tions in the Centre Star came from a different region than those which furnished the other deposits. The fact that the Centre Star was somewhat nearer to the volcanic centre than others, and that its ore shoots trend in that direction, may account for this.

These shear zone fissures, more or less shattered by repeated movements, have afforded permeable channels for the ascending mineral solutions, which have penetrated and decomposed the country rock, replacing its rock minerals wholly or partially by metallic minerals. In places the entire width of the shear zone has thus been transformed into ore, while in other places the mineralization has been narrow. The solutions have frequently jumped across from one set of plating fissures to another, shifting the pay streak from the hanging to the foot side, or to intermediate positions, as the case may be. In the Centre Star-Le Roi vein the foot-wall fissure is the one which is the most regular and distinct, and is marked by a vein of small interlacing calcite seams, which has been found a very reliable indicator of the position of the vein. As a rule, the heaviest ore deposition has taken place near this foot-wall, and mineralization extends to irregular distances on the hanging side, gradually fading into the country rock. In the War Eagle vein the hanging-wall is generally the most distinct and best mineralized, with irregular extension into the foot-wall side.

While many of the dikes and faults merely occasion small displacements, with no effect upon the mineralization, a number of them evidently occurred before this mineralization was begun, or at least before its completion, and acting as partial barriers to the flow have so deflected the solutions as to greatly increase the deposition on one side, although they have not themselves been mineralized. Thus in the War Eagle 6th level solutions rising through the fractured ground, caused by a fork in the vein, have been stopped by a large dike, and been so deflected and accumulated in rising along its under side as to produce exceptionally large and rich ore bodies. In the Josie vein the Tramway dike has in a similar way produced a rich ore shoot in the Annie, and the Josie dike has had the same effect upon the Le Roi and Black Bear veins.

The numerous instances of displacements by faults and dikes where the severed portions of the vein on each side are alike, prove that some of the dikes and some of the faulting occurred after the ore formation. If the dikes were studied in detail and classified they would probably be found to belong to two or more different periods, some of which were later than the deposits. As to faults, the facts observed accord fully with what is known of dynamic action during the long period while volcanic activity is expiring. Shocks and movements occur repeatedly at increasing intervals. Early fractures would afford planes of weakness which would not only be kept open by the repeated movements, but would be multiplied and extended by branches and interlacing fissures. Such action probably continued long after the ore deposition and also after the dike formation, since these are found to be cut by faults.

It is very noticeable that the later solutions introducing the gold and copper bearing minerals with quartz have as a rule followed the pyrrhotite deposition, and do not seem to have sought or found new permeable channels in the rock where these minerals might deposit by themselves. On the contrary, they seem to have been unmistakably restricted to the ground already impregnated with pyrrhotite, and the greatest enrichment has as a rule occurred where the previous pyrrhotite deposition was most extensive.

There seems no reason to believe that the pyrrhotite had chemically any more influence on the subsequent deposition than ordinary country rock would have. It may have been that the friable pyrrhotite ore presented such local weaknesses as to become especially shattered by subsequent movements, and thus afforded the most permeable channels. What probably occurred, however, was that there was one continuous flow which gradually changed in chemical contents and conditions of deposition. The altered solutions at the time of the secondary deposition merely followed the channels of flow which were already established, possibly modified more or less by a refracture or brecciation of the pyrrhotite ore.

CONCLUSIONS.

The conclusions derived from a study of these deposits are as follows:

(1) The pyrrhotite was deposited from aqueous mineral solutions ascending through the more fractured and permeable portions of the shear zone fissures.

(2) The gold-bearing chalcopyrite, pyrite and arsenopyrite with quartz were deposited later from the same flow rising within the same channels, but restricted to those portions of the channels which still remained unfilled, or which were re-opened by further fracturing of the friable pyrrhotite ore.

(3) The main faults and some of the dikes existed before the formation of pyrrhotite began, or at least before its principal deposition.

(4) Their intersections with the shear zones made barriers which more or less directed the flow, accumulated the solutions, and determined the position of the main ore bodies.

(5) After the ore formation more dikes appeared. Faulting was repeated intermittently, continuing probably up to recent times, and the early fractures were kept alive.

The writer is well aware that the origin of pyrrhotite is still in dispute by eminent authorities, but believes that a study of the Rossland deposits must remove any remaining uncertainties as to this question. All observations, from the occurrences of the pyrrhotite as mineral replacements, veinlets and films in the rock to the effect of dikes and fractures in massing its formation, point to deposition from mineral solutions. In these deposits at least, it is impossible to even consider "direct igneous origin" or "magmatic segration," and no evidence has been found to suggest any difference between their origin and that of ore deposits of pyrites or other minerals whose genesis is now established.