the upper part, and the smaller limbs and branches, are quite smooth, whence its popular name. The timber is highly prized by splitters, and for general purposes it is described by many competent authorities as second only to the Blue Gum, though opinions seem to differ as to its durability. It is found in most parts of the Colony, and appears to grow as freely on the table land of the interior, reaching an altitude of not less than 3,000ft. above the sea, as along the coast line. The description of Eucalyptus hæmastoma in Bentham's Flora does not in all respects agree with the character of the tree as known in Tasmania, but the description will probably be revised by Baron Von Mueller.

AURIFEROUS COUNTRY AND GOLD-BEARING ROCKS.

By Charles E. Barnard, M.D., F.L.S.

[*Read* 10*th May*, 1881.]

The subject of my paper is one that cannot fail to prove of interest to this Society, seeing the great importance the gold-mining industry is assuming, and has already assumed, in the colony of Tasmania.

The advantages to be gained by fostering this industry in the colony need scarcely be dilated upon by me, as they are so patent to any one who will take the trouble to examine into the causes of the vast progress the Eastern colonies of Australia have made during the past quarter century. The numerous large towns and villages that dot this portion of the continent—the majority of them founded upon, or connected in some way with, the discovery of gold in their immediate neighbourhood—speak for themselves; and the immense impetus to trade, commerce, and immigration which it brings about shows what mining will do for a country, hitherto in a state of almost primeval solitude. But for this source of wealth, the major portion of these colonies would still have remained in a "state of nature"—one huge sheep run, with but a sparse population and scattered country villages.

With the magic touch of gold, all is changed. Everywhere over the land the busy miner is found digging and delving, and bringing to light the vast stores of hidden wealth. He is the pioneer of civilisation. In the solitudes of mountain and forest he seeks the precious metal, and should Dame Fortune reward his eager search by placing in his reach the long-sought-for golden treasure, the scene at once changes. Soon there springs up, as if by enchantment, first a village, which then

gradually merges into a town as wealth succeeds wealth, and afterwards into a city, with all the comforts of life, and the culture of the civilised world.

For such a comparatively sparsely inhabited country as Tasmania, nothing then could be more advantageous than a large development of its gold-mining industry. True, she has other minerals in abundance besides gold; but no other metal presents such attractions to the ordinary miner. For in alluvial mining, the gold can be won without costly appliances and with merely unskilled labour. Any man who can handle a pick and shovel can go gold mining, and provided he "prospects" in "auriferous" country success is not unlikely to attend him. And so it is important to know by what indications country shows itself to be auriferous. In this continent gold is widely disseminated over a vast extent of country, and almost every day- fresh deposits in newly prospected districts are being discovered, as is lately instanced by the recent finding of gold in the interior of New South Wales, near its N.W. corner.

The aspect of auriferous country somewhat varies in different districts. Usually one sees groups of rounded hills, gentle undulations, and broad valleys between the hills, with creeks and rivers here and there. The soil is generally excellent, as is evidenced by the large forest trees and abundant grass.

Upon going over this country and examining the hills and outcropping rocks, one almost invariably finds the same characteristic features. The rocks are usually of a slaty character, tilted up into a more or less vertical position, and with a strike approaching N. and S. Close by are seen plutonic rocks, as granite, diorite, porphyry, etc., which are evidently the cause of the vertical position of the slates by intrusive action. Besides the slates, we find hills composed almost entirely of conglomerates, with beds of limestone and sandstone interspersed ; and here and there we come upon long, low, narrow, rounded ridges, covered with dark rich soil, gently rising from its bed. These prove to be of volcanic basalt, which has flowed down the ancient valleys and watercourses from some Pliocene crater. Everywhere strewn around we come upon boulders of quartz of various sizes, which have become detached from the parent rock, lying hidden amongst the slates and granites.

The shaly rocks are found to vary in character, according to their position relative to the plutonic rocks. Some are soft and argillaceous, or of a sub-crystalline nature ; others have become hard and silicious from the infiltration of silica in a state of solution through their substance. Others, again, are of a more crystalline character, and are called micaceous,

talcose, or chloritic, according to the prevalence of the chief ingredient. No fossils can be seen in these slates even under the microscope, but their age has been proved to be lower Palœozoic by associated fossiliferous sandstones and limestones. It is of great importance to note the age of the sedimentary strata; for in this continent the richest goldfields are found to be those whose out-cropping rocks are of Silurian age, with intrusive dykes of granite and greenstone. But gold-bearing rocks are not always necessarily confined to one particular age, as is evidenced in America, where auriferous quartz has been proved to be associated with later formations than the Silurian and Devonian.

Gold has evidently been deposited in common with other metals throughout all ages, even up to the present time. In Australia, though we find it associated only with the past, its deposition was co-existent with the dawn of creation of animal life. It belongs to the age of Invertebrata, when the inhabitants of the seas consisted only of echinoderms, trilobites, bivalves, cephalopods, etc.

