ON COMMON SALT

that is

ON MINED OR CRYSTAL, SEA OR SPRING SALT

by

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I.

Testing Salt Water to See How Much Salt it Contains

1. By taste. The most general test is by taste, for by tasting one can tell whether the water contains much or little common salt. However, the sense of taste can be mistaken in determining the quantity, as well as the quality; so it is not enough to check salt water by taste alone, but it is necessary to add physical and mechanical experiments to determine the exact quantity, as well as the real quality.

2. **Common methods.** If one wishes to make a strong salt solution *(lixivium),* as is done in salt-refining operations, the salt must be dissolved in water; when enough is dissolved, the impure and foreign matter is expelled and foams off. Then it is necessary to check the solution to see whether it is saturated or not, that is, whether it has dissolved enough salt. This is tested in various ways, but mainly with *amber.* Since amber is nearly of the same density as water, water and amber balance; thus in plain water, the amber neither bobs up[1] nor sinks, but rather, it floats, so that hardly any of it sticks out of the water; yet it does not go to the bottom, either. So when the solution is saturated, the amber rises visibly and a portion of it sticks out of the water, thus signalling that the solution is saturated, or that a sufficiency of salt is held dissolved in the water. The same thing is being accomplished by others with a *special glass ball* partly hollowed out, or filled with gas *(aether)* or air. This globe is brought into balance with the water, so that it neither sinks nor floats on the top. The ball is watched: when it floats in the liquid and rises to a given height above the water, that is a sign that the water is reaching saturation. By others that globe is made more effectively: it is just heavy enough that it goes to the bottom in fresh water; but in salty water, since this is denser, it floats up and rises out. The device

[1] Reading *fluitat* for *fluit* in ms.

is best made of amber or glass, for if it is made of iron, copper, brass, or some baser metal, it is corroded by the water, reduced in size and thus, since it is no longer as it was originally, loses its balance.

In localities where there are salt-bearing hills, they divert the water into salt-bearing rock, or into a rocky cavern, and there drive it back and forth, or let it settle; eventually, after some time, they test to see if the solution is saturated by throwing a little piece of salt into it. If the salt is still being eaten away and shrinking, it is a sign that the solution is not saturated and can still absorb more; and so it is left for some time, until testing shows that the piece of salt thrown in cannot shrink any more.

I pass by other experiments of the kitchen or common variety, because precision is needed that cannot be obtained except by the following tests, which I wish to present in order so that a method can be chosen that will meet the need.

3. **By solar heat.** In the summer, one can quite accurately determine the amount of salt in the water to be tested. In a sunny place, or in your window facing south, place a glass. It will be best if the mouth is wide, so that evaporation from it can be more rapid; for then a greater amount of radiation and heat hits the surface, expelling the surface moisture. Eventually, all the water is expelled by the sun or by the summer heat, and the salt contained in the water remains.

If, however, the glass has a smaller opening, in keeping with the usual design, and is filled with salt water and placed in the sun as described above, the water will indeed be expelled and the salt remain, but this will take longer.

Several times at the beginning of this year, I tested the amount of salt contained in water by solar evaporation—also, whether the amount of salt dissolved in the water was becoming less or greater. I observed that many watery[2] vapors crept up the sides of the glass, taking salty particles with them; for a certain amount of salt crystallized around the sides of the glass. I observed that the crystal formation was at first fused together, and later distinguished into separate grains of a cubical form. That salty crystallization climbed up to the top of the glass and not only condensed on the edge of the glass, but also spread over part of the outer surface—so that the outside, like the inside, was covered with a salty crust. The crust

[2] Ms. has *aquei;* Acton *aquis* (A. Acton, ed. 1910. *DeSale Communi,* S.S.A.: Philadelphia).

became thicker and thicker; all the salt that had been dissolved in the water stuck around the edges, a little going to the bottom, where it lay separately in larger cubes. The glass was a wineglass, and the water 1/14th of a canthar[3], or a weight of 8 loths[4]; 1 3/4 loths of salt were dissolved in it on the 28th of May; by the 16th of June following, all the water had evaporated to dryness; it had gained 1/8th of a loth in weight, or 1/14th of the weight of the dissolved salt.

4. **By evaporating into a sandy form.** Salt water can also be tested well by evaporation into a sandy form, by slow heat. Some experimenters prepare a small-necked vessel or glass and apply heat so as to slowly expel the moisture; the result is that all the salt remains. Some think they obtain a larger amount of salt, or its true quantity, by this method of evaporation, saying that none of the salt is ejected as it is by violent boiling; but still, hardly more is obtained this way than by ordinary boiling. The salt left in the bottom is very fine-grained and has a sandy appearance; so it does not seem that the most exact quantity and quality is obtained in that way.

