming the decreasing quality of the ashes, due to the declining proportion of salsola soda in the mixture of the plants used. The quality of ashes shipped to Venice and other European ports was not constant over the centuries, but tended to decline. This may have been one reason for the declining competitiveness of Levantine ashes.

Much further research would be necessary to validate this hypothesis, but the scarcity of reliable chemical and botanical information before the beginning of the last century (when the synthesis of Na_2CO_3 by the Leblanc process caused a rapid decline in the commercial importance of plant ashes) will make this a very difficult task.

V. The Expansion of the Soap and Glass Industries

Southern European imports of large quantities of Levantine ash which began at the end of the thirteenth century ushered in the expansion of the soap and glass industries. One need only glance at the Merchant Guides compiled in Italy in the first half of the fourteenth century to be aware of the volume of the soap exports from Italy and other countries as well. By the beginning of the fourteenth century soap was exported from Italy to Syria which had had a well developed soap industry from ancient times.⁷⁸ From the work of Pegolotti we learn that large shipments of soap were sent to Cyprus, Rhodes and Constantinople⁷⁹ and to the provinces of Asia Minor under Turkish rule.⁸⁰ The Genoese exported great quantities of soap

⁷⁸ Marucelliana Library (Florence), C 226, Anonymous Merchant Guide, apud R. - H. BAUTIER, "Les relations économiques des occidentaux avec les pays d'Orient, au moyen âge, points de vue et documents," (in) *Sociétés et compagnies de commerce en Orient et dans l'Océan Indien*, Actes du VIII colloque int. d'histoire maritime, Beyrouth 1966 (Paris 1970), pp. 318, 319.

⁷⁹ p. 33, 158, 318 f.

⁸⁰ p. 56.

from Naples and Gaeta to Egypt in the second half of the fourteenth century.⁸¹ Savona too had a flourishing soap industry in the fifteenth century and exported its products.⁸² The Venetians greatly increased their exports of soap to the Moslem Levant in the fifteenth century.⁸³

TABLE VIII

SOAP EXPORTS ON VENETIAN ALEXANDRIA GALLEYS ABOUT 1500

Year	Quantity	Source
1498	573 sacks	Malipiero, p. 646 *
1500	62 sacks	Marino Sanuto, <i>Diarii</i> III, col. 1188; Priuli II, p. 74 **
1503	378 boxes	Priuli II, p. 255
1511	502 boxes	Marino Sanuto, <i>Diarii</i> XII, col. 78

* *Annali Veneti*, ASI VII, part 1 (1843).

** GIROLAMO PRIULI, *Diarii* (Bologna 1912-1936).

Part of these shipments was soap manufactured in Gaeta, another great centre of this industry.⁸⁴ Ragusa, the growing commercial town on the Eastern coast of the Adriatic also exported soap to Egypt.⁸⁵ The March of Ancona was a major centre for the soap industry, which used Apulian and local olive oils with Levantine ashes. The Anconitans exported great quantities of soap to the Greek and Moslem Levant in the fourteenth and fifteenth centuries.⁸⁶ As the export of soap became an important sector of the industrial production and foreign trade of the South European countries, measures were taken to foster it.

⁸¹ J. DAY, *Les douanes de Gênes 1376-1377* (Paris 1963), pp. 268, 351, 527.

⁸² F. NOBERASCO, "I commerci savonosi del sec. XV", *Atti della Società Savonese di Storia Patria VII* (1924), p. 76.

⁸³ See E. ASHTOR, "Observations on Venetian Trade in the Levant in the XIVth century", *JEEH V* (1976), p. 579.

⁸⁴ See the documents quoted in E. ASHTOR, "The Proche-Orient au bas moyen âge — une région sous-développée", note 21.

⁸⁵ Dat 1171, price list of February 26, 1396.

⁸⁶ E. ASHTOR, "Il commercio levantino di Ancona", *RSI* 88 (1976), p. 227 ff., 235 ff.; see also about the customs tariff C. CIAVARINI, *Statuti anconitani del mare, del terzenale e della dogana* (Ancona 1896), p. 144 f. and cf. p. 35.

Venice granted subsidies to the exporters in 1374 and 1391,⁸⁷ and even the Provençals exported soap to the Near East.⁸⁸

The new expansion of the glass industry was no less spectacular, and Venice especially, where Levantine ashes were used exclusively, became a renowned centre of glassmaking. The use of fern was strictly forbidden.⁸⁹ Whereas in the period of the Crusades only crude vessels had been produced and an effort was made to imitate Orient glass work, in the fourteenth century the manufacture of new types of transparent, coloured and enamelled glass began in Murano. In addition, the production of mirrors was begun,⁹⁰ and spectacles were also produced from the end of the thirteenth century.⁹¹ In the fifteenth century, the Levantine glass industry decayed while that of Murano reached its apogee. In the middle of the century, Angelo Barovier invented the "cristallo" and perhaps also chalcidony, which resembled agate.⁹² It seems that he also invented the *lattimo*.⁹³ All these achievements were due to the use of the high-grade alkali ash, rich in sodium, obtained from the Levant, and to the progress made in its purification.⁹⁴ These are facts borne out by decrees of the Venetian authorities, and also by other documents. Documents from the first half of the

⁸⁷ Misti 41, f. 127b and see *Capitolari dei Visdomini del fontego dei Tedeschi a Venezia*, ed. G.M. Thomas (Berlin 1874), p. 95 ff. i Savi N.S. 145, Commercio.

⁸⁸ ASV, Cancellaria Inferiore, Notai, Ba 229, Leonardo de Valle, sub 7 Febr. 1403.

⁸⁹ M.C., Spiritus, f. 48b.

⁹⁰ M.C., Clericus et Civicus, f. 136a; cf. B. CECCHETTI, *Sulle origini e sullo svolgimento della vetraria veneziana e muranese*, p. 10.

⁹¹ L. ZECCHIN, "Prodotti vetrari nei documenti veneziani (1333-1400)", *Riv. Staz. Sper.* IX (1979), p. 22.

⁹² L. ZECCHIN, "Angelo Barovier, vetraio del rinascimento", *Vetro e Silicati X* (1966), no. 58, p. 26; idem, "Il vetro "cristallino" nella carte del Quattrocento", *Vetro e Silicati VII* (1963), no. 38, p. 21 ff.