It was also the first great change of type in animal life, when endo-skeletal creatures were succeeding the exo-skeletal in the order of things and process of evolution, for the remains of the earliest fishes are found in the upper beds of the Silurian formation.

It was at this time, then, that during active igneous eruptions and intrusions gold and other minerals were brought into association with the shaly sedimentary strata of the Silurian and Lower Devonian systems.

Gold has also been found in sedimentary rocks belonging to the carboniferous formation: but no doubt in these cases the gold has been derived from the original auriferous rocks of the older systems. Its presence here, though, teaches us that it is not impossible to find it in any formation, especially when that formation is derived from the denudation of Silurian strata.

There is one feature about these auriferous formations that is characteristic; they are more or less crystalline or metamorphosed, probably from the action of heat under great pressure. But it is found that the less crystallised they are, the more auriferous they appear.

As regards the matrix of gold, quartz is almost universally the most prevalent. And wherever it occurs it is always in veins or reefs, occupying fissures and rents, either in the primary rocks, or in the plutonic intrusive dykes.

But gold is also found in other rocks besides quartz. Hornblendic granites and diorites, or a greenstone composed of hornblende and feldspar, are most commonly the source of the metal. Serpentine, too, has been worked profitably, and

yielded it in abundance, even though the gold was not visible to the naked eye. But whenever these rocks are found in conjunction with Silurian slates, gold deposits may be confidently looked for, especially if quartz veins are found also in connection therewith.

It is by the disintegration and denudation of these rocks that alluvial drift becomes loaded with gold, which is washed down into the valleys and gullies below. And where the dykes of diorite or granite forms the bed rock of the "lead," the gold is generally in greatest abundance—it being retained or arrested in the joints and crevices of the denuded rock. On each side the drift or "wash" contains only the finer or less weighty particles.

The discovery of rich auriferous reefs is, in many instances, brought about by the removal of the overlying "wash" or drift; and some of the most flourishing reefing districts of the present time in Australia were originally only worked for the alluvial gold. When a reef is laid bare by the miner under these circumstances, there is by far greater likelihood for it to be payably auriferous than otherwise, and the richness of the overlying drift is in a measure a test of that of the vein of quartz thus exposed. So every alluvial miner is strongly advised to search diligently for hidden quartz veins in the bed-rock of his claim. The same, in fact, may be said of all mineral veins. The drift containing the mineral can only have been derived from some neighbouring vein, which probably, by "stripping," would be discovered if persevering attempts were made to search for it. Alluvial mining, then, leads to quartz-mining, and in the most successful instances is the only prelude to it. I recommend this fact to be noted by the capitalists of Tasmania, when contemplating investment in gold-mining; for I am afraid vast sums are spent in quartz reefs that can never be otherwise than unproductive. The most permanently payable auriferous reefs seldom contain gold alone, but are usually intermingled with iron and copper pyrites and other sulphides. Gold, too, is rarely found in a pure state, but almost invariably alloyed with a varying percentage of silver. Pyritous quartz is a good indication of the presence of gold; but in this case the precious metal is so tightly bound up in the sulphides as to be only with difficulty extracted therefrom. And it is a singular fact, that, frequently when gold is proved by chemical analysis to be present in this kind of stone in tolerably large proportion, none is visible on the surface to the naked eye. It is so finely divided, and so closely "held in bondage" by the pyrites, as to be rendered invisible. When this pyritous mineral is decomposed by a process of oxidation, the gold

is then, and then only, liberated from its connection therewith. In these instances the quartz presents a porous or "honeycombed" appearance, and so rendered more easily workable. When gold is found in hard compact quartz veins, and is even quite visible thereon to the eye, as a rule these reefs are not always of a very permanent character.

In alluvial deposits the gold is also found associated with various minerals that have evidently been derived from the same mineral vein—such as platinum, magnetic iron, chrome iron, and tin oxide, as well as quartz, zircon, topaz, and even the diamond.

Miners, as a general rule, restrict their search to the one metal—gold, discarding all others that may appear in their "wash." So probably many valuable metals and precious stones are lost that otherwise could be saved with profit.

The occurrence of gold in quartz veins, and the presence of the quartz veins themselves in plutonic and metamorphic rocks, can be explained by chemical agency. The mineral veins must have been deposited during a very disturbed period; but subsequently to the intrusive action of the plutonic rocks, and the metamorphosis of the argillaceous strata contiguous thereto. Intense heat must have prevailed, while the semi-liquid fused masses uplifted, tilted up and transmuted the Silurian formations, forming dykes by cutting through them. During the contractions that must have ensued on cooling, fissures would be formed both in the intrusive dykes and the sedimentary rocks, which would generally be across the direction of the cooling mass. These fissures would then become filled with infiltrating hot solutions of silica and minerals. Upon further cooling the silica would be deposited and the minerals, including gold, would likewise be precipitated, or gradually crystallise, and become intermingled with the silica mass.