5. **By evaporation and boiling.** Salt water is also tested by stronger or uncovered boiling, or evaporation in a vessel made of pottery, or something else; take care, however, not to do this in an iron or copper vessel, because iron and copper are corroded by salt; so it is preferable to make the test in a vessel of pottery, or silver, or the like. At salt-extracting operations[5], they indeed make use of brass, copper, and iron evaporating vessels, but there it does not matter if a part of the metal is corroded, since it is dispersed into the salt thus obtained; but when the solution is to be tested, then it is as

[3] *Cantharus* = Sw. *kanna* (Haqv. Sjögren. 1814, rev. ed. *Lexicon Manuale Latino-Svecanum et Sveco-Latin urn,* Stockholm: J.P. Marquardt); Swedish *kanna* = old Swedish measure of volume (officially dropped due to the adoption of the metric system 1978), which...according to the regulations of 1737 and 1739 should measure...2 1. 6dl. 1.7cl. (Swedish Academy. 1898-1977. *Ordbok over Svenska Spraket:* Lund; translations ours).

[4] *Loth* [Latin *lothon,* Sw. *lod]* = denomination of weight in use in Holland, Germany, Austria, and Switzerland. It varies locally in amount, but is always 1/32 of the local pound, or half of the local ounce *(Oxford English Dictionary,* London: Oxford university Press, 1933). See footnote 8 below on "pound."

[5] Acton *opera:* ms. demands *operas.*

important to the operation to obtain the correct quantity[6] as it is to investigate the quality; so greater care must be taken that nothing changes either the quantity or the quality.

Put the pottery jar on the fire and evaporate your solution enough so that pure salt remains at the bottom, or salt with a little bit of water in it which can be evaporated from it: in this way you can obtain the quantity and quality of the salt without too much trouble.

But the same can be done better still if part of the solution is evaporated—half of it or more, or until you notice a kind of film on the surface; then you take off the vessel and place it in a wine cellar over night, evaporate the remnant again the following day, and put it back again in the cellar, until the evaporation has been completed in these stages. For when such a solution, mostly evaporated, is left in the cellar, better formed salt crystals will remain at the bottom of the vessel—from which one can obtain the sought-after quantity and quality of the salt.

This job can be done with the same fire provided, of course, you know how to pay attention to its degrees of intensity, so that it is moderate at the beginning, then stronger and stronger and, towards the end, diminishes noticeably. When this operation is completed, you will have the quantity you are trying to determine.

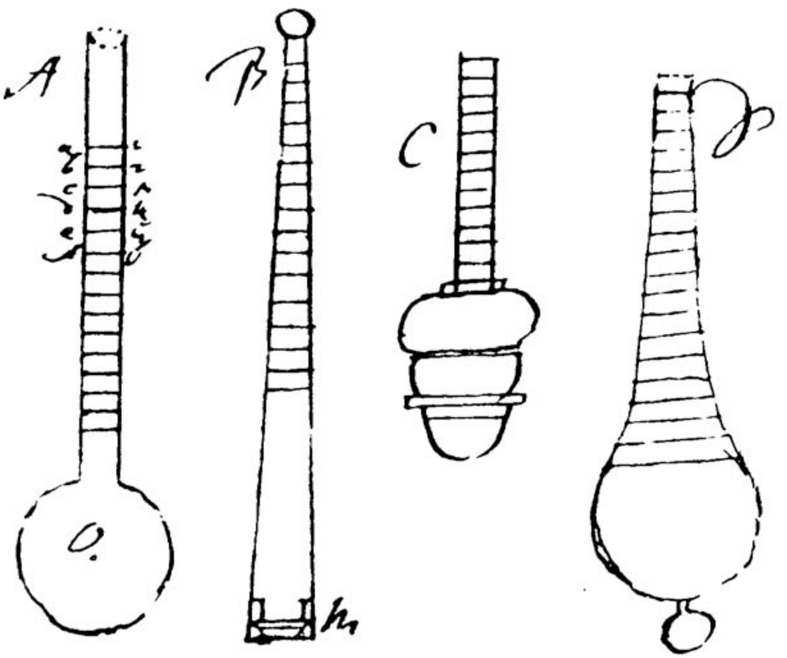
But in all the methods of testing above-mentioned, you should make sure the salty water is filtered through paper *(charta emporetica)* so that it will be free of foreign matter and especially of grease: for if any grease accompanies it, your attempt at crystallization will be in vain. Likewise, if your vessel is coated with grease, the salty matter cannot be separated from the watery.