⁹³ L. ZECCHIN, "I "segreti" dei vetrai muranesi del Quattrocento", *Riv. Staz. Sper.* XI (1981), p. 169.

⁹⁴ L. ZECCHIN, "Prodotti vetrari nei documenti veneziani (1457-1468)", *Riv. Staz. Sper.* X (1980), p. 17; idem, "Nascita del cristallo veneziano", *Vetro e Silicati XI* (1967), no. 66, p. 21.

fourteenth century prove that in Murano Levantine sodium carbonate was used exclusively.⁹⁵ It was also used for the production of artificial jewels.⁹⁶ But it was not only in Murano that there was a great upswing in the glass industry. Tuscan craftsmen came to Murano, and after working there for some time then introduced Muranese methods of production into their own country.⁹⁷ In Tuscany, too, producers began to use Syrian ashes for the manufacture of glass.⁹⁸ Muranese glassmakers were also invited to work in other towns, or, more exactly, were enticed to emigrate from Venice against strict prohibition by the *Serenissima*. This was an old phenomenon, for the emigration of Muranese glassmakers had begun at the end of the thirteenth century when new glass factories were founded in Treviso, Vicenza, Mantua, Ferrara, and Bologna.⁹⁹ In the fourteenth and fifteenth centuries, when the reputation of the Muranese became very great, they were everywhere well thought of and well paid, and other rulers tried to bring them to their dominions.¹⁰⁰ Others left Murano on their own to try their luck elsewhere, and in 1392 some Muranese glassmakers or their apprentices introduced the glass industry into Ancona.¹⁰¹ The

⁹⁵ L. ZECCHIN, "Cronologia vetraria veneziana e muranese dal 1332 al 1345", *Riv. Staz. Sper.* III (1973), p. 215; idem, "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1348 al 1438", *Riv. Staz. Sper.* XI (1981), p. 76; *Dell'arte del vetro per musaico tre trattatelli dei secoli XIV e XV*, ed. G. Milanesi (Bologna 1864), p. 69, 72, 79, 81, 83 f., 86 f. (the second and third treatise published by Milanesi are of Muranese origin, see L. ZECCHIN, "Ricette vetrarie d'ispirazione muranese nel Quattrocento", *Riv. Staz. Sper.* XI, p. 265 ff.); cf. L. ZECCHIN, "Ricette vetrarie del '400 (reprint from *Giornale Economico*, Venice 1954) (Venice 1955), p. 29 f.

⁹⁶ *Dell'arte del vetro per musaico*, pp. 90, 128.

⁹⁷ L. ZECCHIN, "Forestieri nell'arte vetraria muranese (1276-138)", *Riv. Staz. Sper.* VII (1977), p. 275 ff.

⁹⁸ *Dell'arte del vetro*, pp. 39, 60 (the first of these treatises is of Tuscan origin, see L. ZECCHIN, "Ricette vetrarie toscane del Quattrocento", *Riv. Staz. Sper.* XI, p. 213).

⁹⁹ A. GASPARETTO, *Il vetro di Murano dalle origini ad oggi*, p. 53.

¹⁰⁰ L. ZECCHIN, "Vetriere muranesi fra il 1446 ed il 1447", *Riv. Staz. Sper.* IX (1979), p. 152 f.

¹⁰¹ C. ALBERTINI, *Storia d'Ancona*, MS. of the Bibl. Comunale of Ancona, IX, part 2, f. 155a.

Muranese founded glass factories in that period even in Germany.¹⁰² The same is true for the glassmakers of Altare, who were also well received in other countries and in the course of the fifteenth century founded factories in France and Belgium.¹⁰³

In that period, the flourishing glass industries of several regions of Southern Europe began to export their products to other countries. This began as early as the first half of the fourteenth century. In the second decade of the fourteenth century, Murano glass was to be found in Egypt;¹⁰⁴ in the 1340's, if not earlier, Italian glass was marketed in Greece, Rhodes and other regions that had once belonged to the Byzantine empire;¹⁰⁵ glass vessels were also exported to Constantinople and to the commercial towns on the coasts of the Black Sea and the Sea of Azov.¹⁰⁶ In the fifteenth century, the Venetians sold the products of their glass industry in Egypt and Syria, where they had originally learnt the craft of glassmaking.¹⁰⁷ The export of Murano glass and glass vessels to Constantinople went on after the town became the capital of the Ottoman Empire.¹⁰⁸

VI. Import of Levantine Ash in the XIVth-XVth Centuries

As the soap and glass industries of several European countries developed rapidly and production increased, ever greater quantities of Near Eastern ash were needed and its import be-

¹⁰² L. ZECCHIN, "Cronologia vetraria veneziana e muranese dal 1444 al 1454", *Rev. Staz. Sper.* VI (1976), p. 63.

¹⁰³ J. BARRELET, *La verrerie en France de l'époque gallo-romaine à nos jours*, pp. 65, 171 f., 178 ff.

¹⁰⁴ See E. ASHTOR, *Levant Trade in the later Middle Ages*, p. 25, note 122.

¹⁰⁵ *Lettere a Pignol Zucchello*, p. 38.

¹⁰⁶ L. ZECCHIN, "Prodotti vetrari nei documenti veneziani (1333-1400)", *Riv. Staz. Sper.* IX, p. 22.

¹⁰⁷ E. ASHTOR, "Aspetti della espansione italiana nel basso medioevo", *RSI* 90 (1978), p. 19.

¹⁰⁸ L. ZECCHIN, "Prodotti vetrari nei documenti veneziani (1469-1482)", *Riv. Staz. Sper.* X (1980), p. 61.

came a not insignificant branch of trade with the Levant. But even in this period when large volumes of this material were imported, the ashes of local plants were also used almost everywhere in Europe to prepare soda ash for the soap and glass industries, since the ashes of European plants were of course more easily available and cheaper. Competition between Levantine and European ashes therefore also characterised soap and glass production at the end of the Middle Ages.

