

In addition to descriptions of all the known nickel ore deposits in Ontario, there are accounts of methods of mining and smelting the ores, and of the chief nickel regions of other countries.

In the preparation of the work Dr. Coleman was greatly aided by the mining companies. Information was freely granted by the several companies. The compiling of the accompanying maps and plans has been the work of Mr. R. B. Rose.

## VARIATIONS IN VALUES WITH DEPTH

It has been found by actual experience in mining metals in all parts of the world that ore deposits do not continue with undiminished value to very great depth. In many cases the productive portion has been found to be only that within a few hundred feet of the surface, and mines over 3,000 feet in depth are comparatively rare, though several very important deposits continue profitable to considerably lower levels.

Statements of regularity of decrease in values with depths are, however, often based on insufficient data. It is a common practice to point to the history of mining operations in a locality and call attention to the decrease in values as evidenced by gradually waning production, followed by closing down of the mines. We are then told that the values gradually fell off as the deeper levels were opened, and that there is probably no more ore at greater depth.

As a rule the assay plans, showing exactly where the values occur, are not made public, and the information gained by the operators is ultimately lost. It is, however, often possible to obtain sufficient evidence to show that the change in values with depth is not properly described as regular, that many deposits are richer at depth than at the surface, that the variations with depth are often not unlike the variations with lateral extent, that there is often a noticeable relation between length and depth, that many rich deposits do not outcrop, that there are probably ore bodies at depths far beyond the lowest levels yet reached by mining operations which are not known, simply because they do not outcrop, and that in glaciated areas there is often no good reason to postulate any close relation between the character of ore and the present surface.

To properly interpret figures giving production for successive years, and these are the figures most commonly available to the public, it is evidently necessary to know what portion of the deposit the ore was coming from. Where no assay plans are available, we have often, unfortunately, to assume a gradual deepening on the ore deposit; but even in these cases some information can commonly be obtained to show what portions of the mine were being most energetically worked each year.

As a rule, the first openings in a deposit are made in what is believed to be the central and best portion

of it. As depth is attained, lateral extensions are made into the lower grade ore on either side. Without any change with depth the yearly records then show a decrease in values.

In most deposits the ore shoots pitch to right or left with depth. Shafts seldom follow the ore shoots, and if started in them get into poor ore long before the main shoot fails. Again the records show a falling off in values, which is not a true indication of the variation in the character of the deposit with depth.

In some cases, where one ore deposit has proven sufficiently rich to encourage mining to considerable depth, lateral exploration at low levels has resulted in the discovery of other ore deposits, which near surface are valueless, and which would have been undiscovered but for their proximity to a deposit which was rich enough near surface to permit of profitable mining.

One very essential feature to be noted in discussion of variations with depth is the change in character of formations in which the ore deposits occur. It is well known that very remarkable changes occur on passing from one formation down into a lower one. To discuss clearly the influence of depth then, it is evident that all deposits not confined to one series of rocks should be excluded, or that variations found wholly within one series be considered. If this is done, it is found that the general statements regarding decrease with depth in many cases find little support.

In Ontario and the Lake Superior States most of the valuable ore deposits occur in very old rocks which have been deeply eroded and then glaciated and more or less covered with glacial or fluvio-glacial deposits. It is quite unlikely that these deposits have, except for some very minor surface alterations, any close relation with the present surface. There is very good reason to believe that the deposits were formed in Pre-Cambrian or Cambrian times, in rocks that were not at the then surface. They have been exposed later by erosion, which continued down through long geological ages. It is incredible that the depth of such erosion has been in any way influenced by, or bears any close relation to, such minor masses as those which constitute our ore deposits, and on the other hand there is little evidence that the deposits have been much changed since they were exposed. The exposed surface is rather comparable to one which might be sliced off at any arbitrary depth. From general considerations, therefore, there is no good ground to place any reasonable limit on the depths at which ore deposits occur.

There is no necessary connection between the occurrence of ores at great depth below the present surface and the continuance of an individual ore shoot to similar great depth. The former is a probability, the latter has been proven by countless mining operations to be not the case.