6. **By evaporation in small vessels. Erkerius' method** is similar to this, and requires the making of a special small vessel of silver (for copper and iron are eaten away by salt water, with the consequence that the experiment will not show an accurate result). Make it in a square shape, and place a plate under it, so that it can be held over a small fire, either a coal fire or a candle. Since there is but a small amount of salt water, it can be dispersed by a smaller fire. But observe that the water must be weighed before it is placed in the vessel, so that it may be known as exactly as possible how much salt the water contains. The water must also be filtered through paper so as to free it of all impurities.

7. **With an instrument.** Salt water is best tested for its salt content

[6] Ms. *qualitas* erroneously, it would seem.

by means of an instrument made especially for that use. The construction of such an instrument is explainable in various terms: but it is a matter of indifference which construction you use. Let us take, for example, the following designs of the said instrument[7]: A, B, C, or D. The instrument may be made of iron sheets covered with tin, or of brass, of hard wood, of amber, of glass, or of some other material. If it is made of a heavy metal, like A or B, then it must be quite hollow, like A—it must be hollow down to O, where a certain weight or a given number of lead balls is to be placed, which weight must afterwards consistently be maintained; likewise in B, at M there should be a weight of lead or other material, enough that it can settle down in lighter or heavier water; C, however, if it is made of amber, or D if made of hard wood, does not necessarily have to be hollow, but it must be hard and watertight, for it settles down to a given depth; and the fresher the water is, the deeper the device will settle, and vice versa. This is the way the instruments are to be prepared.



[7] "Copied from Kellner": Acton

Now as for the graduations on these instruments, these must be determined mechanically, for they must be partitioned according to the way they settle in different kinds of liquids: the saltier the water is, the less the instrument will settle in it, and vice versa. So as for the marking of such instruments as these, the first thing to be considered is whether you wish to know the quantity of water, and the quantity of salt contained in the water; or, how much salt is contained in a given *weight,* or in a given *volume* of salt water.

As for the first consideration: if you do want to partition the instrument so as to know the quantity of fresh water and at the same time the quantity of salt contained in that solution, then place it in fresh water and mark, with a line or point, where it breaks the surface of the water—as for example in illustration 1, fig. A: then you know, when your instrument sinks as far as 1, that the water is really fresh. Weigh the water, or take one, two, or three pounds[8] as you wish. For example, let us take one pound, add one loth of salt to the same water, then put the instrument into the water salted with one loth and again mark the place where it breaks the surface of the water, designating this line as 2. When the instrument sinks to line 2, it shows that there is one pound of water with a loth of salt in it. If you put in 4 loths and they are dissolved, then place your instrument in the water, and if it sinks to line 4, it shows that the salted water in which the instrument sank to the line marked with the number 4 holds 4 loths of salt, or that there are 32 loths of water with 4 loths of salt in it. But it should be noted here that with this kind of scale, you do not know how much salt a pound of water contains except by calculation; for when there are 32 loths of water and 4 loths of salt, this water or solution of 36 loths holds 4 loths of salt and 32 loths of water. From this one may know immediately how much salt a pound of the solution contains by the simple rule of proportion, namely, 36:4::32:35/9. So when the instrument sinks to mark 4, it means not only that the ratio of water to salt in the solution is 32 to 4, but also that in one pound of such salt water there are 3 5/9 loths of salt.

[8] *Libra* [Sw. *skalpund* = scale pound]: 1 scale pound of victual weight, consisting of 32 loths [Sw. *lod],* contains 8848 ass;...a kilogram, compared with our present weight-measures, is 2.3526 pounds;... 100 pounds are called a centner *(Ordbok över Svenska Spraket).* This would mean that the Swedish pound at Swedenborg's time was slightly less than the modern pound = 2.2046:2.3526 (provided that the kg. has remained constant) —Ed.

If, however, you want to have your instrument marked in such a way that you can know at once, without calculation, how much salt there is in a given pound of salty water, partition the instrument in the same way as described above—and then, calculating by the same method, find out how much salt one pound of the salty water contains and indicate that quantity on another part of the instrument, as at *a, b, c, d, e,* or /, and you will have at one side the quantity of water and salt, and at the other the quantity of salt contained in one pound.

You can also test the same thing mechanically, without calculation. Take one pound of fresh water, and mark the level your instrument sinks to, as before; then take away or pour out water of the same weight as the salt that was put in and dissolved—so if you wish to put in 1 loth, then take 1 loth out of the pound of fresh water, so that 31 loths remain; put 1 loth of salt in the water, place your instrument in this solution, and mark the place. Similarly, if you wish to enrich the solution with 4 loths, first take away 4 loths of water, put 4 loths of salt into the remaining 28 loths of water, let your instrument into the solution, and then you will have the amount of salt that a pound of the salted water contains. Continue until you have done this from 1 to 11 loths, or up to the amount of salt that a pound of water can dissolve.