In the fifteenth century it was mainly fern ash from the local forests and meadows, that was used in Tuscany,¹⁰⁹ in Sicily, the ashes of plants of the local Chenopodiaceae were used,¹¹⁰ since they grew everywhere in the province of Catania,¹¹¹ and were called *shebba*.¹¹² Some Italian manufacturers and merchants also tried to introduce Spanish ashes; letters written by a Florentine firm in Ancona in 1406 to the Datini company in Majorca and Barcelona contain a request for a supply of Spanish ashes.¹¹³ In Germany, in the fifteenth century, large quantities of plant ashes from the forests of Eastern Europe were imported via Reval, Riga and Danzig. From the Hanse towns Russian ashes were reexported to the Low Countries.¹¹⁴ Levantine ashes were supplied by the merchants of the South European "trading nations" who engaged in all branches of the trade with the Levant.

¹⁰⁹ See L. ZECCHIN, "Ricette vetrarie del '400", p. 9.

¹¹⁰ Fr. D'ANGELO, "Produzione e consumo del vetro in Sicilia", *Archaeologia Medievale* III (1976), p. 388.

¹¹¹ See M. BONNANO - Fr. D'ANGELO, "La vetreria di Cefalà Diana ed il problema del vetro siciliano nel medioevo", *Archivio Storico Siciliano*, series III, 21/22 (1972), p. 346.

¹¹² *Ibidem*. *Shabb* means alum in Arabic. So, as a result, in Sicily, as in Venice, sodium carbonate was called by a name derived from alum (*lume*).

¹¹³ Dat 844, letter of Gianni di Freduccio e Giovanni di Pietri of 10 April 1406; Dat 1044, letter of the same of 4 June, 1406.

¹¹⁴ Fr. STEWERT, *Geschichte und Urkunden der Rigafahrer in Lübeck im 16. und 17. Jahrhundert* (Berlin 1897), p. 147 f.; A. ATTMAN, *The Russian and Polish Markets in International Trade, 1500-1650* (Göteborg 1973), pp. 35, 43, 57, 58 and cf. p. 18. The ashes were often called potash because they were packed in boxes called pot. See Gasparetto, *Il vetro di Murano*, p. 24.

Immediately upon the renewal of direct trade with the Mamluk dominions in the middle of the fourteenth century, the Venetians began to ship great quantities of Levantine ashes to their metropolis.¹¹⁵ In that period, the preferred places for these purchases were the Syrian towns of Aleppo,¹¹⁶ Sarmin,¹¹⁷ Latakia,¹¹⁸ Tripoli,¹¹⁹ Beirut,¹²⁰ and Ramla.¹²¹ Sometimes they were also bought in Egypt,¹²² but Egyptian ashes were considered to be inferior. Pegolotti says that they were black and were transported to Europe as large blocks without being put in sacks. According to him, they were a third of the value of those of Syria. At the beginning of the sixteenth century, a Venetian merchant maintained that they could be used only for the production of soap, but not of glass.¹²³ The Venetians had no monopoly in this trade, and all the European Levantine traders had an interest in the purchase of the ashes of the *ushnān* and *salsola* growing in the Levant and eagerly acquired them. The Genoese exported them from Egypt and Syria, often shipping them directly to Flanders and England.¹²⁴ Certain clauses in

¹¹⁵ See *Misti* 23, f. 23b (a. 1345), 58a (a. 1346) 24, f. 20b (a. 1347) 26, f. 89a (a. 1352).

¹¹⁶ G.P. Ter. IX, f. 13a.

¹¹⁷ *Misti* 40, f. 117b.

¹¹⁸ *Cronaca Dolfin*, MS. Marciana Library of Venice, Ital. VII DCCXCIV, f. 378a, 400a.

¹¹⁹ G.P. Sent. 18, f. 85b ff. 54, f. 40a 71, f. 55a ff. 79, f. 118b ff. 84, f. 136b ff. 95, f. 75b f. 97, f. 116b ff. 99, f. 26a ff. 123, f. 53b ff. 140, f. 58b 165, f. 183b 187, f. 101a ff.; G.P., Ter VII, f. 2a f.

¹²⁰ *Misti* 52, f. 34a f.; G.P. Sent. 20, f. 122a 30, f. 74b 53, f. 23a 124, f. 63b ff. 153, f. 28b ff.; G.P., Ter. III, f. 82a; ASV, Cancelleria Inferiore, Notai, Ba 83, Cristoforo del Fiore VI, f. 5b; Marino Sanuto, *Diarii* I, col. 604.

¹²¹ G.P., Sent. 23, f. 75b. Ashes bought in Ramla were shipped from Jaffa, see *Misti* 47, f. 7a f.

¹²² *Misti* 23, f. 23b, 58a 24, f. 20b f. 26, f. 89a.

¹²³ Pegolotti, p. 180; see further the merchant letters quoted by G. della Santa (according to note 157) p. 1550.

¹²⁴ See the freight inventories in E. ASHTOR, "Il volume del commercio levantino di Genova nel secondo Trecento", (in) *Saggi e documenti I* (Studi e testi, serie storica 2) Civico Istituto Colombiano (Genova 1978), p. 432; Car. Vet. 1552, f. 125a, 127a 1553, f. 23b. ASG, notary Battista Airola, 13, sub 3 July 1483. Cf. E. ASHTOR, "Le

the commercial treaties between Florence and the Mamluk sultan refer to the purchase of these ashes in Syria.¹²⁵ The Anconitans, too, carried heavy shipments of Syrian ashes to their town,¹²⁶ while the Provençals did not lag behind them, buying the ashes of the ushnan and salsola in the Near Eastern markets.¹²⁷

The price of the ashes on the Levant was low; in the fifteenth century, in Syria, the price of a kinjār of 180 kg. was 2 ducats or even less¹²⁸ (Table IX), but the freight of this cheap commodity

TABLE IX
PRICES OF SYRIAN ASH IN THE MIDDLE OF THE FIFTEENTH CENTURY

Date	Place	Price of a Kinjār	Source
1426	Tripoli	2 ducats	G.P., Sent. 65, f. 129a f.
1440	»	2 ducats	same series 88, f. 30b ff.
1441	»	1.7-1.87 ducats	same series 97, f. 116b ff.
1468	»	1.2 duc. (60 dirh.)	same series 165, f. 183a
before 1473	»	0.63-0.725 ducats	same series 158, f. 43a, f.
1473	Damascus	1.4 duc. (70 dirh.)	same series 169, f. 172b ff.
1476 (or 1477)	Aleppo	2.5 ashrafis *	G.P., Ter. IX, f. 13a

* The *ashrafī* generally had the same value as the ducat, see E. ASHTOR, 'Etudes sur le système monétaire des Mamlouks circassiens,' *Israel Oriental Studies VI* (1976), p. 272.

