

These analyses show the eruptive waters on the Comstock to be poor in dissolved substances. According to the determination of solid residuum by E. S. Bristol, this would not be the case. He finds the mine-water of the 500ft. level to contain in the Savage north drift 2,660 grammes, and in the Yellow Jacket west drift as much as 3,271 grammes, of solid material in 1 ton (1,000 kilos.). But it is a question whether these figures do not refer to ordinary mine-waters, as the term west drift seems to indicate.

The predominance of sulphates over carbonates is nothing unusual; but the decided predominance of lime, sulphate, or gypsum in the Comstock waters is unique. This relation would still remain if we should reckon a part of the sulphuric acid as combined with the alkalis. The two most trustworthy analyses of Attwood and Johnson give 222 and 535 grammes of gypsum per ton of water, and 492 and 700 grammes per ton of dry residuum. Apart from their gypsum, the Comstock eruptive waters may be classed among the weak or acrothermal springs, like those of Teplitz in Bohemia.

The Sulphur Bank and Steamboat Springs waters are distinguished from all others in the table by a considerable proportion of sodium baborate, and resemble unmistakably certain Suffioni and Lagoni waters of Middle Italy. Their degree of impregnation and their large proportion of chlorides bring them near the waters of Carlsbad and Franzensbad, Bohemia. The proportion of sodium chloride is not surprising in the American West, in the neighbourhood of undrained and therefore salt regions; but it is surprising in Bohemia, a country notoriously free from salt, in which no rock is known to contain these highly soluble substances. We must assume that they exist in the deeper region, in forms not yet decomposed, such as sodalite ($3\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8 + 2\text{NaCl}$), which must be chemically decomposed before its NaCl can be dissolved. The presence of quantities of salt smaller than those here under consideration can be attributed to atmospheric precipitation. A. Bobierre found by careful and continuous analysis of the rain-water falling in Nancy, throughout the year 1863, 14 grammes of salt per ton or cubic metre; and G. Zoppe has argued that the sometimes considerable contents of sodium chloride in the springs of the Inglesiente district, in the Island of Sardinia, can only be explained by the transportation of salt from the sea by wind. (A stormy cloud-burst, March 7, 1886, showed as much as 387 grammes per ton or cubic metre.) The salt of the atmospheric precipitation is concentrated by evaporation. In Bohemia, for instance, only one-fourth of the rainfall escapes into the Elbe; in more southern regions the whole evaporates. The descending ground-water is still further concentrated; so that in this way the salt normally found in the ascending waters may be accounted for.

But while the water of Steamboat Springs is rich in sodium chloride, the Comstock mine-water is poor, notwithstanding the comparatively near neighbourhood of the two places. Both adjoin eruptive rocks, especially basaltic outflows; but the Steamboat Springs break out of crystalline rocks. May not the ascending waters have derived their abundant sodium chloride from minerals, like sodalite, which contain it chemically bound?

Hydrogen sulphide plays an important part in the ascending waters. Its presence seems to be the cause of a greater abundance of dissolved substances. It is attributed to the decomposition of sulphates through the organic matter, traces of which are found in most of the ascending waters. By reoxidation, it produces the sulphuric acid which transforms carbonates into sulphates.

The waters flowing away from mineral springs likewise make solid deposits, which often form horizontal layers, covering considerable areas. These are the so-called travertines—formations analagous to the Carlsbad *sprudel* or *erbsenstein*, &c. But we are concerned at this point with the deposits in the spring-channel itself and in its immediate vicinity, including not merely the crusts upon the walls proper, but also those surrounding large or small fragments of rock within the channel. Many such deposits are characterized by the pisolite formation, which we may observe also in ore-deposits (concretionary iron-ores, &c.). These pisolites are evidently incrustated kernels, the crusts being proportionately much thicker than the kernels. The Carlsbad *sprudelstein* shows, indeed, the same structure on a small scale as many ore-deposits exhibit on a large scale. The pisolites, like those of Tivoli and Hamman Meskoutine, consist of lime carbonate, pure or slightly intermixed with iron oxide and silica. At the last-named locality pyrites occurs between the layers of carbonate, so that the formation must be pronounced to be crusts of lime carbonate and pyrite upon a foreign nucleus, which was elevated and incrustated so long as the ascending column of the spring had energy enough to move it.

A few words may be well added here concerning the Carlsbad *sprudelschale* and *erbsenstein*. As is well known, the *sprudel* represents an action like that of geysers, ejecting thermal water and steam to a considerable height. The precipitate at the present time is a porous, somewhat ferruginous aragonite or travertine mass. The ground from which the *sprudel* breaks forth is composed of horizontal layers of a much denser aragonite mass, which can be polished, and furnishes material for artistic lapidary-work. A part of the town of Carlsbad stands on this so-called *sprudelschale*, from which new thermal springs sometimes break out, and the structural history of which may have been like that of the rising succession of basins at the Mammoth Hot Springs of Gardiner River, in the Yellowstone National Park.

Certain layers of this *sprudel*-deposit are exclusively aggregates of pisolites of pea-size, whence the name *erbsenstein* (pea-stone). Evidently these have been formed, like those of the Hamman Meskoutine spring, immediately at the outflow of the mineral water. The precipitate from the solution (at the moment supersaturated) was deposited around individual rock-grains, which had found their way into the spring, to be for awhile kept in motion by its current. Successive crusts were thus deposited, until the pisolite became too large to follow the movement of the spring and sank to the bottom, where its accessible surfaces received still further precipitate-crusts. It might easily occur that single cavities might remain, into which the precipitate could not penetrate. These would represent, according to our terminology, the central druse. Fig. 12 illustrates this process, while Fig. 13 shows a single pisolite, including pyrite-crusts, from Hamman Meskoutine.