But if you want to know the amount of salt in a given *volume* of water—not in a *weight*—or if you wish to know how much salt a modius[9] or canthar or other volume contains, then you can make your graduations in the same way. Just take your modius, put your instrument in it and mark the water level with a line, so that the level for fresh water is established. In the same water, dissolve 1, 2,3 or more loths of salt, as much as you wish; put in the instrument and mark the level with a line as at first, until you have the levels it sinks to when 1, 2, 3, 4, or more loths of salt have been dissolved in 1 modius of water; repeat this, until you have the amount of water, or 1 modius, and the amount of salt contained in that modius.

In this way you can graduate your instrument mechanically, whether you want graduations according to the weight of the water, or according to its volume. If you want all these graduations on one and the same instrument, you can scale it on one side according to weight and on the other according to volume—which

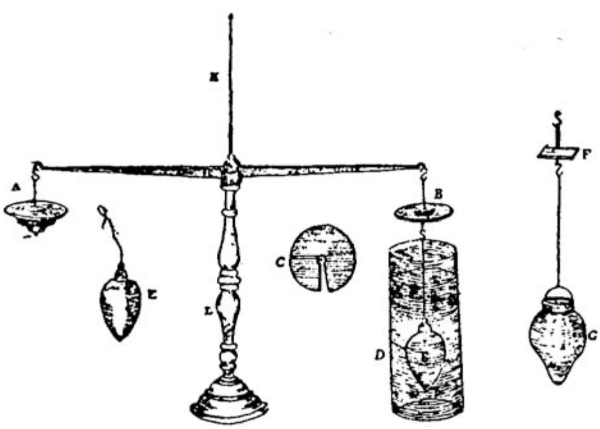
[9] = 8 canthars (Sjögren); see footnote 8.

scales can be better distinguished if the neck of the instrument is either of a triangular or of a square shape, although it does no harm if it is round provided that part of the neck is marked for either weight or volume measurement. Observe that the narrower or thinner the neck is, the more distinct the scale turns out, since a thinner neck allows larger spaces between the graduations than a wider one.

8. With a balance. With a balance it can also be determined how much salt water contains. First, of course, salt solutions of different kinds must be prepared and set apart. Prepare a solution containing 1 loth per pound, then 2, 3, 4, 5, 6, etc., in individual glasses; or you might also prepare the solutions so that you know how much salt is in a given volume, rather than a weight, thus whether 1, 2,3,4,5,6, or 20 or 32 loths are in a modius or canthar. Prepare these in the way described in the preceding test, no. 7.

But by this preparation you will obtain the specific gravity of the salty solution compared to the specific gravity of plain water. Of course, if the volume of the salty solution and the fresh water are the same, then with this balance you immediately have the difference of the specific gravities; and when these are given, the amount of salt contained in the heavier liquid can be determined.

Make or obtain a balance like the one you see in the illustration KL; the round glass is E, which is hung by a very thin thread on one side; B is a copper plate which is hung above it; on the other side is A, also made of copper or brass, but of such a weight that it balances with glass E immersed in water; in other words, the whole balance

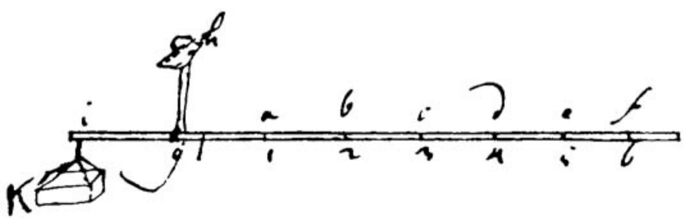


must be in equilibrium, just as you now see it—when, of course, E is immersed in plain water. But you must know how much space this glass occupies in the water, and how much such a volume of water weighs. If, for instance, the glass displaces 400 ass[10] of water, then you must keep this in mind. Now take the salt solution and put it in glass D; then dip the glass globe hanging on the arm of the balance into the solution.

It will immediately be evident that it cannot be submerged, since the solution is denser than fresh water; so place some weights above on B until it submerges, and arm B balances with arm A. Then see how many ass you have added to B to bring about balance, and keep on adding them up to a weight equal to that of the volume of fresh water that E displaces. If you have added 45 ass to B, then add those to 400, making 445: so that the plain water weighs 400 and the solution 445, thus [a ratio of the solution to the salt in it] of 1 to 45/445.