Proche-Orient au bas moyen âge - une région sous-développée", p. 407 and notes 182-184.

¹²⁵ J. WANSBROUGH, "A Mamluk Commercial Treaty Concluded with the Republic of Florence 894/1489", (in) *Documents from Islamic Chanceries*, ed. S.M. Stern (Oxford 1965), p. 65; idem, "Venice and Florence in the Mamluk Commercial Privileges", *BSOAS* 28 (1965), p. 505. In the treaty quoted in the first place, the ashes are called *kily* (*kali*), but in the second one there appears the name *bul*s (here vocalised, and cf. above note 49). This latter word seems to have been the official name of the commodity. It does not appear in the Arabic dictionaries.

¹²⁶ F. MELIS, *Documenti per la storia economica dei secoli XIII-XVI* (Florence 1972), p. 144; *ASV*, Cancelleria inferiore, notai, Ba 229, Leonardo de Valle sub 19 Aug. 1402.

¹²⁷ Dat 1171, freight inventory of the ship of M ... Luziano which arrived on 28 April, 1397, in Marseilles.

¹²⁸ See E. ASHTOR, "Le Proche-Orient au bas moyen âge - une région sous-développée", p. 409. The data in the following table should be added.

was relatively costly, although the ashes were used as ballast; in the course of time it decreased. As can be seen in table X, the freight of a Syrian *kinṭār* of ashes decreased from three ducats at the beginning of the fifteenth century to 1.5 in the second half. The decrease in the freight charges for the Levantine ash was considerable and was the consequences of a well planned policy by the Venetian government, as is evident from comparison with the prices paid for the transport of cotton. Whereas the freight cost of ashes decreased by 50%, that of cotton went down by only 20% (see Table XI). This is a clear proof that the Senate

TABLE X

FREIGHT COSTS OF LEVANTINE ASH ON VENETIAN COGS
(for a migliaio of 477 kg.)

Year	Syrian cogs	Alexandrian cogs	Source
1371		4 ducats	Misti 33, f. 110b
1373		3 "	" 34, f. 48a
1374	3 ducats		" 34, f. 76b f.
1378	6 "		" 36, f. 59b
1384		4 "	" 38, f. 127b
1385		3 "	" 39, f. 92a
1395		3 "	" 43, f. 65a f.
1396		3 "	" 43, f. 130b f.
1400		3 "	" 45, f. 144b f.
1404		3 "	" 46, f. 144b f.
fall 1405	3 "		" 47, f. 7a f.
spring 1406	2.5 "		" 47, f. 25b
fall 1417	2.5 "		" 52, f. 24a f.
spring 1426	2.5 "		" 55, f. 182a
fall 1426	2 "		" 56, f. 16b f.
fall 1427	2 "		" 56, f. 105a
spring 1428	2 "		" 56, f. 142b.
fall 1430		2 "	" 57, f. 233a cf. 232a
fall 1431	3 "		" 58, f. 60a ff.*
fall 1456	2 "		S. Mar V, f. 154b f.
1468	1.5 "		G.P., Sent. 165, f. 183b
fall 1473	1.5 "		S. Mar IX, f. 174a f.**

* Because of great insecurity on the sea, special measures were taken, and freight charges increased.

** In fact this is only a proposal; the decision is missing.

TABLE XI

FREIGHT COSTS OF COTTON ON VENETIAN COGS
(for a migliaio of 301 kg.)

Year	Syrian cogs	Alexandrian cogs	Source
1368		2 ducats	Misti 32, f. 131a
1371		8 "	" 33, f. 110b
1373		6 "	" 34, f. 48a
1374		6 "	" 34, f. 76b f.
1384		6 "	" 38, f. 127b
1385		6 "	" 39, f. 92a
1395		6 "	" 43, f. 65a f.
fall 1405	12 ducats		" 47, f. 7a f.
spring 1406	7 "		" 47, f. 25b f.
fall 1417	6 "		" 52, f. 24a f.
spring 1426	7 "		" 55, f. 182a
fall 1426	6 "		" 56, f. 16b
fall 1427	5 "		" 56, f. 105a
spring 1428	6 "		" 56, f. 142b
fall 1439	6 "		" 60, f. 119a
fall 1456	6 "		S. Mar V, f. 165a
fall 1473	5.5 "		S. Mar IX, f. 164a f.

TABLE XII

PRICES OF LEVANTINE ASH IN ITALY

Year	Town	Price of a migliaio	Source
1428	Venice	10.5 ducats	G.P., Sent. 73, f. (between 86 and 87) *
1444	Ancona	25 "	Same series 104, f. 63a **
1449	Venice	18 "	Accounts Fr. Contarini, f. 45a ***
1452	Venice	16 "	G.P., Sent. 129, f. 84b ff.

* This is a barter price.

** The migliaio of Ancona was of 346 kg.

*** Venice, Museo Correr, PD C 912/L

of Venice considered the import of large quantities of Levantine ash to be vital for her economy. But although the price of the article in the Near East was low and freight charges went down, its price in Southern Europe remained high.

The data we have cited seem to point to at least a 200% gross profit. However, the merchants had relatively high expenses,¹²⁹ as is clearly shown by the accounts that have come down to us of certain Venetian firms (see Table XIII). The profits in any case were considerable, and as the demand for the article was brisk the Levant traders eagerly engaged in this sector of trade.

Venetian merchants bought 400-500 *kinṭārs* or more in a single year.¹³⁰ The total amount of the shipments the Venetian cog convoys carried from Syria in certain years can be found in some sources. The greatest part of the Levantine ashes was shipped to Venice by the cotton cogs, whereas the galleys loaded them only when they had empty space. Of course, sometimes other ships brought the "*lume*" to Venice,¹³¹ but the bulk of the Levantine salsola ashes arrived on the cog convoys, and Venice held the lion's share of this import trade. Data on the shipments of ashes by these convoys are therefore of great value (see Table XIV).