The solutions of these minerals would be effected in this way. During the prevalence of the intense heat that must have been everywhere cotemporary with the igneous action of the period, the temperature of all waters, vapours, and gases would rise excessively high by reason of the enormous pressure to which they would be subjected below at great depths. All would be chaos: every substance would be subjected to intense chemical agencies, and be continually undergoing change. The hot waters and vapours would be dissolving what was soluble, such as the alkalies, silica, and all the compounds of the metals. These latter would be formed by gases and acids of intense chemical activity that would be present, such as chlorine, sulphuretted hydrogen, nitric and hydrochloric acids. These would act and re-act upon all the minerals they came into contact with, and the compounds thus formed

would become intermingled with the hot solution of silica; and so be deposited with it in whatever fissure it was poured into. It would thus appear as a mineral vein upon cooling.

The frequent appearance of gold in a finely divided state and enveloped in iron pyrites can also be accounted for by chemical action. When a solution of sulphate of iron comes into contact with a solution of gold, the latter is precipitated as a very fine powder of a dark colour, and the sulphate decomposed. Gold would be dissolved by the chlorine of the nitric and hydrochloric acids present or in its free state, while the sulphate of iron would be formed by the oxidation of the sulphide which is always so abundant. In this way the invisibility of gold when disguised by iron pyrites can be accounted for. But gold being volatile under very high pressure, and at a high temperature, could also be sublimed and condensed similarly to other metals which are conveyed in this way.

Besides the minerals, gold is found associated with remains of the animal and vegetable kingdoms. These, though of no commercial value, yet are of no less interest and importance. By their means the age of the auriferous drift can be relatively approximated, and when found over a large tract of country they can be compared with one another.

The animals whose bones and teeth are occasionally found belong entirely to the past. They evidently must have been of larger growth than is seen now. They comprise huge marsupials and immense birds. The fossil vegetable remains, as leaves, fruits, stems of trees, etc., also indicate an ancient flora that has almost entirely passed away. In a few instances some modern genera resemble those that are found fossil but only in a modified form. The majority of them belong to extinct genera; and all are of Tertiary age—probably pliocene or even miocene. As these organic remains have so frequently been found in auriferous alluvial drift, the miner in these colonies is encouraged to proceed in his search when he comes upon a layer of fossil leaves, fruits, etc., especially if these lie beneath Tertiary basalt.

During the pliocene period, this land must have been the scene of intense igneous action, as is evidenced by the immense flows of basalt that are met with throughout long stretches of country. The course of the ancient valleys and watercourses can be traced by observing the direction of the basalt; for as the semi-liquid lava would flow where there was least resistance, it would naturally take the easy descent down low-lying valleys and river-beds, and in this way they can be traced for miles. The miner, then, should not be discouraged or deterred from sinking by finding basaltic

rock in his shaft, for there is every probability of "payable" auriferous wash being found beneath the massive layer.

In conclusion, while sincerely rejoicing at the prosperous condition of several of the gold mines of Tasmania, I cannot contemplate but with serious misgiving the "mining mania" that has apparently seized the Tasmanian public, especially in the North. Rash investments in mythical quartz reefs is not legitimate mining, and can only lead in many instances to disaster, as happened at Hill-end and Tambaroora, in New South Wales, some few years back.

I sincerely hope it will not be so; but would wish to see every confiding shareholder gladdened by dividends to his heart's content.

There can be no doubt that Tasmania has unbounded wealth in her mines; and I feel assured that in their development she has the means of rising, Phœnix-like, from the ashes of her former comparative poverty to a dazzling height of permanent prosperity.

TYPE SPECIES OF TASMANIAN SHELLS UNRECORDED IN THE "CENSUS OF TASMANIAN SHELLS."

By Professor R. Tate, Assoc. Lin. Soc., F.G.S., &c.

[*Read 14th June*, 1881.]

Having, in the course of my researches in the bibliography of Australian Mollusca, noted that some specific names, founded on Tasmanian types, are not referred to in the conchological papers contained in recent issues of the Society's transactions, I have thought some utility may be served by their publication. They are not necessarily addenda to the "Census" by the Rev. J. E. Tenison-Woods, as it remains to be ascertained whether they are applicable or not to good species, and if to good species then whether they have priority or not over others already enumerated in the "Census." This task I relegate to the author—a "Revised Census."

To the following list I have appended references to the authorities for the specific names, and the localities of the type-specimens:—

Columbella rosacea, *Reeve*, Icon. Conc., (?)—*C. semiconvexa*. Tasmania.

Cerithium Diemense, *Quoy* and *Gaimard*, Voy. Astrolabe to 55, f. 11-13. Tasmania.

Cerithium dubium, *Sowerby*, Mes. Con., sp. 62; and *Reeve*, Icon. Con. t. 12, f. 78 (has priority over *C. monachus, Crosse)*, Tasmania.