And so, if you had prepared solutions of different strengths, as first said, you can find out how much weight, in ass, is required on B if 1 or 2 or 3 or 4 or 5 or 6 loths are in one pound or one modius of water, and make a table so that you have at hand and know at a glance how much salt is contained in your brine solution. You can also determine this same thing by arithmetic, but since more work is required for such a calculation, it is better to have a prepared table ready than to have to track down the quantity of salt by calculation.

9. **With a bar.** You can get the same results with a type of bar. Make a bar in the usual rod-like shape, and a vessel of iron or lead or silver, like K, square or round; prepare solutions of different



strengths, containing 1, 2, 3, 4, 5, or 6 loths of salt in one pound or one canthar of water, weigh them one after the other, and mark on your bar *a, b, c, d, e,* or */* corresponding with a content of 1,2, 3, 4,5, or

[10] See footnote **8** on "pound."

6 loths of salt; in this way you can, with very little effort, always know how much salt is in water by a plain and simple weighing: for once you have marked the quantity on the bar, always using the same vessel, you can determine the quantity of water by the easiest technique.

10. **By dissolving salt.** If you lack instruments, balances and bar, and nonetheless wish to test salty water, then take the salt water and put salt into it, stirring the salt around until it is dissolved as much as possible. But before starting this test, weigh your salty water, and weigh the salt you are putting in. When as much salt as possible is dissolved, take out the rest that would not dissolve and from the weight of the salt residue you immediately have the amount dissolved. As it is known that 11 to 12 loths of salt can be dissolved in one pound of water, therefore if only 3 and no more can be dissolved, it means that about 9 loths were in your water. If 4 loths can be dissolved, it means that about 8 loths were in your water. For if it is a rule that salt can be dissolved up to a definite quantity, then by dissolving salt in salty water you can ascertain how much salt was there before. But take note that you must use the best kind of salt, for if it is powdered, more can be dissolved than if it is not.

11. **By winter and cold.** In wintertime you can invesigate the quantity of salt contained in water by using the cold itself, just as is the case with heat in the summer; for fresh water turns into ice, but not salt water; hence fresh water as it were *(tanquam)* separated from its saltiness turns to ice when exposed to the winter. Therefore when the vessel is large and the cold intense, this takes place in a short time, but the method is not as accurate as by solar heat. Many methods of investigating salty water may exist, but because the ones mentioned above are sufficient, I wish to pass over the rest.

In regard to tests of salty water it should also be observed that the tester may go wrong many times if he uses the balance or bar instruments. For the water may be impregnated with some other kind of salt, possibly nitre, or an alkali, or something else; for no spring or river water is so pure that it does not contain some kind of salt, even if the water is tasteless; this adds to its density, and if the test is done simply by weight, then from this additional weight, the quantity of salt *is* obtained—but not the quantity of pure common salt. For as fresh water itself differs much in density, so also does salty water; salty waters of the same density do not always assure the same amount of common salt, for in one there may be a different salt adding to the weight. Hence, the test is best done by evaporation, either with the sun or with fire; then one can find out exactly how much salt there is, and at the same time its quality.

II.

Testing Earth in which Salt Is Found

Earth that is impregnated with salt is recognized for the most part by taste; but earth is very rarely found impregnated with pure common salt—rather with a kind of nitrous salt. This sort of earth is first washed in the same way as ashes or nitrous earths. Of course, the solution must sometimes be filtered through paper so as to be well cleansed from its impurities. The solution so filtered is then evaporated, until salt appears at the bottom that can then be examined for quantity and quality.

III.

Determining the Quality of Common Salt

It is very difficult to find out the quality of salt by simple tests, for at first glance it can look good, but still turn out to be useless for domestic purposes and of little value. The following signs, given by authors, are suggested for investigating the goodness or quality of salt.

1. **By dissolving.** It has been found that salts of different kinds dissolve differently. For if 6 loths of salt of different kinds are dissolved in 1 pound and 12 loths of water, then (l) Spanish salt dissolves the slowest, taking no less than 30 hours, and this without any foaming. (2) Refined salt, which is called *rafineradt salt,* dissolves in a quarter of an hour, and without foam—although a little may appear. (3) Lüneburg salt dissolves in 1/8th of an hour, with a kind of whitish foam. (4) The Halle variety dissolves in the same time, without foam and motion, although some flecks of foam appear; but to dissolve it better and faster, the solution should be stirred with a spatula.

The solution of Spanish salt verges on a grey color; the solution of refined salt becomes clear. That of Lüneburg salt turns white. That of Halle salt does not change. Spanish salt drops many impurities on the bottom; refined salt none. Lüneburg salt leaves impurities on the surface as well as in the middle and on the bottom. Halle salt shows no impurities.