The data available are not sufficient to draw firm conclusions, but they give the impression that at the end of the fourteenth century and the beginning of the fifteenth century the spring convoys of the Venetian cotton cogs carried no more than 400-800 sacks to the metropolis. The quantity carried to Venice by the autumn convoy of 1396 may perhaps have been more characteristic of the volume of the Venetian shipments of this commodity. Yet there is a great discrepancy between the evidence on the purchases of Levantine ashes made by single Venetian merchants in the fifteenth century and these shipments. On the other hand, certain data of the late fifteenth century point to 1000-1200 sacks being loaded on one Venetian cog.¹³² One could therefore con-

¹²⁹ See S. Mar I, f. 125b about the consular dues.

¹³⁰ See E. ASHTOR, "The Venetian Supremacy in Levantine Trade", *JEEH* III (1974), p. 45; to be added G.P., Sent. 54, f. 40a f. 153, f. 28b ff.; G.P., Ter. IX, f. 13a.

¹³¹ See G.P., Sent. 146, f. 47b ff. On the transport of the ashes on the cogs, see (besides the texts quoted in note 115) *Misti* 32, f. 131a.

¹³² See GIROLAMO PRIULI, *Diarii I*, p. 42; DOMENICO MALPIERO, *Annali Veneti*, p. 629.

TABLE XIII

ACCOUNTS OF VENETIAN TRADERS

a) Luca & Andrea Vendramin	a. 1441
	purchase of 2184 <i>ķintār</i> ashes in Tripoli
	net price 4905 duc.
G.P., Sent. 97, f. 116b ff.	expenses in Syria 1389 duc.
	expenses 34.7%
b) Domenico Erizo	a. 1468
	purchase of 282.4 <i>ķintār</i> in Tripoli
	price (with expenses
	in Syria) 542.5 duc.
	freight 175 "
	expenses in Venice 20.5 "
G.P., Sent. 165, f. 183b	(expenses 36%)

TABLE XIV

VOLUME OF IMPORTS TO VENICE

Year		Quantity	Source
1386	spring fair	160 migliaia	Dat 548, letter of Zanobi di Taddeo Gaddi of 15 May 1386
1394	spring fair	790 sacks	Dat 797, letter of the same of 30 April 1394
1395	spring fair	1200 migliaia	Dat 926, letter of the same of 26 May 1395
1396	fall fair	2000 sacks	Dat 550, letter of the same of 26 Oct. 1396
1406	spring fair	500 sacks	Dat 929; letters of the successors ("commessaria") of Zanobi and of Ant. di Ser Bartolomeo of 14 and 21 Aug. 1406; Ibid., letter of Giannozzo Ant. degli Alberti of 7 Aug. 1406*

* The last letter states that the cogs carried 563 sacks of ashes to Venice.

clude that in the course of the fifteenth century the volume of the Venetian ash trade increased very greatly as the data for the end of the fifteenth century point to the import of 10,000 sacks a year.¹³³

It is certainly true that Venetian merchants supplied Constantinople, and especially Gaeta,¹³⁴ with the Levantine ashes, just as did the Genoese,¹³⁵ and that sometimes the stocks in Venice were so great that there were requests to export it¹³⁶ but this was in fact conceded only as an exception,¹³⁷ because the policy of the Venetian government was to forbid the supply of this excellent raw material to the industries of other countries. Time and again the *Maggior Consiglio* or the Senate decreed that the export of "lume" was forbidden (e.g., in 1332,¹³⁸ 1384,¹³⁹ and 1468.¹⁴⁰ The attitude of the Venetian government was very rigid because some merchants carried Levantine ash to Gaeta and Gallipoli (in Apulia), which were centres of the soap industry, as an investment in order to market the soap produced with it in the Near East. This was strictly forbidden in 1489.¹⁴¹ Proposals to allow the export of the ashes were seldom carried in the Senate,¹⁴² and the *Serenissima* took no notice when the prohibition aroused the anger of princes. In the year 1394, Gian Galeazzo Visconti, prince of Milan, sent an ambassador to Venice to request the re-

¹³³ G.P., Sent. 78, f. 57b ff. 165, f. 93b f.

¹³⁴ G.P., Sent. 20, f. 122a 71, f. 55a ff.

¹³⁵ Car. Vet. 1552, f. 125a.

¹³⁶ Misti 39, f. 58b.

¹³⁷ Misti 47, f. 161a; L. ZECCHIN, "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1439 al 1452", *Riv. Staz. Sper.* XII (1982), p. 65.

¹³⁸ M.C., Spiritus, f. 48b; published by B. Cecchetti, *Sulla storia*, p. 32; cf. L. ZECCHIN, "Materie prime e mezzi d'opera nei documenti veneziani dal 1233 al 1347", *Riv. Staz. Sper.* X (1980), p. 174.

¹³⁹ Misti 38, f. 117a.

¹⁴⁰ S. Terra VI, f. 20b.

¹⁴¹ MALIPIERO, *Annali Veneti*, p. 685; S. Terra X, f. 170a f. The decree was repeated in 1492, see S. Mar. 13, f. 92b.

¹⁴² See L. ZECCHIN, "Materie prime e mezzi d'opera dei vetrai nei documenti veneziani dal 1348 al 1438", *Riv. Staz. Sper.* XI (1981), p. 77.

vocation of this prohibition, because Levantine ashes were a raw material necessary for the production of majolica. As a reprisal he threatened that he would forbid the export of the pebbles of the river Ticino to Venice. Since these pebbles were the most important component of glass the Venetians were very keen indeed to obtain this particularly excellent kind.¹⁴³ The German merchants who traded in Venice also tried to purchase the precious Levantine ashes, but this was forbidden in 1469.¹⁴⁴

VII Levantine and European Ashes, 1500-1650

The competition between the Levantine ashes and the ashes of local European plants continued in the sixteenth and seventeenth centuries. In some countries of Western and Central Europe, the ashes of local plants or those from other parts of Europe were largely, if not exclusively, used for the production of soap and glass. In other centres of these industries the Levantine ushnān and salsola ashes were still used.

In sixteenth century England, there were various kinds of soap: coarse soap, made from train oil (obtained from the blubber of whales); sweet soap made from olive oil; and speckled soap made from tallow. The ashes used for the production of these soaps were imported from Denmark. Perfumed soap from Bologna and Naples was imported, as well as soap from Spain, in the production of which the ashes of the local plants were certainly used.¹⁴⁵ Ashes of plants growing in Russia and the neigh-

¹⁴³ *Libri Commemorali* VIII, no. 415 (ed. Predelli III, p. 225 f.)

