ments. Within the grant, the several *knoten*-layers are united into a single bed, about 72ft. thick, separated by a conglomerate layer from the Devonian rocks below, and overlain by another conglomerate, the so-called *wackendeckel*, above which is the barren red sandstone. In general terms, there lies here upon an impermeable floor a previous group composed of sandstones and conglomerates, overlain by argillaceous red sandstone and loam.

The *knoten*, never larger than peas, exhibit, when prepared in thin sections and mounted in Canada balsam, crystalline aggregates of galena, in which the crystal-faces are turned outwards, away from the centre; that is, they are by no means composed of spherical masses, as they seem to the naked eye to be, when examined as they come from the crumbly rock. Their distribution in the sandstone generally follows the bedding; but in the neighbourhood of the cross-faults an accumulation of *knoten* in zones parallel to these steep fissures could be observed. Moreover, occasionally in the fissures themselves threads of galena and pyrite was found; and hence, no doubt, the ore-deposition here was secondary, and proceeded from the fissures. To gain a clear view of this question, it is necessary to include the ore-occurrence in the conglomerates, where, as already observed, it impregnates the material cementing the pebbles, and also the nearest ore-occurrence in the Devonian limestone, where it appears in fissure-veins.

In my opinion, the loose, pervious sandstone, enclosed between less permeable strata, and cut by many fault-fissures, was impregnated by ascending springs, which employed it as a path in their circulation; but it cannot be determined what constituted the centres around which the galena concretions are formed. May it have been minute particles of feldspar, such as are occasionally visible; or was it organic substances, which have now entirely disappeared?

Freihung.—Perhaps additional hints may be furnished by the mines of Freihung, in the Bavarian Upper Palatinate, which Cotta considers analogous to those of Mechernich. Here galena and cerussite impregnate the *keuper* sandstone, the steep dip of which they share. At the Nuremberg Exposition of 1882, maps, ore- and rock-specimens from the mines of the Bavarian Lead-mining Company were exhibited. Fig. 83 is a section through the Vesuvius Mine. There were numerous specimens of tree-stems changed to galena; and on my coming subsequently into possession of such a specimen, a polished section was prepared from it. The pieces of these stems exhibited are about 8in. long, and elliptical in sections—say, 2in. to 3in. by 4in. to 6in. The fibre and the annual rings could be recognised on the surfaces of fracture, but were extremely plain in the polished section. Indeed, they were indicated by the cleavage of the specimens. Thin slivers, in my possession, 0·08in. to 0·16in. in diameter, and several inches long, represent the fibres of the original wood. The former bark is replaced by a zone of first pyrite, and then quartz grains cemented with pyrite. Fig. 84 is a diagram of the section of such a stem altered to galena.

Certainly we have here another instance showing that the organic substance attracted metallic solutions, and reduced them to sulphides, and this under conditions similar to those of Mechernich. The latter occurrence may, therefore, be most simply explained by the hypothesis of an organic substance, distributed through the rock, which reduced the circulating mineral solutions and occasioned the formation of the concretions (*knoten*).

Silver Reef.—Accustomed as we are to find silver associated with lead-ores, we are surprised by the occurence, in the Silver Reef district of Utah, in probably Triassic sandstones, of silver accompanied by copper. So far as can be gathered from the various descriptions at hand, there occur here two beds (the outcrops of which are called "reefs") which carry silver, either exclusively or with a little copper—the former usually as a chloride, but sometimes native; and the latter in the ordinary oxidized ores. It may be reasonably inferred that the deposit has been thus far exposed in its upper, chloridized, and oxidized zones; and that in depth it would be found to contain sulphide-ores.

The beds consist of red and grey argillaceous sandstones and arenaceous clay-slates, between the laminæ and in the cross-joints of which the ores occur, being the more concentrated the more highly fissured the condition of the rock. Although traces of silver are found throughout the bed, the pay-ore is confined to separate chimneys or channels, which descend on the true dip, or pitch obliquely to it. The richest bodies are said to be most frequently found above a certain thin, very clayey sandstone stratum. Very often, but not always, the silver-ore is accompanied by carbonized vegetation, such as trunks and stems of trees, and reed-like plant-remains, which are covered and impregnated with horn-silver. The copper- and silver-ores, while occurring to a certain degree in association, seem to exclude one another, and are seldom found in actual mixture.

The same sandstone which here carries ore is said to be represented in the plateau cut by the Colorado River; but there the strata are horizontal and undisturbed, whereas in the ore-district they dip rather steeply, are much disturbed, and are in many places covered with eruptive rocks, including basalt. This neighbourhood to eruptives renders it probable that here, as in so many other places in Western America, the ores have been introduced by the mineral springs which usually follow eruptive activity. Rothwell, Couch, and Rolker are of this opinion, whereas Newberry is inclined to suppose a contemporaneous origin of ores and rock. The principal arguments for his view are, the alleged great area of silver-bearing Triassic strata in that region, and the circumstance that the richest bedded and lenticular ore-bodies are inclosed in almost impermeable slate-clays, which would not have permitted a subsequent entrance of the mineral solutions. Neither of these statements disproves the secondary origin of the ores. They could have been deposited in any given way on a large scale, as well as a small one, and that the almost impermeable slate-clays did not prevent the entrance of solutions is proved by the subsequent alteration of the original filling to chlorides and oxides.

Moreover, the deposits are not regular strata, but chimneys and channels in parts of strata, and this character, which they possess in common with so many other deposits, should be decisive in favour of their secondary origin—a conclusion which, in my opinion, is always reached when observations are not confined to single localities, but extended over whole series of analogous phenomena.