The solutions of Spanish, refined and Lüneburg salts weigh the same, while that of Halle salt is a little heavier.

From these things we may conclude that the best salt is the one that does not eject foam, does not color the solution, does not drop impurities on the bottom or leave them in the middle or on the surface; and whose solution has a good smell and taste and weighs more, as was shown by the device in paragraph I, article **7.**

2. By foaming off. A solution of common salt can be made to foam off by means of goat's blood, as is the custom in Germany and elsewhere; for if the salt is dissolved over a fire or other heat source and some of that blood is thrown in, certain impurities appear on the surface, and the greater the amount of impurity, the worse the salt is. You will have this effect immediately with 4 pounds of water, 8 loths of salt and 1 spoonful of blood. *Spanish salt,* by means of this blood, produces a quantity of foam or impurities that find their way to the higher part of the vessel. *Refined salt* likewise produces many dregs, which attach themselves like slime to the vessel. *Lüneburg salt* gives off a light foam, but one which sticks to the upper part of the vessel and can therefore easily be separated from it. *Halle salt* yields the least amount of dregs. It has been observed that Spanish salt and refined salt can with difficulty be put to the process of boiling, but Luneburg and Halle salt more easily.

3. **By cracking or decrepitation of salt.** If salt is baked to powder in a ceramic or iron vessel over a fire, the salt will crackle; and the more fixed and dry it is, the more it will crack. In regard to this decrepitation, color should also be observed: a white color in the decrepitated salt proves that a very small amount of impurity is in it. *Spanish salt* crackles at once, with some vehemence. *Refined salt* crackles more gradually, but not so vehemently. *Lüneburg salt* crackles rather feebly and not very much. *Halle salt* crackles very strongly and continually, depending on the size of the grains. As for the color in baked or decrepitated salt: *Spanish salt* is said to become of a brown color; *refined salt* brown but also verging on grey; *Lüneburg salt* brown; *Halle salt* very white.

4. By pure baking or fusion. If the salt is fused over a burning log for 6 or 7 hours, it can be determined whether there is a loss of salt or not, for the less the loss or destruction, the better. Hence it is said that *Spanish salt* loses much, but *Lüneburg salt* not so much; *refined salt,* still less, and *Halle salt* loses the least amount.

5. By adding another material to the baked or fused salt. If, for example, to 8 loths of salt is added 1/2 loth of saltpeter, it can be seen immediately what color the flame or smoke shows. *Spanish salt* is said to give off a black flame or smoke, *refined salt* and *Lüneburg salt* a bluish flame, *Halle salt* a yellowish flame. If a spoonful of the oil called *bomolja*[11] is added, one can also tell whether it yields much or little impurity—if, of course, after it has been added, the salt is again fused. From this test one may see that *Spanish salt* carries many impurities with it, likewise *Lüneburg salt; refined salt* a fair amount; *Halle salt* little, as we are told.

6. **By brightness or whiteness of color;** for the brighter the salt appears, the purer it is considered to be. This color differs in brightness among all kinds of salts, but from brightness alone one cannot judge between them as to the purity and goodness of the salt—except that a brown, yellow, or grey color indicates that there is much foreign matter in it.

7. **By its translucency,** the salt that was being investigated above in regard to brightness can also be tested.

8. **By shapes and crystalline forms.** In what follows we will discuss the shapes of common salt, and here we wish to note this much: that the shape of salt is cubical, even when divided into its smallest grains, which escape the sight. There is also a figure terminating in a point that likewise tends to be flat on top; there is a cubically solid shape; and there is one that is hollow on one side, and yet cubicular. Crystal or rock salt has bigger crystals; sea salt, middle sized; and salt boiled down from springs consists of little crystals. So common salt is of a square form, sometimes ending in a kind of little point, sometimes sticking together so that the corner of one cube protrudes from the side of another and so forms a figure that is triangular, hexagonal, etc. Cubical and solid salt seems to be the best and the genuine salt.

9. **By lightness.** Some think that lightness is also a sign of goodness in salt, perhaps because there is then less dampness in it and it will therefore be sharper tasting and stronger. Some have found great differences in lightness to exist. When they filled a little vessel with *Spanish salt,* they observed that its weight was 76 loths and 1 dramm[12], and that if they filled it with *refined* or *boiled down salt,* its weight was 69 loths and 1 dramm. *Lüneburg salt* 53 loths. *Halle salt* 501/2 loths. From this we see that there is much difference in the

[11] Swedish for *olive oil*

[12] (Sjögren); Sw. *drakma* = special apothecary term for a medicinal weight (=1/8 ounce), used in Sweden until 1816 *(Ordbok över Svenska Spraket).* If a *loth - 111* ounce, a *drakma* would be 1/4 *loth.*

heaviness and lightness of salt.