¹⁴⁴ L. ZECCHIN, *Nuovi appunti di storia vetraria muranese* (Venezia 1958), p. ff.; idem, "L'arte vetraria muranese all'inizio del 1469", *Riv. Staz. Sper.* VI (1976), p. 253 f.

¹⁴⁵ GIBBS, "The History of the Manufacture of Soap," *Annals of Science* IV, p. 173 f. Concerning the salsoleae plants in Spain, see M. WILKOMM - J. LANGE, *Prodromus florum Hispanicae* (Stuttgart 1861-1880) I, p. 257 ff. On the imports of Spanish soap into England in earlier periods see R. DOEHARRD - Ch. KERREMANS, *Les relations commerciales entre Gènes, la Belgique et l'Outremont* (Brussels-Rome 1952), no. 643.

bouring regions of Eastern Europe were also widely used in the soap industries of Central and Western Europe in the sixteenth century. They were imported via Riga, Königsberg, and Danzig through the sixteenth and seventeenth centuries to Lubeck and farther to the Netherlands and to England.¹⁴⁶ However, certain quantities of Levantine ashes were imported into Germany from Venice.¹⁴⁷

As in earlier ages, much high-quality soap was manufactured in Italy, using various raw materials. Genoa and Venice were the main centres of the industry. The renown of Venetian hard soap was very great everywhere and accordingly people in other countries tried to imitate its production. In the year 1622, a patent was granted in England to two manufacturers, Jones and Palmer, for the production of this article, called Venetian or Castille soap.¹⁴⁸ In Venice, use was made of olive oil and also the fat of oxen and cattle, together with ashes of the bitter oak [*quercus cerris*] and the Levantine *ushnān*, as can be learned from treatises on the subject written in the sixteenth century.¹⁴⁹ A well-informed author in the middle of the sixteenth century says that for soap-making ashes from Beirut were the best, and those of Tripoli which were second only to them: the third place in terms of quality was held by that of the West, the ashes of Alicante. The lowest quality were the ashes coming from Egypt.¹⁵⁰ There can be no doubt that in sixteenth-century Venice considerable

¹⁴⁶ FR. SIEWERT, *Geschichte und Urkunden der Rigafahrer*, p. 199, 237, 286, 309; H. RACHEL, *Die Handels-, Zoll- und Akzisenpolitik Brandenburg-Preussens bis 1713* (Berlin 1911), p. 368; A. ATTMAN, *The Russian and Polish Markets in International Trade, 1500-1650*, pp. 43, 46, 47, 49, 51 ff., 54, 55, 56 ff., 58, 60.

¹⁴⁷ H. SIMONSFELD, *Der Fondaco dei Tedeschi in Venedig* (Aachen 1968) II, p. 196.

¹⁴⁸ GIBBS, "The History of the Manufacture of Soap", p. 175.

¹⁴⁹ GIOVANVENTURA ROSSETTI, *Notandissimi secreti de l'arte profumatoria*, p. 47 f., 64 ff., 102, 104 f., 111 f. The oak tree is called cerro in Italian, that is, *quercus cerris*, cf. P. ZANGHERI, *Flora Italica I* (Padua 1976), p. 82; A. FIORI, *Nuova flora analitica d'Italia* (Florence 1923-1929) I, p. 364.

¹⁵⁰ TOMASO GARZONI, *La piazza di tutte le professioni nel mondo* (Venice 1665), p. 605 (The first edition of the book is of Venice 1587).

quantities of Levantine ash were needed as the soap industry was flourishing and its export reached a sizeable volume. There were many soap factories in Venice, on both sides of the Grand Canal, in the parish of S. Giobbe (where the name Ponte della Saponella remains to this day), in that of S. Pantaleone (where there is a Calle della Saoneria), in S. Polo (Calle seconda dei Saoneri) and in S. Barnaba (Calle dei Saoneri).¹⁵¹ The Venetian soap for which Levantine ash was used was a high-quality product, and when, in 1566, Teodoro Spinola proposed introducing into Venice the manufacture of soap such as that produced in Lombardy, Genoa, Rome, Naples, Sicily, Provence, France and Savoy, the "Provveditori di comun" refused to grant him a licence, maintaining that the production of such soap, (for which the ashes of Provençal and Spanish plants would be used) would be prejudicial to the reputation of the Venetian industry.¹⁵² As in earlier ages, the Senate of Venice maintained a strict prohibition of the export of these Levantine ashes.¹⁵³ The volume of production at the end of the sixteenth century was about 13 million pounds a year.¹⁵⁴ The olive oils of Apulia and the ashes of Syrian and Egyptian herbs were still preferred. The production of 18,000 lb. of soap required 3000 lb. of Syrian ashes plus 1500 of Egyptian.¹⁵⁵ The prosperity of the Venetian soap industry continued in the first half of the seventeenth century and in the 1620's 6 million pounds a year were exported.¹⁵⁶

That considerable quantities of Levantine ashes were imported to Venice and other industrial and commercial centres in the sixteenth century is borne out by documents referring to this trade.

¹⁵¹ G. TASSINI, *Curiosità veneziane*, p. 624 f.

¹⁵² G. MANDICH, "Privilegi per novità industriali a Venezia nei secoli XV e XVI", *Deputazione di Storia Patria per le Venezie, Assemblee*, 8 Sept. 1963, p. 31.

¹⁵³ *Savi* N.S. 145, Commercio, part 2, decision of the Senate of 8 Nov., 1553.

¹⁵⁴ D. SELLA, *Commerci e industrie a Venezia del secolo XVII, notizie sull'industria del sapone* (Venice 1961), p. 132 ff.

¹⁵⁵ *Ibidem*.

¹⁵⁶ *Ibidem*.

