tiary andesitic group, with which they are indeed orographically closely connected.

In any consideration of the question of the persistence of gold ore in depth the foregoing divisions must be kept closely in mind, since the recurrence of the evidence of the complete dependence of gold deposits on geological conditions, both for deposition and for extension, lateral and vertical, is certainly the most salient feature arising from the study of the goldfields of the world.

The Younger Goldfields.

It will probably be most convenient to first consider the younger goldfields. These are the andesitic fields that have furnished some of the greatest bonanzas that have been known. Their petrological range is from pyroxene-andesite to quartz-trachyte, and occasionally to rhyolite, all apparently the differentiation members of dacitic magma. Their geological range is from Eocene to Pliocene with a special development in the Oligocene and Miocene. With one notable exception they follow very closely and are confined to the so-called "Pacific Circle of Fire," with which line of volcanic activity they have clearly a very close genetic connection. The outstanding feature of gold deposition in this group is its modernity and its consequent intimate association with existing volcanic phenomena. The geographical exception is the Transylvanian goldfield of Hungary, the andesites of which were erupted during the Aquitanian stage, and along lines of crustal weakness initiated in the Oligocene and indicated at the present day by the active volcanoes of the Mediterranean.

Auriferous deposition in this group has probably been closely associated with solfataric action. Maclaurin has indeed shown that the hot springs of the solfataric region of New Zealand at the present day bring to the surface and deposit notable quantities of gold and silver in the siliceous sinter that forms on the edges of the boiling springs. A similar deposit is recorded from near the De Lamar mine, Idaho. The New Zealand hydrothermal region is on the same line of crustal weakness as the goldfields of the Hauraki peninsula. On it, only 40 miles away from Rotorua, is the famous Waihi mine, until three years ago one of the greatest of the world's gold mines. The chalcedonic character of the siliceous filling of the veins of many andesite fields also appears to point to a deposition from hot waters. In andesitic and allied rocks in the neighborhood of auriferous veins "propylitization" is universal. In this facies of the original andesite rock the feldspars and ferro-magnesian silicates have been converted to quartz, sericite, calcite, epidote, chlorite, serpentine and pyrite.

The outstanding feature of auriferous ore bodies in andesitic fields is their general irregularity, both in form and in tenor. The great persistent fault fissures so often found in older and deeper seated rocks are unknown, or, at any rate, have not served as loci of deposition. There is nothing in any andesitic field comparable, e.g., with the Mother Lode fracture of California.

It is, of course, conceivable that strong fault fissures could readily have been formed, but it is improbable that in any active volcanic and solfataric region, such fault fissures would remain open for any length when large quantities of cementing igneous and aqueous matter were being brought to the surface along the assumed line of weakness. The Comstock Lode with a total length of two and a half miles is probably the longest fault-fissure lode of economic importance in the andesitic fields. Normally the fissures of andesitic fields appear to be local tension fractures due sometimes to cooling and sometimes to minor local movements. They are therefore limited both in linear and in vertical extension, falling into the group of "gash veins" of an old nomenclature. When two or more local series of fractures intersect, the "stockwerk" so characteristic of many New Zealand and Transylvanian areas results.

Where the veins of the stockwerk are sufficiently close together a great bonanza may result as in the case of the Shotover and Caledonian mines, Thames, New Zealand. The original irregularity of the andesitic fissures is greatly accentuated by the selective action of auriferous solutions that replace the fissure walls with ore.

No andesitic field has as yet carried its bonanzas to great depths. By far the deepest is the Comstock, where shafts were sunk to 3,300 feet, but though ore was found erratically distributed through the lower workings, it was in nowise comparable to the great bonanzas that occurred between the 1,000 ft. and 1,800 ft. levels. Only a very few mines in andesitic regions have carried rich ore below 1,000 feet, and the characteristic feature of even these is uncertainty of persistence in depth. For the lack of persistence a definite reason may very often be given, viz., the change along the downward course of the lode from dacite or andesite to the underlying basement rock, or, in rarer cases, to a member of the andesitic differentiation series unfavourable to gold deposition. Often the mere approach to the basement rock connotes impoverishment of lodes. Instances are numerous, e.g., in New Zealand (at Coromandel and Thames), in Colorado (at Cripple Creek and Telluride), in Transylvania (at Vulkoj, Korabia, and Nagyag); but there are many lodes that persist in a homogeneous rock, which may be either a member of the andesitic differentiation series or may form a member of the basement complex through which andesites have burst, and that nevertheless show a marked diminution in value at comparatively shallow depths, often less than 500 feet. For some of these impoverishments a physical cause may be advanced, viz., approach to the bottom of the fissure of tension; but for others, indeed for the majority, no such explanation is possible. For example, the Comstock fissure is well defined as far as it has been followed downward. The great Martha lode-fissure (Waihi) persists as strongly as ever below 1,000 feet, but whereas above that level the gangue was mainly quartz, below it the matrix is calcite. The Martha Lode appears to have been originally wholly a calcite lode that was attacked by solfataric waters above 1,000 feet, silica with accompanying gold almost completely replacing the calcite. Either, then, 1,000 feet below the surface marks the horizon at which solfataric waters become active agents of solution and deposition, or, and more probably, the percolating waters had no access to a zone of the lode immediately below the 1,000 foot level. Whether at greater depths they used the lode-fissure as a channel and replaced its calcite gangue future exploration alone can show. Here, as has so often been the case, the solution of the question of the persistence of ore in depth depends on economic considerations.

The impoverishment of the veins of the andesitic goldfields in depth is a feature so universal that a general cause for diminution in value must be sought. I have attempted to show elsewhere that the probable form in which gold travels in solution, in depth at least, is not as the chloride, but as an alkaline auro-