10. **By dryness** they also like to test out the quality of salt; for the drier salt is, the better.

11. **By the smallness of the grains** they also judge the quality of salt; Spanish salt consists of larger grains, boiled down salt of smaller.

12. **By taste.** Some kinds of salt do not taste pure, but have a taste mixed with bitterness or with nitre; for if much foreign matter is found in the salt, this affects the taste, and from this its quality may be recognized. There are also almost tasteless salts, which are of less value. The flavor of *Spanish salt* is considered repugnant to the taste-that of *refined* or *boiled down salt*, pure; that of *Lüneburg salt*, strong and sharp: thus the purer the flavor, the better the salt.

13. **By smell** also, the quality may be recognized, that is, it is good if it does not smell bad.

14. **By solubility.** One kind of salt may be dissolved more easily than another, either on meats or on fish; some think the salt is better the more easily it dissolves, so that it is best when none at all remains undissolved. *Spanish salt* dissolves with difficulty, or slowly, which is apparent in the salting of meats or fish; *boiled down salt* likewise dissolves slowly. *Lüneburg* and *Halle* salt dissolve more easily; but still, the salt that remains whole for a longer time is supposed to be the best, so that the salting of meats or fish is best accomplished with Spanish salt.

15. **By keeping ability.** The longer salt keeps before it is dissolved by damp air, the more it is valued. This may be tested if several varieties of salt are spread out upon a board and thus placed in a damp place; the one that resists the damp longest is thought to be the best.

16. **By sharpness or sourness.** But this test is the same as the test by taste; if the salt somewhat burns the tongue, and despite[13] the sourness, still tastes good, it is considered to be the best.

17. **By its better ability to preserve all foods.** The most obvious and best sign of the quality of salts is that they preserve everything well; for when meats or fish are stored with salt and are kept for a long time from rotting, this is a sign that that kind of salt is the best; for this is the use that people especially demand from salt.

[13] Lacking in the ms., we here insert the equivalent of *contra.*

IV.

The Salt Mountain of Poland

Around Bocknia not far from Krakow there are places that are excavated and almost hollowed out as a result of the salt mines there. The places referred to are Bocknia and Wieliczka; they say the mine at Wieliczka is 456 steps *(gradus)* deep, but the one near Bocknia has no less than 80 stairways. Rsacfynski says this salt-works was discovered in 1251 by Cuningundus, whose ring was found by a certain cobbler in 1748, who, while he was digging a well, discovered a spring in the midst of which ran a thin wall of salt; that then the inhabitants of this region, from Morstif, began to dig deeper wells, and for a space of 200 years found unlimited quantities of salt, most of which the Poles, Silesians, Bohemians, etc., used, as also those inhabiting part of Hungary. The return from these salt-works is thought to have been *800,000 tympfen,* or *25,000* imperial *thalers* per year. In the mine itself are so many paths or ways curving and winding this way and that, and in the deeper places it is very much like a city that takes a long time to go through completely. These circuits are so constructed that the columns of salt left here and there act as supports, and consist of pure salt; they were made intentionally to prevent the mine from collapsing. Even so, there are examples of columns in that mine which did collapse, causing the buildings on the ground above to sink down. These columns are a lovely sight, for when the light touches them, they appear like a most glittering crystal. Near Wieliczka, a temple was carved out of pure salt, as also a statue of King August II himself. In these underground places, you can see a kind of subterranean republic, having its own laws, and also its own household. There are horses, for carrying the salt chunks to the locations where they are to be elevated above-gound, which never see the day. There are also many mechanical devices in the depths of this mine. And they say that many people are born there.

It surpasses belief, that a stream of very pure fresh water flows through the middle of this mountain, nor does it have any salty taste. This stream supplies enough water for the people who live there, and for the animals. Elsewhere, there is a river of salty water. Aside from these, there is no other water, for the climate is dry; nor does water fall in from the higher ground, even when, during heavy rains, the higher ground is swampy. There are also certain places in the mine where no work can be done, because no candles or fire can be brought in; for when fire approaches, particles and vapors *(effluvia)* can easily ignite and burst into flame—something they found out at Wieliczka in 1644, when a fire started which, they say, continued for a whole year, pouring out clouds of vapors and sulphurous odors. They say that in these caverns you can sometimes hear sounds like the yelping of dogs, the chattering of chickens, and many more which the workers take as bad omens. The salt is carried out of here in big pieces, sometimes weighing 20 or 30 hundredweight *(centenariorum).*

