little sodium bromide has begun also to deposit. At specific gravity 1.311 the volume of the water contained—

|  |  |
| --- | --- |
| Magnesium sulphate . | • 11.45% |
| 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 %  . 0∙0624%  . 0.0153%  . 2.7107%  . 0.0222 % |
|  | 2∙8389% |

Of this about 95% 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 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, barely above high-water mark, is levelled, and if necessary puddled with clay. In tidal seas a “ jas ” (or storage reservoir) is constructed alongside, similarly rendered impervious, in which the water is 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 *aires, 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 undergoes 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. The salt is collected from the surface by means of a sort of wooden scoop or scraper, 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.

Generally speaking this salt, which may contain up to 15% of impurities, 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, containing about 5% of impurities. In northern Russia and in Siberia sea water is concentrated by freezing, the ice which separates containing little salt; the brine is then boiled down when an impure sea salt is deposited.

*Rock-salt.*—To mineralogists rock-salt is often known as *halite*—a name suggested in 1847 by E. F. Glocker from the Greek αλs (salt). The word halite, however, is sometimes used not only for the species rock-salt but as a group-name to include a series of haloid minerals, of which that species is the type. Halite or rock-salt crystallizes in the cubic system, usually in cubes, rarely in octahedra; the cubes being solid, unlike the skeleton-cubes obtained by rapid evaporation of brine. The mineral has perfect cubic cleavage. Percussion- figures, readily made on the cleavage-faces, have rays parallel to faces of the rhombic dodecahedron; whilst figures etched with water represent the four-faced cube. Rock-salt commonly occurs in cleavable masses, or sometimes in laminar, granular or fibrous forms, the finely fibrous variety being known as “hair-salt.” The hardness is 2 to 2∙5 and the spec. grav.

2.1 to 2.6. Rock-salt when pure is colourless and transparent, but is usually red or brown by mechanical admixture with ferric oxide or hydroxide. The salt is often grey, through bituminous matter or other impurity, and rarely green, blue or violet. The blue colour, which disappears on heating or dissolving the salt, has been variously ascribed to the presence of sodium subchloride, sodium, sulphur or of a certain compound of iron, or again to the existence of minute cavities with parallel walls. Halite occasionally exhibits double refraction, perhaps due to natural pressure. It is remarkably diathermanous, or capable of transmitting heat-rays, and has therefore been used in certain physical investigations. Pure halite consists only of sodium chloride, but salt usually contains certain magnesium compounds rendering it deliquescent. Minute vesicular cavities are not infrequently present, sometimes as negative cubes, and these may contain saline solutions or carbon dioxide or gaseous hydrocarbons. Some salt decrepitates on solution (*Knistersalz),* the phenomenon being due to the escape of condensed gases.

Halite may occur as a sublimate on lava, as at Vesuvius and some other volcanoes, where it is generally associated with potassium chloride; but its usual mode of occurrence is in bedded deposits, often lenticular, and sometimes of great thick- ness. The salt is commonly associated with gypsum, often also with anhydrite, and occasionally with sylvite, carnallite and other minerals containing potassium and magnesium. Deposits of rock-salt have evidently been formed by the evaporation of salt water, probably in areas of inland drainage or enclosed basins, like the Dead Sea and the Great Salt Lake of Utah, or perhaps in some cases in an arm of the sea partially cut off, like the Kara Bughaz, which forms a natural salt-pan on the east side of the Caspian. Such beds of salt are found in strata of very varied geological age; the Salt Range of the Punjab, for instance, is probably of Cambrian age, while the famous salt- deposits of Wieliczka, near Cracow, have been referred to the Pliocene period. In many parts of the world, including the British area, the Triassic age offered conditions especially favourable for the formation of large salt-deposits.

In England extensive deposits of rock-salt arc found near the base of the Keuper mad, especially in Cheshire. The mineral occurs generally in lenticular deposits, which may reach a thickness of more than 100 ft.; but it is mined only to a limited extent, most of the salt being obtained from brine springs and wells which derive their saline character from deposits of salts. Much salt is obtained from north Lancashire, as also from the brine pits of Staffordshire, Worcestershire, Yorkshire, Durham and the Isle of Man (Point of Ayre). The salt of N.E. Yorkshire and S. Durham is regarded by some authorities as Permian, but that near Carriekfergus in Co. Antrim, Ireland, is undoubtedly of Triassic age. The Antrim salt was discovered in 1850 during a search for coal: one of the beds at Duncrue mine has a thickness of 80 ft. Important deposits of rock- salt occur in the Keuper at Berchtesgaden, in the Bavarian Alps; at Hall in Tirol and at Hallein, Hallstatt, Ischl and Aussee in the Salzkammergut in Austria. Salt occurs in the Muschelkalk at Friedriehshall and some other localities in Württemberg and Thur- ingia; and in the Bunter at Schöningen near Brunswick.

The Permian system (Zechstein) yields the great salt-deposits worked at Stassfurt and at Halle in Prussian Saxony. The Stassfurt deposits are of special importance for the sake of the associated salts of potassium and magnesium, such as carnallite and kainite. These deposits, in addition to having a high commercial importance, present certain problems which have received much attention, more particularly at the hands of van't Hoff and his collaborators, whose results are embodied in his *Zur Bildung der ozeanischen Salzab­lagerungen,* vol. i. (1905), vol. ii. (1909). (A summary is given in A. W. Stewart, *Recent Advances in Physical and Inorganic Chemistry,* 1909; see also van’t Hoff, *Lectures on Theoretical and Physical Chemistry,* vol. i.) A typical section is as follows: Beneath the surface soil of sandstone there is a layer up to 100 ft. in thickness of carnallite, MgCl2·KCl·6H2O, mixed with a little salt; this is followed by a thicker deposit of kieserite, MgSO4·H2O, containing rather more salt than the upper bed. Deeper down there are successively strata of polyhalite, MgSO4·K2SO4∙2CaSO4·2H2O, and anhydrite, CaSO4, interspersed with regular layers of rock-salt; whilst below the anhydrite we have the main rock-salt deposits. A bed of rock-salt in the Zechstein at Sperenberg near Berlin has been proved by boring to have a thickness of upwards of 4000 ft. The salt of Bex in Switzerland is Jurassic, whilst Cretaceous salt occurs in Westphalia and Algiers. Important deposits of salt arc developed in many parts of the Tertiary strata. At Cardona, near Barcelona, Tertiary salt forms hill-masses, while the Carpathian