MINING.

REMARKS ON THE PHOSPHATE AGE.

Both Canadian and Norwegian apatites are encountered in the older fossiliferous or Laurentian rocks; the former in extensive and highly phosphoriferous quantities; the latter in small deposits, which preclude any possibility of unwise competition with the British American rock. The principal deposits of Canadian apatite occur in Quebec and Eastern Ontario, a western extension of the former district, and the Laurentian rocks which carry them are subdivided as follows:—

(1)—Red granite gneiss and hornblend gneiss, with small bands of crystalline limestone, containing apatite only in minimum quantities.

(2)—Red orthoclase gneiss quartzite and pyroxenic strata, with irregular deposits of crystal apatite intermixed with mica.

(3)—Rust-colored gneiss and pyroxenic and felspar rocks with small bands of crystaline limetone containing rich deposits of mica associated apatite.

(4)—Rust-colored garnitiferous gneiss, rust-colored quartz and orthoclase rocks, crystalline limestone with pyrallolite and serpentine, containing irregular deposits of mica and apatite. In most cases the containing apatite rock is pyroxenite. The deposits are in the form of irrregularly sized veins. Sometimes almost imperceptible, and at others swelling into huge pockets or masses of several thousand tons weight, and of unknown depth, but in few instances are very precise walls or divisions perceptible between the true apatite and the enclosing pyroxenite (Norway "Geflickter gabbio" rock) calcite or iron pyrites, and these frequently intermix to such an extent that when the enclosing element is pyroxenite only considerable difficulty is encountered in economical mining. In some cases these veins are sharply defined in radiating rock fissures, but more divergence of opinion is encountered in relation to the general rules of the deposition of these fluor-apatites than in relation to any other economic mineral. As a rule they vary in color from green or grey to almost black, although samples of a reddish shade are occasionally encountered. In texture the deposits vary very considerably from crystalline or "rock phosphate" to finely granulated,—the former yielding the high-class grades known as "lump phosphate," the latter the "seconds" of the chemical manure market,—and in their pure state yield from 88 per cent. to 89.810 per cent. of tribasic phosphate of lime. More impure deposits, however, range as low 74.295, of which from 3 to 4 per cent. is fluorine and are occasionally associated with some chlorine, carbonate of lime and other elements. The relative value of the Norwegian phosphate may be also determined from the percentage of tribasic phosphate of lime in the rose-red, whitish, green or yellowish apatites of that country, which vary from a minimum of 75 to an average maximum of 95 per cent. As I remarked at the outset, however, the Scandanavian mineral cannot be regarded as economically important, for, quite outside the superior ease with which Canadian apatites are mined, the lower grade cheaply mined phosphates of the Tertiary or Cretaceous period in South and North Carolina, Georgia and Florida, which vary in tribasic phosphate from 53 to 60 per cent. plus sulphuric and fluoric acid, ammonia and sesquioxide of iron, are sufficient to keep it off the market for some time to come. This southern mineral must not be confounded with the Canadian apatite, for it is of an entirely different character, occurrent in clay nodules of phosphate of lime, largely disseminated in the marly clays through which the rivers of these regions flow. Unlike the undefined Canadian, its origin is presumably organic, and points to the congregation of such matter, by preference, over the affected areas at an epoch when the relation of years and the aspect of the planet differentiated from that now prevailing. The origin of the Canadian phosphate perplexes and baffles the western geologist, and numerous hypotheses reflect the insatiable thirst for an accurate cue, the contagion of which, I have to confess, has spread to myself. In my opinion the operations of "The Phosphate Era" were in perfect harmony with the simple natural laws, so familiar to every mineralogist. The action of the ancient seas spread a silt or thin plastic alluvium over the Laurentian bed rock. In course of time this silt became the habitation of phosphoric acid, absorbing organisms, such as shells, animal or fish bones, and excreta of birds, all of which possesses the faculty of storing up molecules of this widely dessimated element or substance, which, as I have remarked, forms such an important ingredient in the original or ancient rock. At some subsequent period we must imagine, the strata contortions and convulsions of which the enclosing Laurentian of the Ottawa valley affords such evidence, and no scientific reasoning is necessary to suggest the sequential gravitation of the phosphorus charged silt or mud into the fissures of the earth's crust. This argument on hypothesis will doubtless be met with an interrogation concerning the actual origin of such enormous quantities of phosphoric acid, and undoubtedly the question is pertinent. Any of us who have travelled the Atlantic have doubtless noticed the luminous phosphorous which its waters contain. In the days of the "Phosphate Era," however the western ocean corroded and washed a shore composed of more ancient and highly phosphoric rocks, and consequently the water of the ancient seas would be abnormally charged with the valuable subetance. Following this train of reasoning, we cannot overlook the fact that areas of phosphate apatites are forming upon the bed of the ocean to-day. Very little doubt can be entertained of this. In conclusion I submit that the organic substances stored up in the sand, silt and mud of the bed of the ancient seas, attracted the molecules of phosphoric acid of the water as a magnet attracts steel filings and stored it up for the use of another age in the same manner as coal.

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