There are several kinds of salt in this mine. Some count only two, *one* which is quite hard and transparent and whose crystals are more perfect; this is the genuine gem-salt, which can be cut like crystals, and from which many necessary and useful things are made. The *second* kind is less solid, nor can it be put to other than domestic use, as in salting fish and meats, on tables, and in preparing foods. Others, however, count more than two kinds: *one* which is hard and stony like crystal; a *second* which is hard but translucent; a *third,* brittle, not hard, and also white and pure; and a *fourth,* still softer. Also a kind of salt is found, black in color, like coal or liquid pitch, which is made use of as a cleanser.

These larger and smaller chunks of salt carried out of the mines are pounded with hammers until they are suitable in size to go through the mill; then the salt is ground into a kind of flour of a bright white color, and in this form it is taken out and sold. They also dissolve this kind of gem-salt and crystallize it out in the usual way, especially within the borders of Silesia's Tomaschow *(Tomovicus).* Salt is also extracted there in larger and smaller pieces. It is then cut into cylindrical shapes, and these cylinders are used for domestic purposes by the inhabitants of the Kingdom of Poland: for these purposes, they scrape off the amount of salt they need from the outside surface of the cylinder. This kind of salt can be dissolved easily.

It is a common opinion that the pieces of salt in this same mine, or in their birthplace, are lighter, but as soon as they come into the air, become heavier; but about these mines, the *Acta Maris Baltic!* tell of Dobel *(Dobelius)* having examined several pieces of salt with balance and scales both within the Willich *(Villichius)* and Krakow mines and outside when they had been in contact with the air, and having found no difference in weight; others, however, are said to have weighed this salt more accurately under the ground and above, and to have observed a difference, although a small one.

ABBREVIATED TITLES

Theological Works

Abom.—Abomination of Desolation*
AC—Arcana Coelestia
Adv.—Adversaria*
AE—Apocalypse Explained*
AR—Apocalypse Revealed
Ath.—Athanasian Creed*
BE—Brief Exposition
Calvin—Conversations with Calvin*
Can.—Canons*
Char.—Doctrine of Charity*
CL—Conjugial Love
CLJ—Continuation of the Last Judgment
Conv. Ang.—Conversations with Angels*
Coro.—Coronis*
DLW—Divine Love and Wisdom
Dom.—De Domino*
DP—Divine Providence
Ecc. Hist.—Ecclesiastical History of the New Church*
EU—Earths in the Universe
F—Doctrine of Faith
5 Mem.—Five Memorable Relations*
HD—New Jerusalem and its Heavenly Doctrine
HH-Heaven and Hell
Hist. Crea.—History of Creation*
Idea—Angelic Idea concerning Creation
ISB—Intercourse between Soul and Body
Inv.—Invitation to the New Church*
Jus.—Concerning Justification and Good Works*
Life—Doctrine of Life
LJ—Last Judgment
LJ post—Last Judgment (posthumous)*
Lord—Doctrine of the Lord
Love—Divine Love*
Mar.—On Marriage*
PP—Prophets and Psalms*
Q—Nine Questions*
SC—Scriptural Confirmations*
SD—Spiritual Diary*
SD min.—Spiritual Diary Minor*
SS—Doctrine of the Sacred Scripture
TCR—True Christian Religion
Verbo—De Verbo*
WE—Word Explained (Adversaria)*
WH—White House
Wis.—Divine Wisdom*

Philosophical Works

AK—Animal Kingdom
BR.—The Brain*
Cer.—The Cerebrum*
Chem.—Chemistry*
EAK I, II—Economy of the Animal Kingdom
Fib.—The Fibre (EAK III)
Gen.—Generation*
Inf.—The Infinite
JD—Journal of Dreams*
L Pr.—Lesser Principia*
Misc. Obs.—Miscellaneous Observations
Ont.—Ontology*
OPS—Origin and Propagation of the Soul*
Pr.—Principia
Psych. Trans.—Psychological Transactions*
R. Psych.—Rational Psychology*
Sens.—The Five Senses*
Trem.—Tremulation*
WLG—Worship and Love of God

For lists of the Theological Works see: Tafel's *Documents,* Vol. II, pp. 950-1023; Potts' *Concordance,* Introduction; and General Church *Liturgy,* 5th ed., pp. 236-238. For lists of Swedenborg's earlier philosophical and other works see: Tafel's *Documents,* Vol. II, pp. 884-949; and *A Classified List* by the Rev. Alfred Acton.