Letters of Venetian merchants at the beginning of the sixteenth century deal with the import of various kinds of Levantine ashes into the metropolis which were purchased in Tripoli and Beirut.¹⁵⁷

However, high-grade soaps were also produced from other raw materials in that period in Italy. A sixteenth-century author reports that a lye prepared from the ashes of poplar and quicklime was used,¹⁵⁸ and in place of Levantine ashes a good deal of oak ash was used for the production of certain kinds of soap. In the first half of the seventeenth century, new soap industries were founded in various provinces of Italy — in Ferrara, Mantua, and Liguria — all of them using the ashes of local plants.¹⁶⁰ The soap industry of Venice began to decay when owing to the decline of Venetian trade and of her fleet, the supplies of Levantine ashes were no longer sufficient. Perhaps the qualitative decline of the Levantine ashes also played a part in this. Competition from the new soap industries of other towns was another reason. The soap-makers of Venice began to emigrate although government tried in vain to induce them to return.¹⁶¹ On the other hand, soap produced outside the Venetian territory began to be imported. In the middle of the sixteenth century, the Senate began to take measures against these infringements of the law.¹⁶² Most of the soap produced by the new industries was of inferior quality, but nevertheless it was imported into the Venetian dominions despite the prohibition by the government.¹⁶³

¹⁵⁷ D. DALLA SANTA, "Commerci, vita privata e notizie politiche dei giorni della Lega di Cambrai, da lettere del mercante veneziano Martino Merlino", (in) *Atti del R. Istituto Ven. di scienze, lettere ed arti* 76 (1916/7), p. 1549 f.

¹⁵⁸ *The Secrets of Alexis of Piedmont* (London 1615), f. 50a.

¹⁵⁹ See above MS. TIMOTEO ROSELLI, *De' secreti universali* (Venice 1644), f. 86b, 89b.

¹⁶⁰ Sella, *Commerci e industrie*, p. 133 f.

¹⁶¹ See the decree: Parte presa nell'eccellentissimo Senato 1613 a 19 genaro in materia di savoni, stampata per Ant. Pinelli, stampator ducal.

¹⁶² H. KALLPELZ, Die venezianische Seifenindustrie im 17. und 18. Jahrhundert, *Zeitschrift f. Bayerische Landesgeschichte* 29 (1966), p. 440.

¹⁶³ *Ibidem*.

As far as the glass industry is concerned, Venice reached the apogee of a long development in the sixteenth century and the production of her workshops was renowned and imitated all the world over. This was undoubtedly to a great extent the consequence of the use of high-grade raw materials, among them the ashes of the Levantine *ushmān* and *salsola*. This fact is clearly shown by treatises written in the sixteenth century by specialists. These authors explain that ashes of Spanish plants produce a bluish glass.¹⁶⁴ Glass made from ashes of fern, they say, is yellow and fragile.¹⁶⁵ Even the methods of production used in Murano were considered exemplary.¹⁶⁶ In the glass exhibition in the Correr Museum (Venice) in October, 1982, an unpublished manuscript of about 1700 was exhibited which reads: « Da molti paesi vengono ceneri che si adoprano in Murano. Da Spagna, e questi sono buonissime da vetro come ancora quelle che vengono da Tripoli di Soria, ma quelle che vengono d'Aleppo, da Acris, da Cartagine sono inferiori, e s'addimandano magre... stentano a far vetro, ma vengono anco d'Alessandria, ma queste non sono buone a far altro che negro ». The author of the compendium (of the kind of those "Ricettari" so popular in those days¹⁶⁷) considered the ashes brought from Tripoli in Syria and those coming from Spain as the best. But he held not all Syrian ashes in esteem. Haudicquer de Blancourt who published a comprehensive and scientific work at the end of the seventeenth century had another opinion. He emphasizes that crystal is always made from Syrian ash because the sodium carbonate obtained from it is white and blue tinge and ren-

¹⁶⁴ ANTONIO NERI, *L'arte vetraria* (Florence 1612, reprint Milan 1980), cap. I.

¹⁶⁵ LEONARDO FIORAVANTE, *Specchio di scientia universale* (Venice 1564), f. 68a.

¹⁶⁶ *Op. cit.*, f. 67b. See further on the use of Levantine ashes the "Ricettario di Montpellier" dating to 1536 and of Muranese inspiration, published by L. ZECCHIN, *Bollettino della Staz. Sper. del Vetro* VII, no. 5 (1963), p. 8, 12 and cf. "Le ricette vetrarie di Montpellier", *Journal of Glass Studies* VI (1964), p. 75 ff.

¹⁶⁷ The MS is property of Dr. Mario Barbini of Florence. Cartagine is of course Cartagena in Spain.

ders the glass as beautiful as it is. The author also says that in his day Levantine ash was still used in Murano.¹⁶⁸

So through the sixteenth and seventeenth centuries the ashes of the Levantine *ushnān* and *salsola* held a preeminent place among the raw materials used in Southern Europe for the production of high-quality merchandise. Even in that period they were used not only for the production of soap and glass, but also of artificial jewels such as beads of different colours.¹⁶⁹ The soda obtained from the Levantine ashes was also used for cleaning teeth and hands.¹⁷⁰ However the use of Levantine ash was very limited or even rare in the glass factories that had sprung up in the sixteenth and seventeenth centuries in Western and Central Europe. In England in the sixteenth century fern ash was used and although Levantine ashes were imported from Venice later, attempts were made to use potash (instead of the ashes of plants growing on sea coasts). In France the ashes of local plants were used; in the sixteenth century it was those of ferns growing on the banks of the Rhone. Haedicquer de Blancourt says that at the end of the seventeenth century Levantine ash was not used any more in France: the Royal glass manufacturers in Saint-Gobain normally used Spanish ashes.¹⁷¹ Even the new glass factories in some towns of Italy used either ashes of Spanish plants¹⁷² or those of plants growing on the coasts of the Adriatic or in the marshes of Tuscany.¹⁷³

¹⁶⁸ De l'art de la verrerie, p. 49 ff.

¹⁶⁹ NERI, *L'arte vetraria*, cap. 102.

¹⁷⁰ ROSETTI, *De' secreti universali*, f. 96a; *Ricettario galante del principio del secolo XVI*, ed. O. Guerrini (Bologna 1883), p. 66, 72.

¹⁷¹ VANNUNCIO BIRINGUCCI, *Pirotechnia* (Venice 1559), f. 98b; Haedicquer de Blancourt, p. 52. The *vareque* was used a great deal, see P. FOURNIER, *Les quatre flores de la France* (Paris 1961), p. 135; Cl. Pris, *La manufacture royale de glace de Saint-Gobain, 1665-1830* (Université de Lille 1975) I, p. 197.

¹⁷² G. TADDEI, *L'arte del vetro in Firenze* (Florence 1954), p. 29.

¹⁷³ De' discorsi di M. Pietro Andrea Matthioli Senese, part II (Venice 1604), p. 1430 (first edition 1554) (Matthioli lived 1500-1577).

