

"clayish soil, and this has, in the gold region of North Carolina etc., a reputation for its richness in gold."

What influence the crystalline rocks, or the causes which produced them have had on the formation of the quartz veins with which the gold is generally associated, has not been in any case satisfactorily determined.

GEOLOGICAL AGE OF GOLD.

It would appear however, apart from secondary causes in connection with the alluvions, that a general similarity in the geological conditions and associations under which the gold occurs exists in all auriferous regions, whether the veinstones are connected, as in Canada, Britain, and Australia, with cozoic and paleozoic strata; or as in California and Switzerland, with mesozoic formations; or as in Hungary and Transylvania with rocks of tertiary age; and thus the probability of the occurrence of veins bearing gold, or any other metal or metallic ore in any particular region, can never be determined by the geological age of the rocks alone, but rather by the physical conditions and influences connected with metamorphism, upheaving, fissuring, dislocation and invasion by crystalline rocks, to which they have in each case been subjected since their original deposition.

I have no wish to enter here on the intricate question of the age, origin, and mode of formation of metallic deposits, and mineral veins; and it is unnecessary to refer to the numberless theories which have been propounded to account for the varied phenomena which they present, except in so far as they are more immediately connected with the facts observed regarding the auriferous quartz veins of Nova Scotia, and other parts of the Dominion or appear to have some practical reference to their probable extent and future development.

ORIGIN OF MINERAL VEINS.

It is now generally admitted that direct igneous agencies, in the sense of injection or fused matter, have played very little, if any, part in the production of mineral veins, or in the distribution of the ores found in them, and also that auriferous quartz veins present no features which would serve to distinguish them from any other class of ore-lodes, either in their origin or in their mode of occurrence; and on these grounds I have long held the opinion that there was *a priori* reason why such veins should not contain gold in sufficient quantity to be profitably extracted at any depth to which ordinary mining operations can be carried.*

If most mineral veins and their ores are due, as I believe them to be,† to infiltration and segregation of mineral matters, chiefly through the agency of subterranean mineral-charged gases and thermal waters, penetrating and percolating under favoring conditions into and through cracks and openings which have been formed in the crust of the earth, either by seismic, plutonic or volcanic action, or through desiccation and cooling, causing contraction and cor-

* My opinions on this point are quoted in Murchison's *Siluria*, 3rd Edition, 1858, pages 495, 496, 497; and 4th Edition, 1867, chap. xix, pages 464, 465, 466.

† See in this connection Dr. Hunt's remarks, *Geology of Canada*, 1863, page 735.

rugation; then there appears no reason physical, chemical or geological which should determine all or the greater part of the gold in auriferous veins, towards those particular parts which now constitute their surface-outcrops, but which at some remote earlier period were certainly many hundreds of feet beneath it.

VEINS IN DEPTH.

In some parts of Australia, and doubtless elsewhere also, veins have been traced from their outcrops on hills considerably elevated above adjoining valleys, across these valleys, and up the opposite slopes to equal or greater elevations; portions of the outcrops in the valleys being as rich as other parts of the same vein on the summits of the hills. In such cases the valleys represent at least a great part of the denudation which the strata have suffered since the veins were formed, and if the latter are followed vertically downwards from the hill-tops, there seems no reason why the quartz at the bottom of such shafts should not be as rich in gold as it was at the surface, or at an equivalent depth beneath it, in the valleys; the relative level of the two positions being equal, and the scooping out of the valley an accident comparatively almost as recent as the sinking of the shafts.

DISTRIBUTION OF GOLD IN VEINS.

Again, if there were really any relative and constant proportion between depth and amount of gold, then, in all cases such as that cited, admitting even a much smaller amount of denudation of the vein than would be given by the entire depth of the valley, it ought still to be manifested by the superior richness of the hill-outcrops; but so far as I am aware, no such relation has ever been observed, and indeed no definite law of general practical application seems to be yet known as affecting the distribution of gold in veins, beyond the prevalence of that regular irregularity which is more or less characteristic of ore-deposits of all kinds, and in every region. In the Montague gold district Mr. Brown, manager of the Montague mine, states there are numbers of cross veins, some exceedingly rich, while others are totally barren. Locally, however, there are doubtless indications of various kinds, which, through long practical acquaintance with them, are valuable guides to the miner in directing his explorations; but these are not generally applicable beyond the limits of the district or country in which they have been observed.

AGE OF NOVA SCOTIA VEINS.

Though it is not difficult to show that the great majority of all the worked auriferous quartz-deposits are of more recent origin than the rock in which they occur, it is seldom possible to determine exactly at what subsequent period they were formed. In Nova Scotia there seems good evidence in the well-known occurrence of gold in the Carboniferous conglomerates at Gay's River, that at least some of the veins are of pre-Carboniferous age; but on the other hand there is no reason why many others may not be even of tertiary date or immediately preceding the denudations by which the recent auriferous alluvions were formed.