years greatly fallen off under the competition of the rock- salt works of Cheshire, but some small manufactories still exist, at North Shields and elsewhere, where salt is made by dissolving rock-salt in sea water, and evaporating the solution to crystallization by artificial heat.

The process of the spontaneous evaporation of sea water has been very carefully studied by Usiglio on Mediterranean water at Cette. The density at first was l·02. Primarily but a slight deposit is formed (none until the concentration arrives at specific gravity 1·0509), this deposit consisting for the most part of calcic carbonate and ferric oxide. This goes on till a density of ·1315 is attained, when hydrated calcium sulphate begins to deposit, and continues till specific gravity 1·2646 is reached. At a density of 1·218 the volume of the sea water has become reduced to 95/1000ths of what it was at first, and from this moment the deposit becomes augmented by sodium chloride, which goes down mixed with a little magnesium chloride and sulphate. At specific gravity 1 ·2461 a little sodium bromide has begun also to deposit. At specific gravity 1·311 the volume of the water is only 16/1000ths of what it was at first, and it is thus composed:—

|  |  |
| --- | --- |
| Magnesium sulphate |  |
| Magnesium chloride | 19·53 |
| Sodium chloride | 15·98 |
| Sodium bromide | 2·04 „ |
| Potassium chloride | 3·30 |

Up to the time then that the water became concentrated to specific gravity 1'218 only 0·150 of deposit had formed, and that chiefly composed of lime and iron, but between specific gravity 1·218 and 1·313 there is deposited a mixture of—

|  |  |
| --- | --- |
| Calcium sulphate  Magnesium sulphate  Magnesium chloride  Sodium chloride  Sodium bromide | 0·0283 per cent.  0·0624 „  0·0153  2·7107  0·0222 |
|  | 2·8389 |

And of this we see that about 95 per cent. is sodium chloride. Up to this point the separation of the salts has taken place in a fairly regular manner, but now the temperature begins to exert an influence, and some of the salts deposited in the cold of the night dissolve again partially in the heat of the day. By night the liquor gives nearly pure magnesium sulphate ; in the day the same sulphate mixed with sodium and potassium chlorides is deposited. The mother-liquor now falls a little in density to a specific gravity of 1·3082 to 1·2965, and yields a very mixed deposit of magnesium bromide and chloride, potassium chloride, and magnesium sulphate, with the double magnesium and potassium sulphate, corresponding to the kainite of Stassfurt. There is also deposited a double magnesium and potassium chloride, similar to the carnallite of Stassfurt, and finally the mother-liquor, which has now again risen to specific gravity 1·3374, contains only pure magnesium chloride.

The application of these results to the production of salt from sea water is obvious. A large piece of land, varying from one or two to several acres, barely above high-water mark, is levelled, and if necessary puddled with clay so as to prevent the water from percolating and sinking away. In tidal seas a “jas” (as the storage reservoir is called) is constructed alongside, similarly rendered im­pervious, in which the water is stored and allowed to settle and concentrate to a certain extent. In non-tidal seas this storage basin is not required. The prepared land is partitioned off into large basins *(adernes* or *muants)* and others (called in France *aircs, oeuillets,* or *tables salantes)* which get smaller and more shallow in proportion as they are intended to receive the water as it becomes . more and more concentrated, just sufficient fall being allowed from one set of basins to the other to cause the water to flow slowly through them. The flow is often assisted by pumping. The sea salt thus made is collected into small heaps on the paths around the basins or the floors of the basins themselves, and here it under- goes a first partial purification, the more deliquescent salts (especially the magnesium chloride) being allowed to drain away. From these heaps it is collected into larger ones, where it drains further, and becomes more purified. Here it is protected by thatch till

required for sale.

The salt is collected from the surface by means of a sort of wooden scoop or scraper which the workman pushes before him, but in spite of every precaution some of the soil on which it is pro­duced is inevitably taken up with it, communicating a red or grey tint. Sea salt is thence known in many of the French markets as *sel gris,* and frequently contains as much as 15 per cent. of impurity. Yet such is the ignorance and prejudice of many people that they will buy it in preference to the purer article from the evaporation of rock-salt brine, asserting its action to be milder and more even. Even if this were true they forget that mud ought to be cheaper than salt. The salt made on the coast of Brittany possesses the following composition :—

|  |  |
| --- | --- |
| Sodium chloride |  |
| Magnesium chloride | 1·58 |
| Magnesium sulphate | 0·50 „ |
| Calcium sulphate | 1·65 „ |
| Insoluble | 0·80 |
| Water | 7·50 „ |

Generally speaking this salt goes into commerce just as it is, but in some cases it is taken first to the refinery, where it either is simply washed and then stove-dried before being sent out or is dis­solved in fresh water and then boiled down and crystallized like white salt from rock-salt brine. The salt of the “ salines du midi ” of the south-east of France is far purer than the above, however, its composition being as follows :—

|  |  |
| --- | --- |
| Sodium chloride |  |
| Magnesium chloride | 0·23 |
| Magnesium sulphate | 1·30 |
| Calcium sulphate | 0·91 |
| Insoluble | 0·10 |
| Water | 2·35 „ |

This is perhaps partly owing to the fact that of late years, by way of obviating the above-mentioned cause of impurity, a species of moss has been introduced there with some success from Portugal and forms a bed on which the salt is deposited. The mother- liquors from the crystallization of the common salt contain still a little sodium chloride and most of the bromine and iodine of the sea water, all the potassium salts, much magnesium sulphate, and a large quantity of magnesium chloride. They are often thrown away as useless, but lately, in the south of France, in the “ salines du midi, ” they have been used for the production of certain chemi­cals by a system of ulterior treatment introduced by M. Merle and still continued by his successor M. Pechinet.

As soon as the water arrives at specific gravity 1·2407 and has deposited most of its salt, it is drawn off and stored in large tanks of 50,000 or 60,000 cubic metres capacity. From these it is withdrawn in successive portions, and artificially cooled to 0·4° Fahr. Under these circumstances, indeed at any temperature below 26° Fahr., a double decomposition takes place between the sodium chloride and the magnesium sulphate—crystallized sodium sulphate being thus separated. After being withdrawn and freed from the mother-liquor by a hydro-extractor, this sulphate, which contains two atoms of water, is then rendered anhydrous by heating in a reverberatory furnace. From the refrigerating vessel the water now passes to an ordinary evaporating pan, where the remaining salt is precipitated by boiling, collected, and purified by the hydro- extractor. Here the water attains a specific gravity 1·2680, and, being spread out in a thin layer on a smooth level bed of cement or concrete, deposits on cooling all its potassium as the double chloride of potassium and magnesium, the same as the carnallite of Stassfurt.

Fig. 1 represents the usual form of an Austrian “Salzgarten” at Capo d’lstria. It is a parallelogram of 2 to 3 acres in extent

surrounded by a dyke or sea-wall *a.* The sea water enters by the sluice *b,* and passes into the wide fosse *c*, where, clarifying by settlement, it passes by the openings *f* into a sextuple series of large basins divided by the separations *d,* first of all entering the