VIII. The Decline of the Levantine Ash Trade

In the seventeenth century both the soap and the glass industries of Italy (mainly those of Murano) which produced high-quality articles began to decline. This decline resulted in a further decrease in the import of Levantine ash and later it was no longer necessary because new inventions made its use superfluous and anachronistic.

In the year 1714, of the 30 soap factories with 90 boiling-vats that had existed in Venice, only 7 plants with 21 boiling-vats remained. The decay of the once famous soap industry of Venice was the sequel of the upswing of the soap factories of Naples, Apulia, Milan, Mantua and Genoa.¹⁷⁴ But it was also the consequence of the imposition of a tax on olive oil first introduced in 1625, abolished in 1635, 1649 and 1715, but each time reestablished.¹⁷⁵ At the end of the seventeenth century and at the beginning of the eighteenth century the decline was rapid; whereas in March-July 1641, 499,000 lb. had been exported to Germany (via the *fondaco*), between 1713-1715 only 36,000 lb. on average were exported.¹⁷⁶ When the decline became obvious, there were attempts to replace Levantine by local ash, but these attempts did not prove successful.¹⁷⁷ Ashes imported from the Levant were still used for producing high-grade soaps, and export accounts in the years 1697-1706 show that the quantity of the inferior "black soap" exported from Venice was less than half of that of the "white soap".¹⁷⁸ At the same time, a flourishing soap industry developed in Crete and its products were exported to Turkey, Syria, Egypt, and also to Italy. This industry, whose

¹⁷⁴ KALLFELZ, Die venezianische Seifenindustrie im 17. und 18 Jahrhundert, p. 438. But in another document referring to the olive oil used by the soap factories in 1715-1717, eight are listed, see *Savi* N.S. 145, Commercio, part 2.

¹⁷⁵ Art. cit., p. 435. The (printed) decrees of the abolitions in 1634 and 1715 are to be found in *Savi*, N.S. 145.

¹⁷⁶ Art. cit., p. 450.

¹⁷⁷ Art. cit., p. 436.

¹⁷⁸ *Savi* N.S. 145, Commercio, part 2.

success was a severe blow to that of Venice, used Sicilian ash,¹⁷⁹ but in order to improve its quality (it was very poor in alkalis) it was shipped to Tripoli where Syrian ash (as much as a fourth of the weight) was added to it. This was reported by the Swiss traveller, J.L. Burckhardt, who had embraced Islam and visited Syria in 1811.¹⁸⁰

The reason for the decay of the famous Venetian glass industry was the development of new industries in several countries of Western and Central Europe, most of them founded by glassmakers who had emigrated from Murano or Altera. They had founded glass factories in France in the fifteenth century, and in the sixteenth and seventeenth centuries they worked in England and elsewhere.¹⁸¹ No Levantine ash was used by these factories. Then, around 1680 in Bohemia, a new method of using potash (instead of soda) together with a great quantity of chalk was invented: the glass produced by this method was colourless and strong, and it began to be exported to Venice.¹⁸²

In Venice attempts at recovery were made by introducing other raw materials. In the year 1739, the brothers Mazzola proposed to use in Murano certain Silesian materials which were also used in England, and made the glass white and transparent. The Venetian government hesitated and finally allowed its use in one furnace producing *lattimo*.¹⁸³ The enterprising glassmaker Giuseppe Briatta succeeded in bringing the decline of the famous industry of Murano to a halt through the use of this material on a large scale.¹⁸⁴ Then in 1776, Giorgio Barbaria, back from long travels in Western Europe, proposed the use of Spanish plant ash.¹⁸⁵

¹⁷⁹ Y. TRIANTAFYLIDES, "L'industrie du savon en Crète au XVIII^e siècle, aspects économiques et sociaux", (in) *Etudes Balkaniques* XI (1975), p. 78.

¹⁸⁰ J.L. BURCKHARDT, *Travels in Syria and the Holy Land* (London 1882), p. 168.

¹⁸¹ G. MARIACHER, *L'arte del vetro* (Milan 1954), p. 116 ff.

¹⁸² A. GASPARETTO, *Il vetro di Murano dalle origini ad oggi*, p. 115.

¹⁸³ B. CECCHETTI, *Sulla storia dell'arte vetraria muranese*, p. 231.

¹⁸⁴ *Op. cit.*, p. 24.

¹⁸⁵ GASPARETTO, *op. cit.*, p. 191.

Three years later, in 1779, Pietro Arduino, a botanist and professor of agriculture in Padua (1728-1805) suggested cultivating the local plant called *roscano* systematically and published instructions on how to obtain soda for glassmaking from its ashes.¹⁸⁶ Another Venetian, the engineer Lorgna, suggested using fern ashes.¹⁸⁷ None of these proposals, however, had any success. The times when the Venetian cogs had carried thousands of sacks of Levantine ashes to Venice and Murano glass had enjoyed an unchallenged reputation were over. But ashes imported from other regions were still used in Venice. A French traveller who visited Venice in 1785 recounts that ashes from Spain were used in Murano for producing the glass.¹⁸⁸ At the beginning of the nineteenth century there was a shift to the use of Sicilian ashes coming from Catania.¹⁸⁹

Meanwhile new methods of producing the alkali carbonates for manufacturing soap and glass had been discovered and imports of ashes of *ushnān* from the Levant or ashes from other regions were no longer necessary.

¹⁸⁶ The Senate decreed its publication in 1780, see S. Terra 398, f. 150. It was published with the title: *Istruzione dei modi da praticarsi per coltivare il kali maggiore o sia salsola soda erba comunale nota col nome toscano e di formare la soda, genere che impiegasi nella composizione di vetri, e di sapone ... stanpata ... aprile 1700, Figliuoli di Ant. Pinelli.*

¹⁸⁷ B. CECCHETTI, "Sull'origine e sullo svolgimento della vetraria veneziana e muranese", p. 32.

¹⁸⁸ Joseph-Jerôme Le Français de Lalande (ou de la Lande), *Voyage en Italie*, 2nd ed., (Geneva 1790) VII, p. 83. Lalande (1732-1807) was an astronomer.

¹⁸⁹ V. ZANETTI, *Guida di Murano e delle celebri sue fornaci vetrarie* (Venice 1866), p. 24.